SMART CITY
京島

Georgia Institute of Technology
Urban System Design Studio
Spring 2018

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Acknowledgement

Tokyo Sumida Ward Office

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Executive Summary

The Tokyo Smart City Studio is a practical capstone project housed within the Eco Urban Lab at Georgia Tech's School of City and Regional Planning and School of Architecture. Throughout the four-month semester, students collaborate on innovative urban design solutions for some of Tokyo's most important problems. In conjunction with the Global Carbon Project (GCP), the National Institute for Environmental Studies of Japan, the Department of Urban Engineering of the University of Tokyo, and the University of Tsukuba, Georgia Tech Students tackled issues ranging from energy consumption and disaster preparedness to heat stress and a vulnerable elderly population. The group completed five comprehensive reviews, a week-long site visit to Tokyo, multiple workshopping sessions, an Architecture Exposition, and two final reports.

The focus area of this year's studio was Kyojima, a one-half kilometer neighborhood in Sumida-Ku. In the late 19th century, this neighborhood was characterized by paddy fields, marshes, and a few small factories. It's known for its traditional Japanese crafts, tight alleyways, and wooden tenement housing. The area is dense and in need of revitalization. Kirakira Street, the neighborhood's once bustling shopping destination, is in substantial economic decline.

This document is a detailed report of all student proposals aimed at assisting community members and other Kyojima stakeholders with technological, design, and policy solutions. It begins with an overview of the studio process and the problem statements, which are followed by the history and context of the study area. From there, the report is divided into the six sections with each section introduced by a written summary discussing process, goals, and recommendations. The six sections are as follows:

1. Green Community Goals and Certification
2. Performance Modeling
3. Transportation
4. Design Guidelines
5. Smart Community Framework and IoT Design
6. Architecture Typology Design

Dr. Perry Yang, Dr. Akito Murayama, and Dr. Yoshiki Yamagata were instrumental as co-leaders of this studio. The studio members would like to thank those other experts, stakeholders, and reviewers who took time to give critical feedback and guidance on the proposals found herein.

Introduction and Studio Process

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Abigail MARINELLI

Studio Process

The Tokyo Smart City Studio developed a plan to integrate the needs of current residents with the fast-paced development Tokyo is experiencing.

The studio focused on the Kyojima neighborhood within the Sumida Ward. Kyojima is a very old part of central Tokyo that has not experienced investment since World War II. The building stock is generally quite poor and the residents tend to be elderly and of lower incomes compared to other neighborhoods in the area. The goal of the studio was to provide for the current needs of these residents (by maintaining human comfort elements and providing increased mobility options) while also introducing advanced technology and prototypical designs.

The studio began by performing an existing conditions analysis. Four scales of analysis were considered. First, the largest scale was all of Japan. Second, the medium scale was the Tokyo area. Third, the small scale was Sumida Ward, and fourth, the extra-small scale was the Kyojima neighborhood. The team members divided into six groups and examined the climate, demographics, disaster risk, transportation network, land use, and building stock at the different scales. Several maps, charts, and other tools were developed to present the analysis.

Next, the studio undertook a detailed analysis of the study area, Kyojima. A Pattern Language analysis was performed to understand the development patterns within Kyojima over time. The six groups formed in the first phase of the studio were combined into three super-groups for this second phase. The three super-groups were: (1) the Network group focused on the various flows within the study area, (2) the Built group focused on the building stock and the land use in the study area, and (3) the Social group focused on the people most likely to be in the study area, including the current residents, future desired residents, and tourists visiting for the 2020 Olympics. At this stage, several design concepts began to emerge.

Next, the studio completed a set of pre-site visit design proposals and modeling work. The design proposals included 6 typology designs for buildings and building systems. Some typologies addressed retrofitting existing buildings, while other typologies proposed tearing down the most distressed buildings and building new structures. A variety of performance modeling was performed on these typologies including energy, human comfort, solar irradiance and wind modeling. Additionally, the studio continued to study the networks of Kyojima and undertook mobility and water analyses.

In mid-March, the studio members traveled to Tokyo to visit the study area of Kyojima. While in Tokyo, the studio presented their pre-visit proposals to the Tokyo Smart Cities Symposium and received feedback from planners from around the world. The site visit to Kyojima was accompanied by a question and answer session with a member of the Sumida Ward government who provided insight to the key issues and goals from the government's perspective. All of this feedback and insight was incorporated into the changes made to the pre-visit proposals during the three-day workshop hosted by the National Institute for Environmental Studies and the University of Tokyo. Several students from Japanese institutions were also available to help with design proposals and contextual understanding. At the conclusion of the workshops, the studio presented their post-visit proposals to the local stakeholders and clients. The post-visit proposals included refined versions of the typologies along with new mobility designs, performance modeling and design guidelines.

After their return from the Tokyo site visit, the studio continued to refine their ideas and presentations. Several final reviews were given. The presentation and critique to a local Atlanta audience was made in mid-April, along with a summary report of the changes since the Tokyo workshop was given the Japanese clients. The typology designs were displayed in the Georgia Tech School of Design's end-of-semester exhibition. Two final reports were produced: (1) a comprehensive report containing the entire body of work produced by the studio, and (2) a policy report designed for distribution to the Kyojima government and community.

Studio Process

January 一月	Step 1: Existing Conditions Analysis
February 二月	Step 2: Emerging Design Proposals
Early March 月初旬	Step 3: Pre-visit Proposals
Mid- March 月中旬	Step 4: Post-visit Proposals and Stakeholder Presentation
April 月	Step 5: Final Presentation, Typology Exhibition, and Report Submission

Step 1: Existing Conditions Analysis

- Mapped and analyzed
  - Climate
  - Demographics
  - Disaster Risk
  - Transportation
  - Land Use
  - Buildings
- Scales of Analysis
  - Large: Japan
  - Medium: Tokyo
  - Small: Sumida
  - X-Small: Kyojima
- Grouping
  - 6 groups with 1 architect and 2 planners per group

January 一月

Step 2: Emerging Design Proposals

- Detailed exploration of Kyojima
- Pattern Language analysis
- Began design proposals
- Grouping
    - 3 Super-Groups
        - Network
        - Built
        - Social

January 一月 | February 二月

Step 3: Pre-Visit Proposals

- Began Modeling
  - Mobility
  - Energy
  - Human Comfort
  - Solar Irradiance
  - Wind
  - RPI
  - Water
  - Economy & Identity
- Proposed 6 typology designs
- Defined studio process
- Grouping
  - Design
  - Performance Modeling


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January 一月 | February 二月 | Early March 月初旬

Step 4: Post-Visit Proposals and Stakeholder Presentation

- Finalized symposium presentation
- 3-day workshop at NIES and University of Tokyo
- Final Stakeholder presentation
- Grouping
  - Typologies
  - Mobility Design
  - Performance Modeling
  - IoT
  - Design Guidelines

January 一月 | February 二月 | Early March 月初旬 | Mid- March 月中旬

Step 5: Final Presentations and Reports

Final Presentations

- Presentation and critique by Atlanta audience – April 18
- Summary report to clients in Tokyo – April 18
- Architecture Expo – April 21

Final Reports

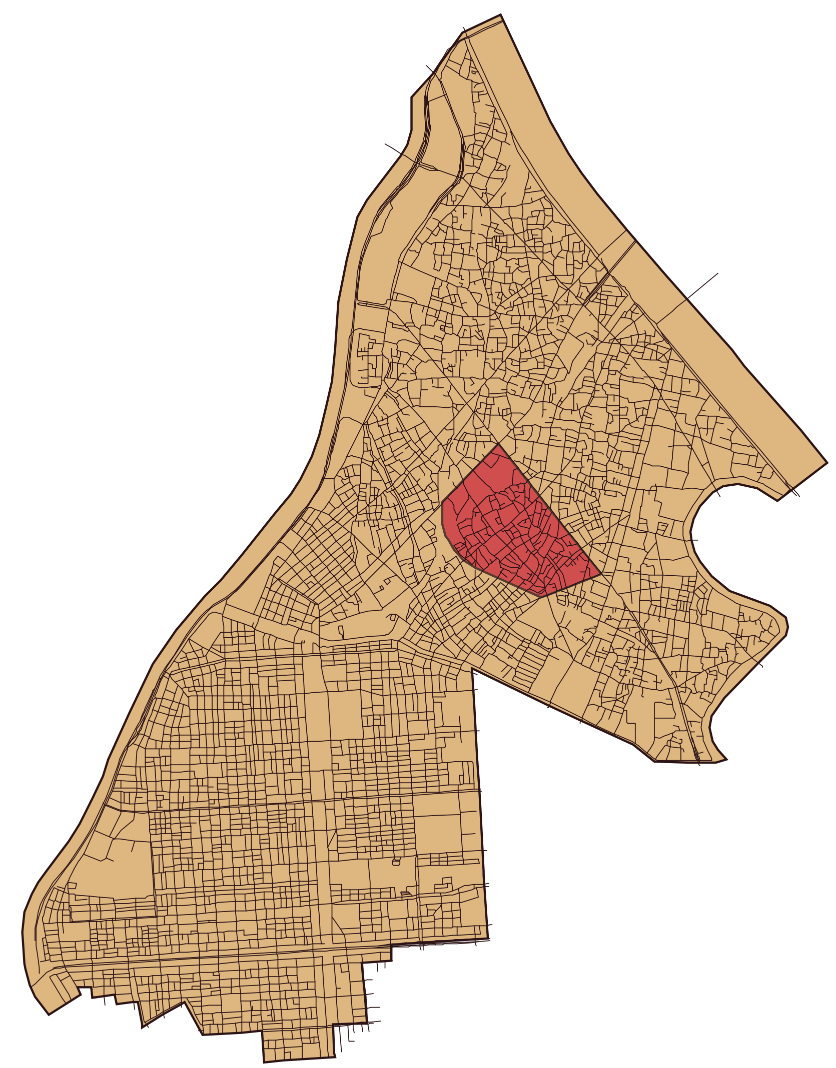
- Policy Report for Stakeholders in Tokyo – May 2
- Complete Report for clients in Tokyo – May 2

January 一月	February 二月	Early March 月初旬	Mid- March 月中旬	April 月

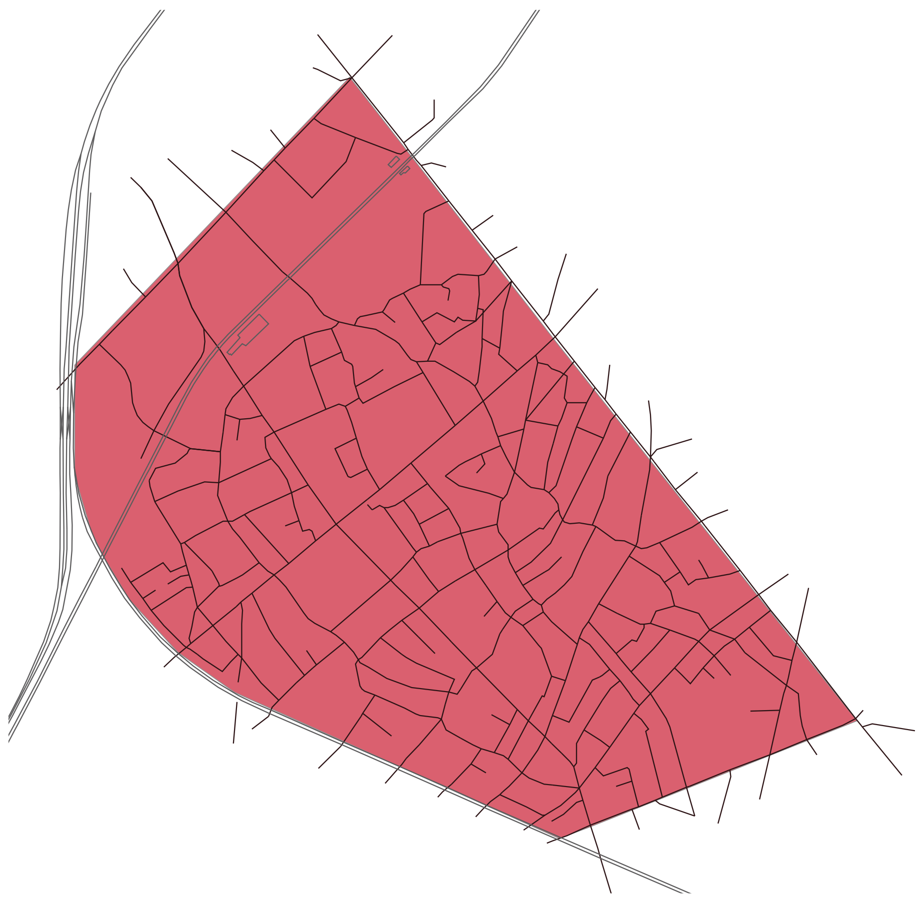
Three Scales of Thought

Although our studio primarily focuses on the Kyojima neighborhood as the agent of change, we also examined both Sumida Ward and Tokyo as a whole for influences, opportunities, and challenges to our proposed designs.

Tokyo (large scale)



Sumida Ward (medium scale)



Kyojima (small scale)

History of Kyojima

Through the Edo period, the land in Kyojima was used for farming.

During the late 19th and early 20th centuries, craftsmen moved into the area.

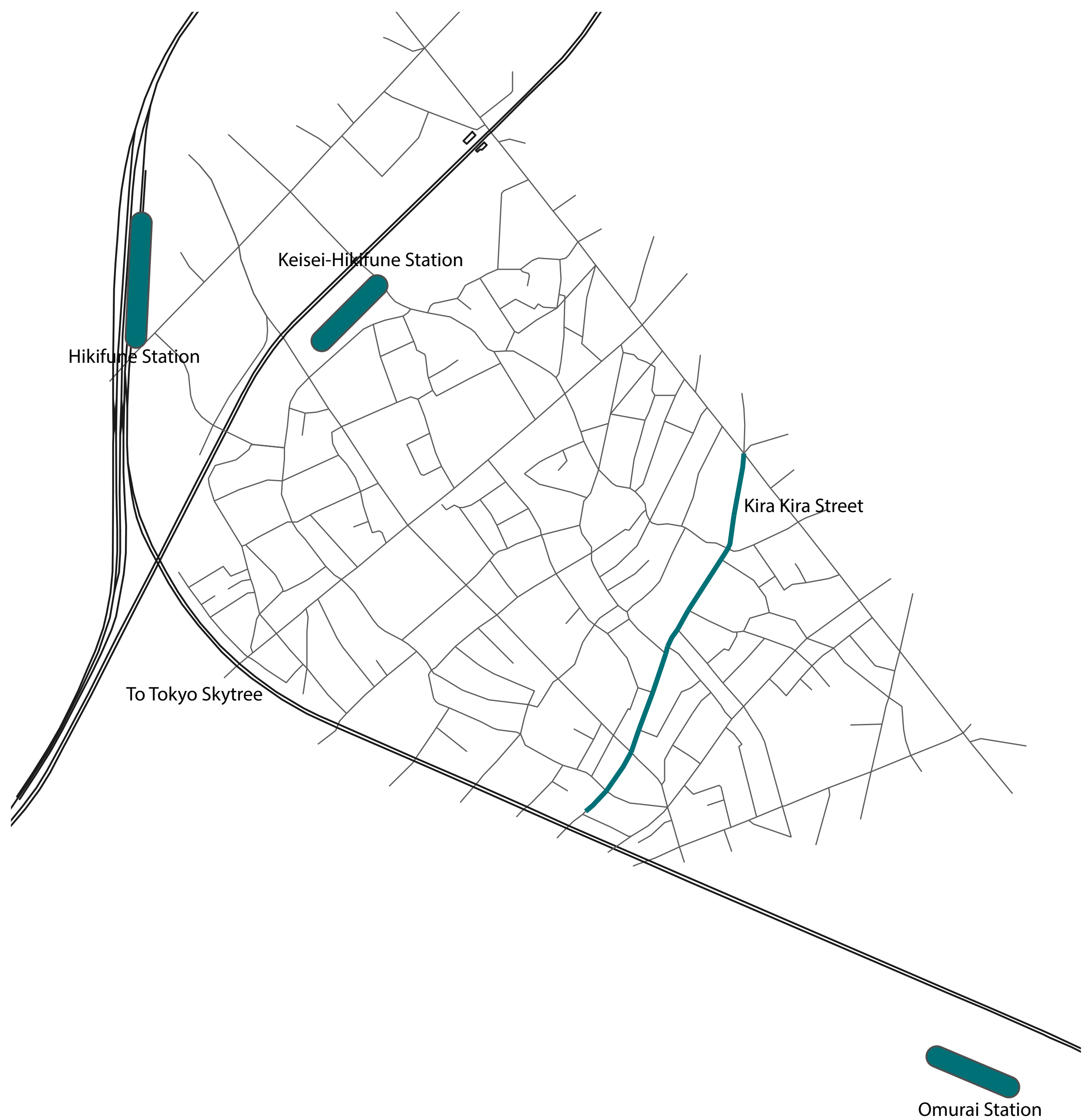
After the great earthquake of 1923 and the fire bombings of World War II, people moved into Kyojima because of the affordable, quickly built wooden housing.

Source:: tes.com

Source: nippon.com

Source: commons.wikimedia.com

Current Infrastructure



Current key infrastructure

Existing infrastructure in Kyojima includes three close train stations:

- Hikifune 曳舟駅
- Keisei Hikifune 京成曳舟駅
- Omurai 小村井駅

Within Kyojima, Kirakira Street キラキラ橘, is a popular shopping street for both locals and tourists.

Tokyo Skytree is also only a 1 km walk away.

Street Widening

Planned streets for widening

The roads highlighted in pink are scheduled to be widened in order to increase fire safety.

These wide roads will act as fire breaks so fire won't spread as easily in the event of a fire resulting from an earthquake.

The buildings in Kyojima are at risk because of the widespread use of wooden construction.

Existing Conditions of Kyojima's Buildings

Many of Kyojima's single family homes are wooden tenement buildings from the early 20th century.

There are several community houses projects in Kyojima that offer several floors of apartments.

Existing Conditions of Kyojima's Roads

Kyojima's narrow streets are used heavily by bicyclists and pedestrians.

Some roads in Kyojima have been widened to include dedicated sidewalks for pedestrians.

Kirakira Street キラキラ商店街

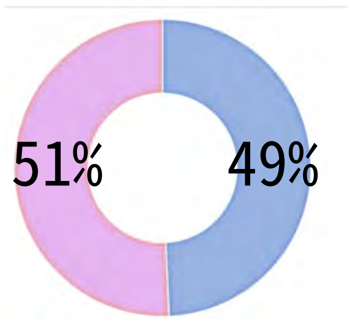
A flower seller on Kirakira street.

A street food vendor on Kirakira street.

Demographics 人口統計

Population

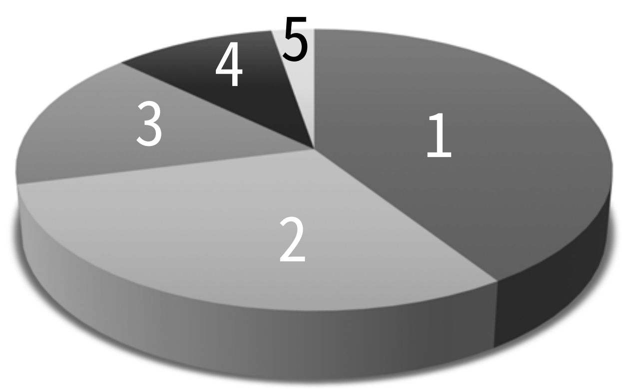
12,234 people



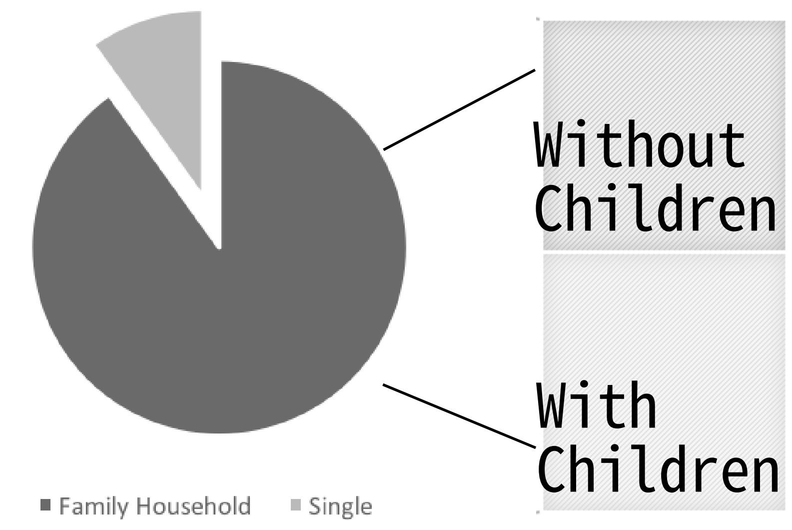
Households

5,876 Households

Household Size



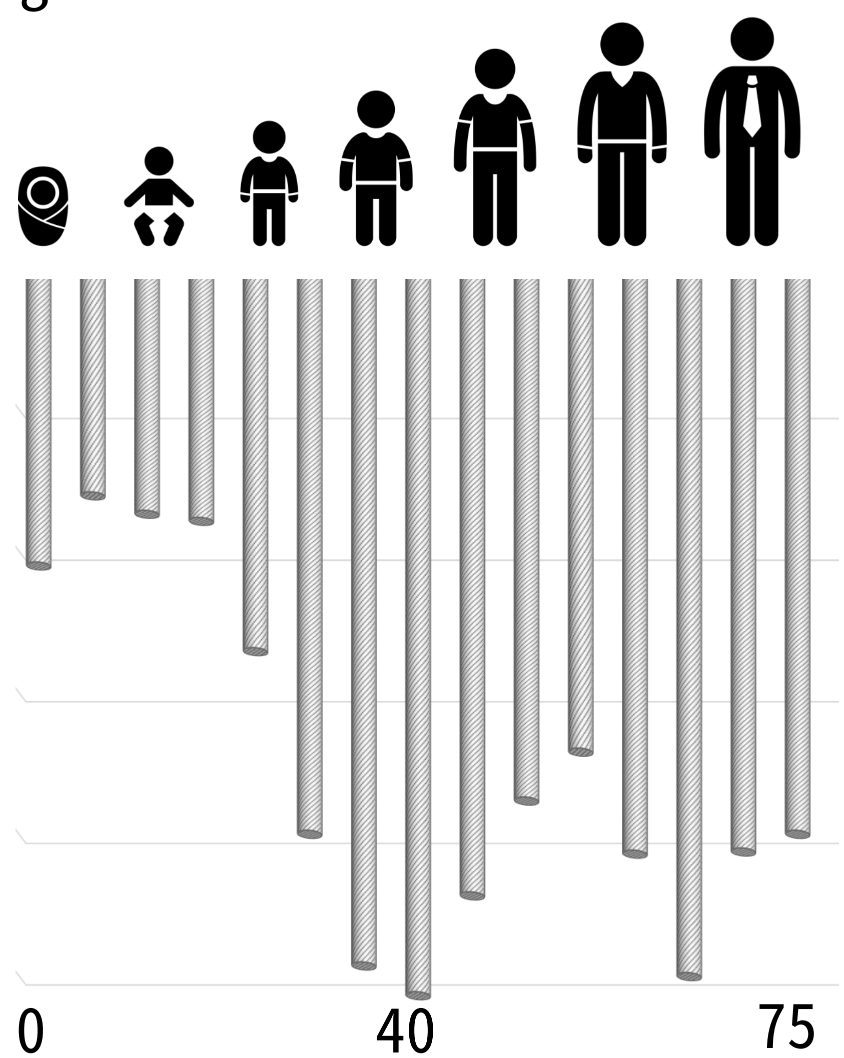
Household Type



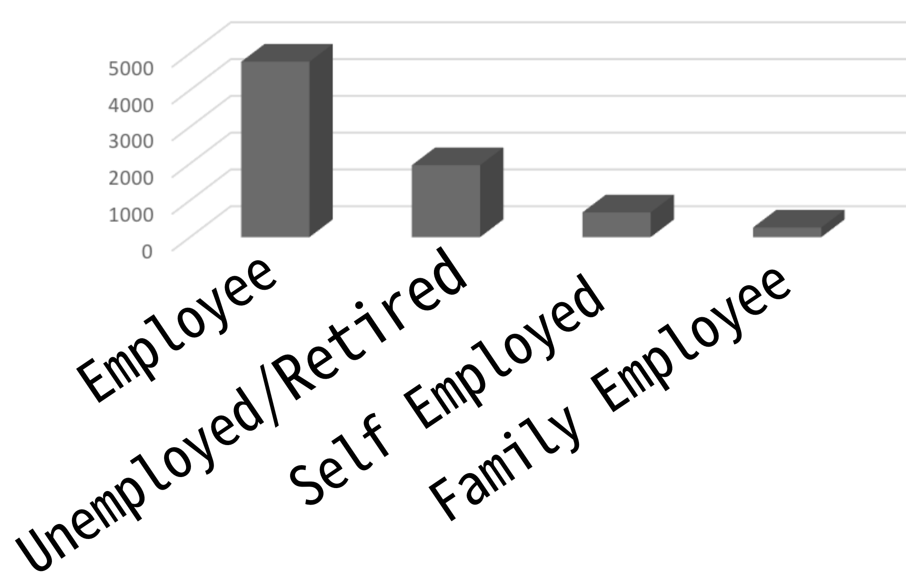
Housing

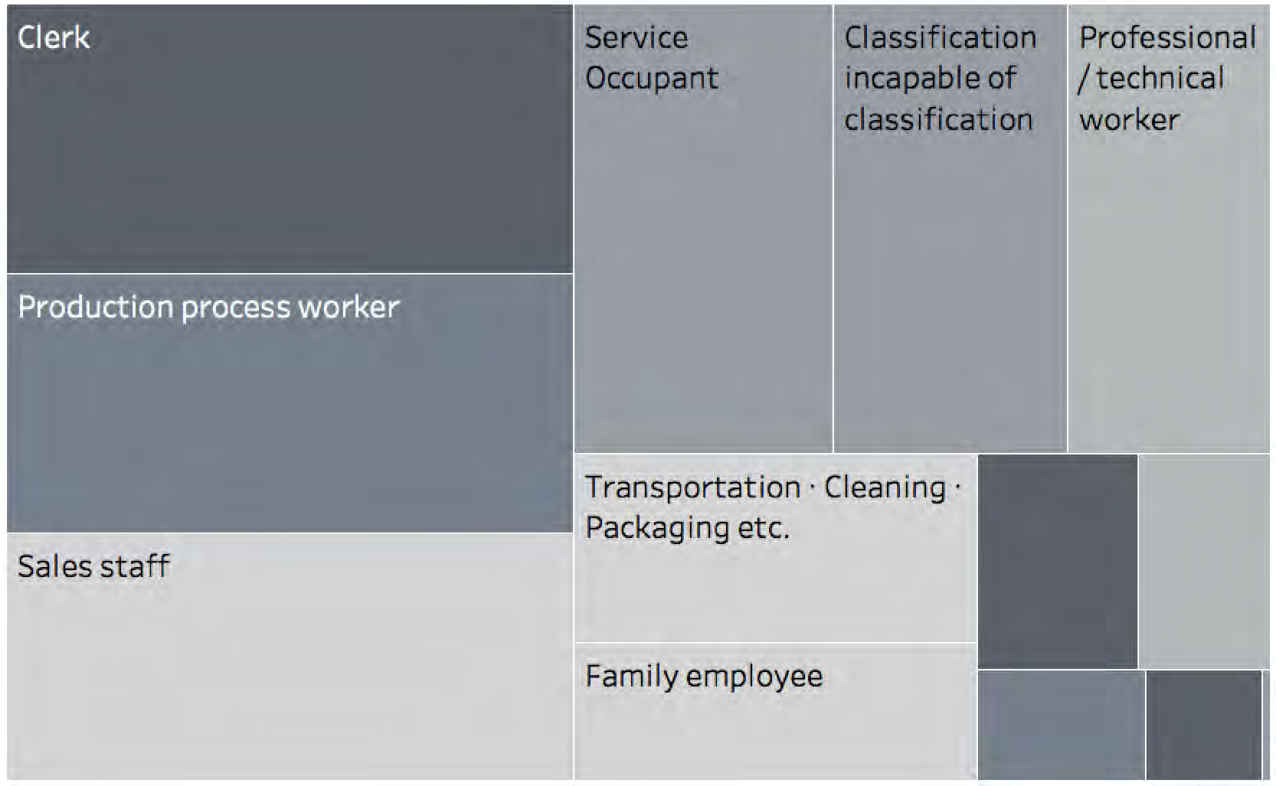
Joint house................3350
Detached house................2089
3-5 stories high................848
6-10 stories...................577
1-2 stories....................447
Nagaya..........................285

Age Structure



Employment





Green Community Goals and Certification

Tate DAVIS

Boruo CHEN

Green Community Goals and Certification

Intro

Green certification systems have become an integral way of understanding performance and impact at both a building and neighborhood scale. While early certification systems focus on building, more holistic systems have been created to assess a community or neighborhood as a whole. In guiding the creation of certification system within a Tokyo context, these systems were reviewed to understand the vital criteria and components necessary for a green certification system. Global and local systems provide insight and key lessons in certifying green neighborhoods. These systems, however, do not provide an appropriate set of measures and metrics for neighborhoods in Tokyo; these communities have obstacles created by context specific factors and unique development patterns.

Why other systems don't work

Tokyo's level of density and access to transit is high enough such that most systems that incorporates these metrics would be meaningless. While these systems do show how well Tokyo's neighborhoods score on issues related to density and transit, it would give platinum range scores to projects that may not improve the neighborhoods in relevant ways that align with the overall goals established by the local government.

How we studied the current systems

Assessing the multitude of green certification systems ensured that the Kyojima green neighborhood certification system was globally relevant while maintain context appropriate metrics. Green certification systems fall into two categories: global and local. Three major global systems were analyzed to understand which metrics can apply to a wide range of neighborhoods. LEED ND, BREAM, and CASBEE were used to understand far reaching systems which have global application but represent a North American, European, and Japanese context respectively. Locally relevant certification systems include those systems which were developed out of a need for or response to metric integrity, location specificity, or framework discrepancies. Studying systems such as Living Communities, EcoDistricts, Enviro Development, and other local certification systems provided insight in how to address current gaps in systems and provide a more holistic approach to green certification and guidance.

What we came up with

The Kyojima Sustainable Smart City Guidelines is a system that takes into account the proposed goals that were stated by the local government. Thematically, they incorporate public resources, resilience, and social bonds.

These goals are community defined, although they also align with some top-down goals issued by the Tokyo government. This guideline is meant to help Kyojima, and other residential neighborhoods in Tokyo, evaluate real estate developments and capital improvements, in the context of how they match up with the community defined goals. The guidelines are organized under three categories: Well-being, Resources, and Resilience. Each category consist of five measures or metrics which align with community goals and government initiatives. Measures in all three categories comprise the scorecard which is intended to quantify green certification in communities and track progress.

Well-being	Resources	Resilience
Community Amenities	Energy Efficiency	Disaster Readiness
Human Comfort	Water Use	Emergency Access
Social Engagement	Air Quality	Medical Response
Cultural Fortitude	Building Lifecycle	Fire Resistant Design
Economic Prosperity	Renewable Energy	Flood Management

In addition, the data and metrics that would support the measurement of these goals will also be community defined. The establishment of a data structure (as defined in the IoT section) that is community owned, would give residents a feeling of security and control over their data. Allowing the community to define the metrics would also give the community a voice in the level of privacy they would want, in how the data are collected.

Green Community Goals and Certification, cont.

How to use the system to leverage money/marketing
Japan created a Green Bond Guideline to align their climate goals with that of the Paris Agreement, in an effort to curb the increase of global average temperature to under 1.5 ℃ above pre-industrial levels, as well as to encourage corporate behaviors to become more environmentally-friendly.

Green Bonds are bonds issued by organizations with the specific purpose of funding projects that contribute to the reduction of Greenhouse Gas emissions, and for the prevention of natural capital deterioration. The Japanese Guideline for the issuance of these Green Bonds specify nine specific goals:

1. Renewable energy
2. Energy efficiency
3. Pollution prevention and control
4. Sustainable management of living natural resources
5. Terrestrial and aquatic biodiversity conservation
6. Clean transportation
7. Sustainable water management
8. Climate change adaptation
9. Eco-efficient products, production technologies and processes

Of these, Renewable Energy, Energy Efficiency, Climate Change Adaptation, and Eco-efficient Production/Processes were the goals that are most relevant to Tokyo, and thus were incorporated into the Certification System.

By promoting projects that specifically addressed these issues, the Certification System can be leveraged for funding for investors seeking to invest in Green projects. This further aligns with Tokyo's own strategy of curbing GHG emissions, which includes a cap and trade system that began in 2008 and was implemented in 2010. Investors understand that Green projects are more likely to succeed, because it is being incentivized by the Tokyo Metropolitan Government.

Japanese companies have already begun issuing Green Bonds in large amounts. The Sumitomo Mitsui Financial Group and the Mizuho Financial Group have each issued €500 million(roughly $600 million), while the Tokyo Metropolitan Government and the Japan Railway Construction, Transport and Technology Agency have issued over ¥10 billion($90 million) and ¥20 billion($180 million) respectively. The funding for these projects exist, as long as developers can prove that their projects can credibly prove their green characteristics are consistent with the Green Bond Principles.

In addition, the United Nations Education, Scientific, and Cultural Organization(UNESCO) works to preserve cultural heritage by funding the safeguarding of historic cultural practices. This is a part of the Intangible Cultural Heritage program, which has thus far provided over $25 million dollars in funding. With the inclusion of social bonds as an overarching goal, the Kyojima Sustainable Smart City Guidelines aim to preserve the local culture and heritage of arts, crafts, and other industrial practices.

Conclusion
The Kyojima Sustainable Smart City Guidelines are both a guidance tool and progress tracker. The intention of integrating these features is to achieve a holistic approach to green certification. Through careful consideration of local and global certification systems, context specific obstacles, and government alignment, this system provides guidance at a neighborhood level to achieve a smarter, more sustainable Tokyo.

Fitting Global Standards to a Local Context

ECODISTRICTS

LEED-ND

CODE FOR A SUSTAINABLE BUILT ENVIRONMENT
BREEAM

DGNB
Deutsche Gesellschaft für Nachhaltiges Bau
German Sustainable Building Council

建築環境総合性能評価認証
CASBEE®

HKGBC
香港綠色建築議會

enviro DEVELOPMENT™

SUSTAINABLE DEVELOPMENT GOALS

3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
7 AFFORDABLE AND CLEAN ENERGY
6 CLEAN WATER AND SANITATION
13 CLIMATE ACTION
11 SUSTAINABLE CITIES AND COMMUNITIES
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

福祉 (Wellbeing)

Community Amentities

Human Comfort

Social Engagement

Cultural Fortitude

Economic Prosperity

資源 (Resources)

Energy Efficiency

Water Use

Air Quality

Building Lifecycle

Renewable Potential

強韌性 (Resilience)

Disaster Readiness

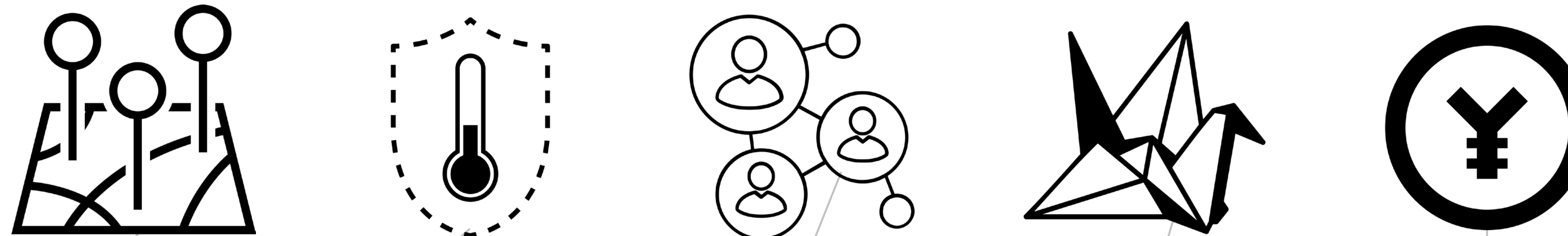
Emergency Access

Medical Response

Fire Resistant Design

Flood Management

福祉



:health, happiness, and comfort OF the people

Community Amentities

Local programming
Accessibility to services
Wayfinding

Human Comfort

Temperature
Humidity
Noise
Wind Speed

Social Harmony

Social Connections
Support Systems
Familiarity

Cultural Fortitude

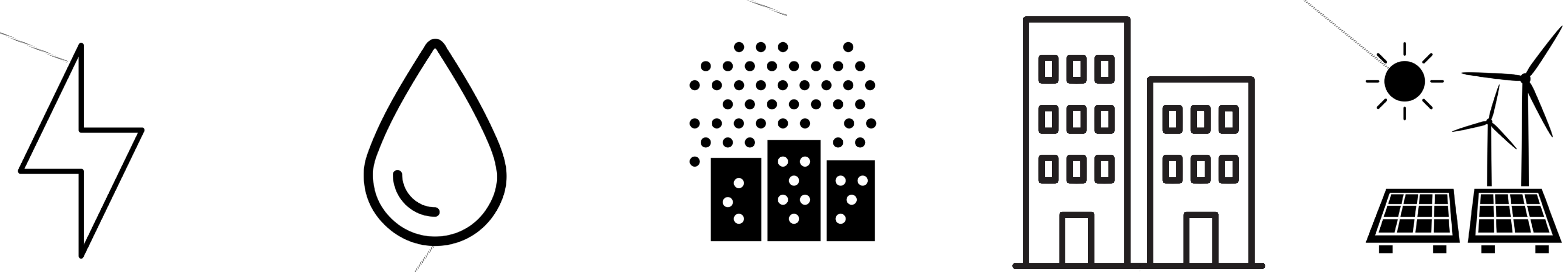
Historic preservation
Cultural promotion

Economic Prosperity

Employment
Tourism
Supported local businesses
Local events and prgramming

資源
(Resources)

:supply, support, and facilities FOR the people



Energy Efficiency

Reduce Energy Consumption
Emergent Technology Use

Air Quality

Indoor & Outdoor
Particulate Matter
Ozone
NOx and CO2

Renewable Potential

Solar
Wind
Hydropower
Hygogen Cells

Water Use

Graywater Reuse
Stormwater Managment
Efficiency

Building Lifecycle

Construction Material
Supply Chain
Longevity

Disaster Readiness

Evacuation Training
Resident Check Points
Communication Platform and Network

Emergency Access

Access to supplies and shelters
Adaptive Evacuation Routes

Medical Response

Response Time Reduction
Access for Emergency Vehicles
Improved Response System

Fire Resistant Design

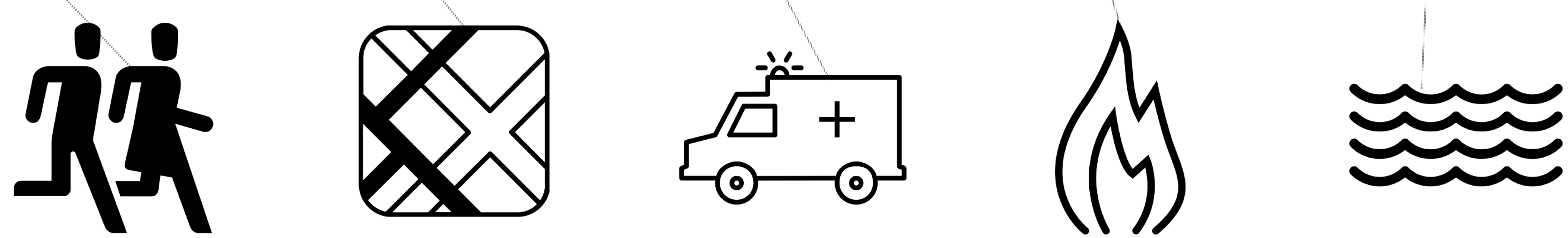
Improved Fire Breaks
Reduction of Wooden Structures
Fireproof Material Use

Flood Management

Stormwater Systems
Green Infrastructure
Protect Flood Prone Areas

ability of the PEOPLE to optimize resources to protect wellbeing

強靭性 (Resilience)



Leveraging Financial Incentives and Marketing Capacity 町の資産価値向上

Green Bond Goals:

Renewable energy

Energy efficiency

Sustainable water management

Climate change adaptations

Eco-efficient products, production technologies and processes

UNESCO Goals:

Safeguarding of Intangible Significant Cultural, Historical, Artistic Practices

Performance Modeling

Isabel SEPKOWITZ
Rebekah KIM
Yanlin WU

Performance Modeling

Human Comfort
Human comfort factors were modeled to better understand how residents and visitors would respond to environmental conditions. For this studio, we focused on wind, solar and temperature modeling to quantify human comfort levels.

Wind
For specific sites, airflow and wind velocity was modeled with Autodesk Flow Design 2018. The building massing was exported from Rhinoceros 5.0 from a .3dm file to a .3ds file to be imported into Autodesk Flow Design. Then, the orientation was changed to z=112.5 ◦ to reflect Tokyo's typical summer wind pattern. During this modeling process, the objectives were to understand potential wind tunnel's direction and magnitude, quantify human comfort and identify potential renewable wind energy sites, specifically locations of 10-15 m/s. The output from this modeling was velocity, thus speed and direction. Three sites were modeling: 1) Eco-cell, 2) Sumida Modern, and 3) Adaptable Village.

Temperature
Heat stress risk is one of the biggest concerns for climate change scenarios in Kyojima. To model heat stress risk, we obtained temperature information from Dr. Kanae Matsui's data sources. She monitors outdoor and indoor temperature on six buildings in Kyojima. We used IoT sensor data that was collected from July to September 2017 to model a summer heat stress risk scenario. The one minute data was then aggregated to hourly data. Building 3 near Kirakira street was used to highlight the heat stress risk scenario. The data results depicted 82% outside of human comfort from July to September.

Viewshed
Viewshed for a section of Kirakira Street was modeling to better understand how humans would experience the built environment. Through a Grasshopper plug-in called "view rose", four different point were placed along Kirakira Street.

Solar Energy Production
The energy radiation data (kWh/m²/year) were simulated by Archsim with the Rhino geometry model. Because the simulation does not consider the influence of other factors, such as cloud coverage, the raw data need to be calibrated. We selected the data of 50 random buildings in Kyojima in the Japan Solar Roof Panel website (http://tokyosolar.netmap.jp/map/) as samples for the calibration. The formula is:

$$\frac{\bar{e}_{sample}}{\bar{e}_i} e_i$$

e_i: the value of raw data in each pixel
e_{sample}: energy per square meter of the samples

The website also regulates that an area with solar radiation larger than 1100m² is suitable for the placement of solar panels. Therefore, the total solar radiation that can be used for energy production in Kyojima is:

$$\mathrm{E} = \frac{\sum_{>=1100}^{n} \left(\frac{\bar{e}_{sample}}{\bar{e}_i} e_i\right)}{S_{GFA}} \cdot \frac{n}{N} \cdot S_{roof}$$

n: number of pixels higher than 1100kWh/m²
N: total pixel number
S_{roof}: total roof area
S_{GFA}: Gross floor area

The following is the conversion formula of solar radiation to energy production:

$$PV_m(G_i) = I \times \tau \times roof^{PV}(G_i) \times \eta_{pc} \times K_{m,pt} \times T$$

where τ is the conversion ratio of solar panel (0.2 as default) and the roof is the installation area (30% of the total area considering the inclined roof and the obstructions).

Using this formula, we calculate that the average solar production in Kyojima is 8.081kWh/m², which is about 17.4% of the current solar consumption of the buildings.

Performance Modeling, cont.

We aggregate the calibrated data of energy production into black level and recognize it as the dependent variable. We associate this dependent variable with a linear regression with 12 independent variables: sky view factor, FAR, density, percentage of single-family houses, percentage of slab buildings, percentage of cubes buildings, percentage of L-shaped buildings, percentage of towers, percentage of tower-podiums, percentage of big box buildings, percentage of school, and floor difference between the highest and the lowest buildings. The result is shown in Figure 1 below:

Figure 1. Outputs of linear regression.

	Estimate	Std.	Error	t value	Pr(>|t|)
constant	-7.76231	9.253382	-0.839	0.40841	
sky view factor	0.307581	0.096776	3.178	0.00351	0.01
FAR	-3.86489	1.780408	-2.171	0.03827	0.05
density	28.99874	13.76526	2.107	0.04392	0.05
% of single-family houses	-11.6065	7.164238	1.62	0.11604	
% of slabs	-20.7559	7.136805	-2.908	0.0069	0.01
% of cubes	-22.798	6.532027	-3.49	0.00156	0.01
% of L-shapes	-25.088	7.424556	-3.379	0.00209	0.01
% of towers	-18.5328	8.16646	-2.269	0.03086	0.05
% of tower-podiums	-6.57783	6.854938	-0.96	0.3452	
% of box	-17.1874	5.707603	-3.011	0.00535	0.01
% of school	-19.6531	5.802131	-3.387	0.00205	0.01
difference of floor	0.004492	0.215443	0.021	0.98351	
R-squared	0.893		Adjusted R-squared		0.8488

The linear regression shows that sky view factor is a strong and significant positive independent variable for the energy production—10% increases of average sky view factor of a block will lead to 3 kWh/m^2 increase in energy consumption. The linear regression also shows that all the existing building typology is negatively related to the energy consumption. There is no existing building typology that is positively related to the energy production, so new building typology is needed.

Moreover, we study the relationship between minimum width between the south building and the north building and the difference of height between the south and the north to insure the solar potential for the north building.

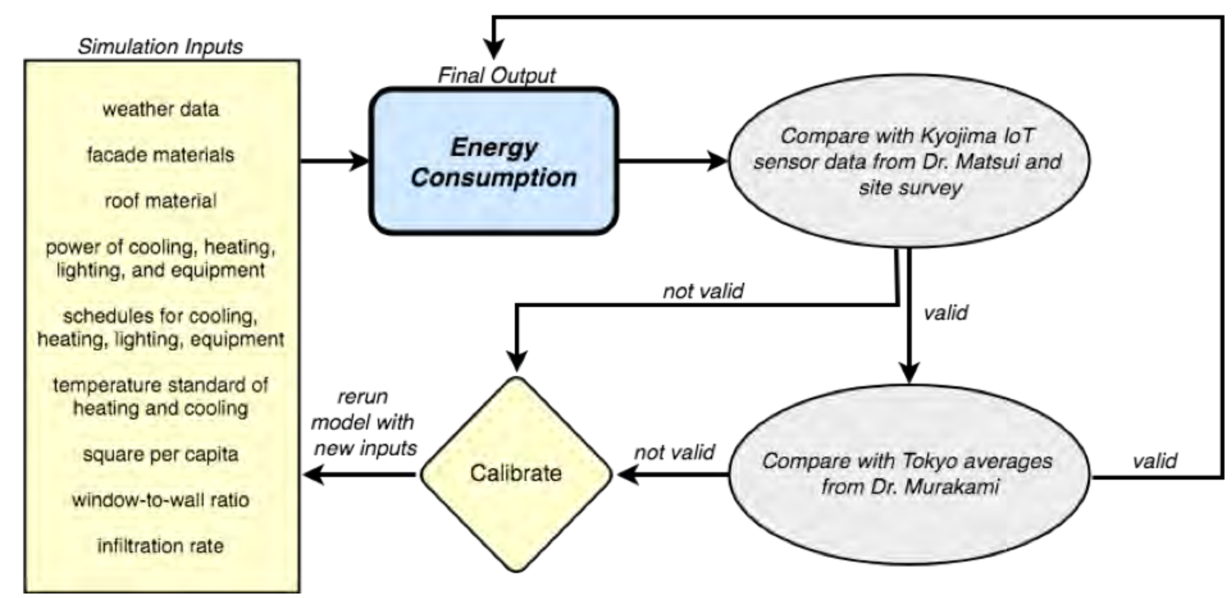
Energy Consumption

The software used for energy modeling included Rhinoceros 3D, which was used with Grasshopper and EnergyPlus to model the existing conditions related to energy efficiency in Kyojima. These tools were also applied to model new designs and to inform strategies for energy efficiency.

The energy model simulated energy consumption in kilowatt hours per square meters per year for cooling, heating, lighting, and equipment systems according to Energy Plus weather data for Tokyo. The sum of all four categories indicate total building energy consumption.

The model process is illustrated in the following chart. The model takes into account a number of variables including construction material type and schedule of cooling, heating, lighting, and equipment systems over time. All variables are listed in Figure 2 under "Simulation Inputs."

Figure 2. Modeling Process with Calibration



After simulating energy consumption, we calibrate the result using local IoT data and the average Tokyo weather values. We aggregate the calibrated result into three types of buildings: wooden-structure single-family houses, concrete-structure single-family houses, and apartment buildings. It shows that the energy consumption of apartment buildings is about 35% lower than that of the single-family houses. In the apartments, slab type generates the lowest result, and tower-podium comes second.

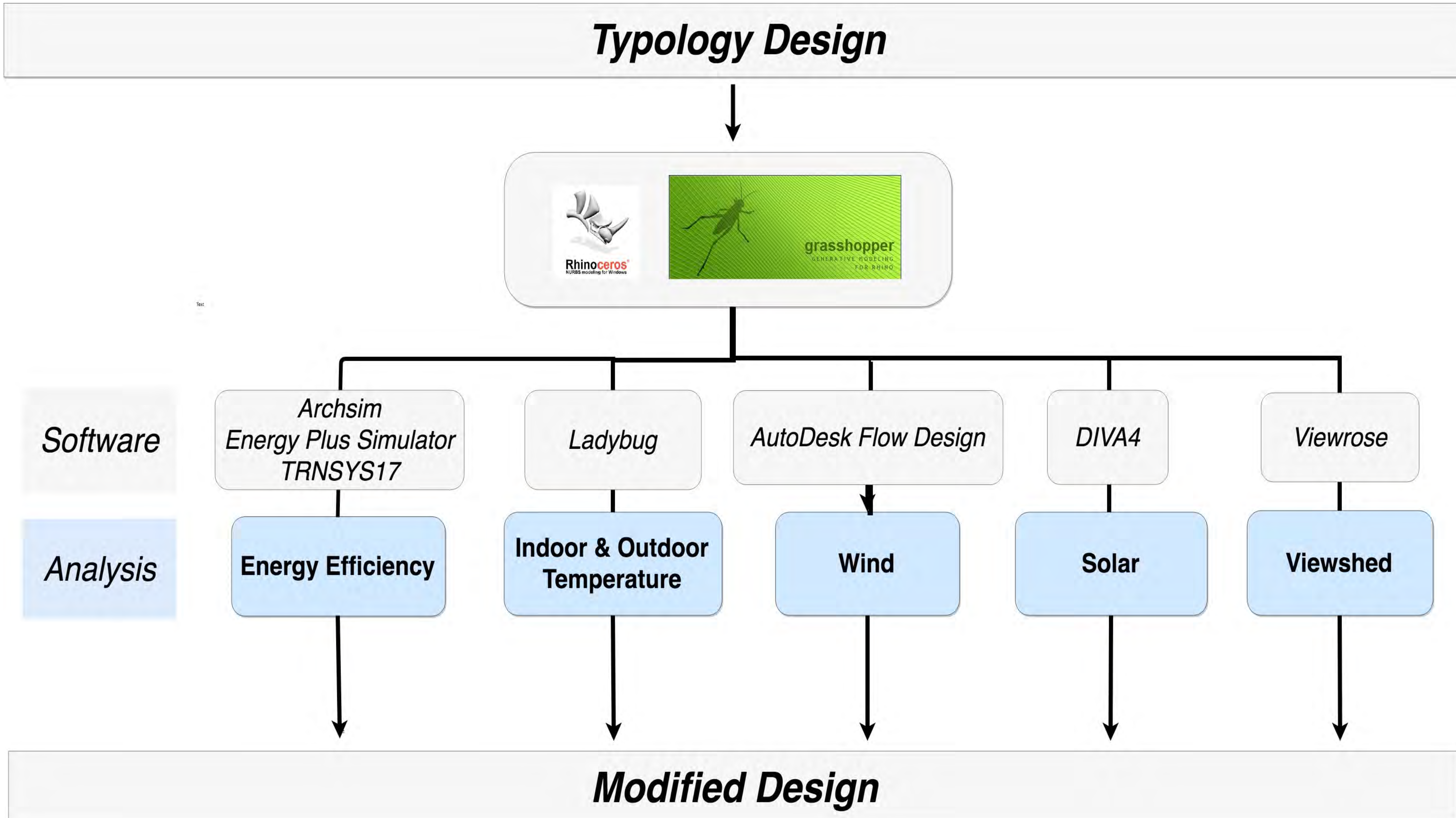
We summarize some observations influencing the energy consumption: 1. Larger building footprint generates lower consumption per square footage for all building typologies; 2. North-South window orientation results in lower consumption; 3. High-density urban fabric increases the lighting consumption but increases the transmission of heat; 4. Facade material highly affects the energy consumption.

Performance Modeling, cont.

Based on our observations and other rationales of reducing building energy consumption, we make variants for the design prototype provided by the designers while keeping the FAR constant: increase the building footprint, increase/reduce building density, changing the orientation, placing larger windows, introducing new material, and changing the air conditioning system.

We apply these adjusted variants for the Adaptive Village design. In this design, the most efficient variation is increasing the footprint and introducing green building material (EPS). Currently, the energy consumption of the original design is about 19% higher than that of the existing single-family houses. With the application of these two most efficient adjustments, the consumption can be reduced to 21% lower than the existing single-family houses. If we consider both production and consumption, the design can reduce the gap between production and consumption about 41% of the existing single-family houses, while the FAR of the design is similar to that of single-family houses.

Modeling Framework

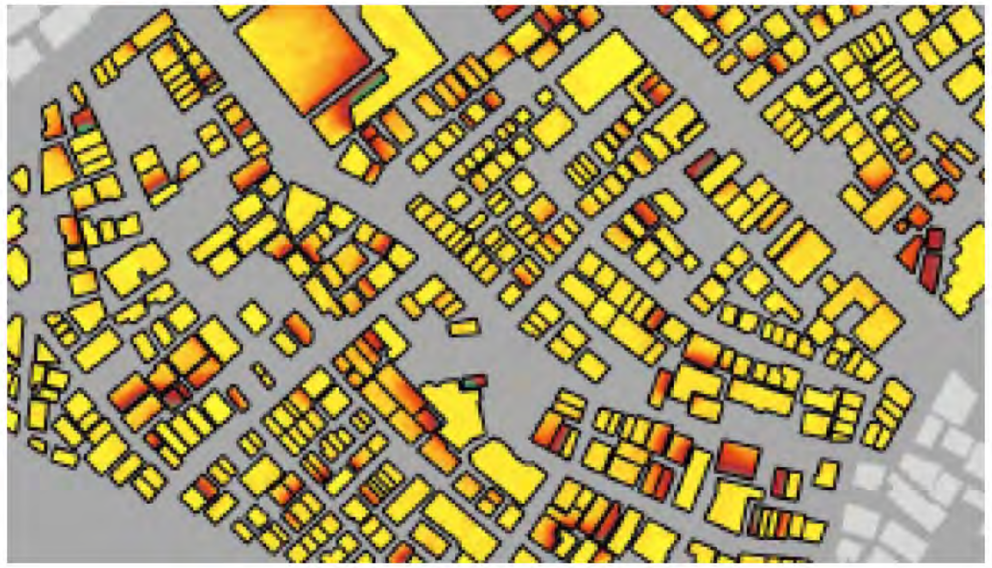


スマートシティ
京島

Urban System Analysis

Key Takeaways

Energy High-rise buildings and detached houses tend to be energy inefficient
Solar High solar irradiance tends to be in parks
Viewshed Wind passes through Kyojima from south (Tokyo Bay) in the summer
Wind Dense, compact urban fabric reduces airflow (related to urban heat island effect)



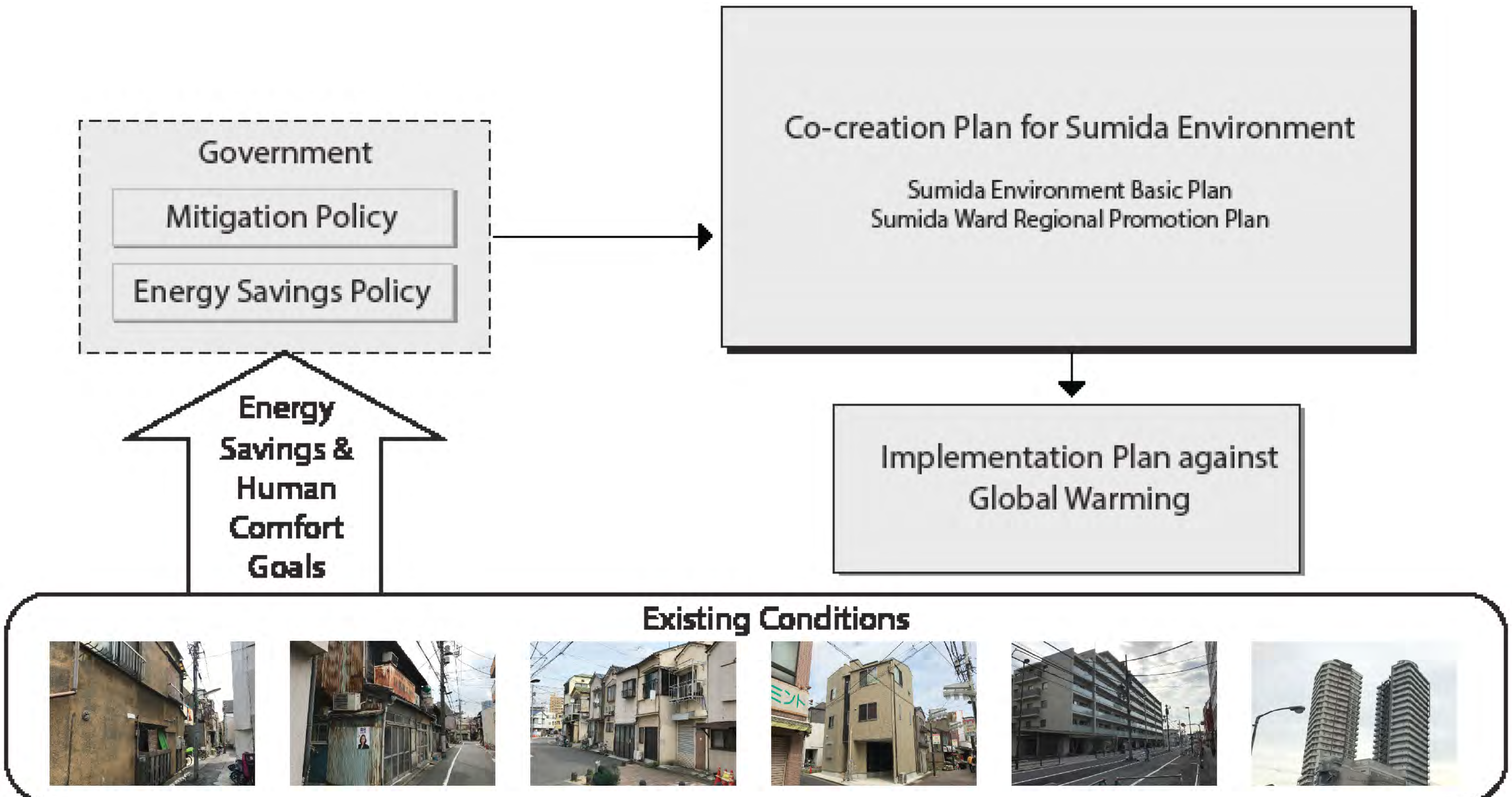
Solar Irradiance

Viewshed

Wind

Sumida Policy Context

Sumida Ward Global Warming Countermeasure Action



Heat Stress Risk

IoT building sensors location in Kyojima

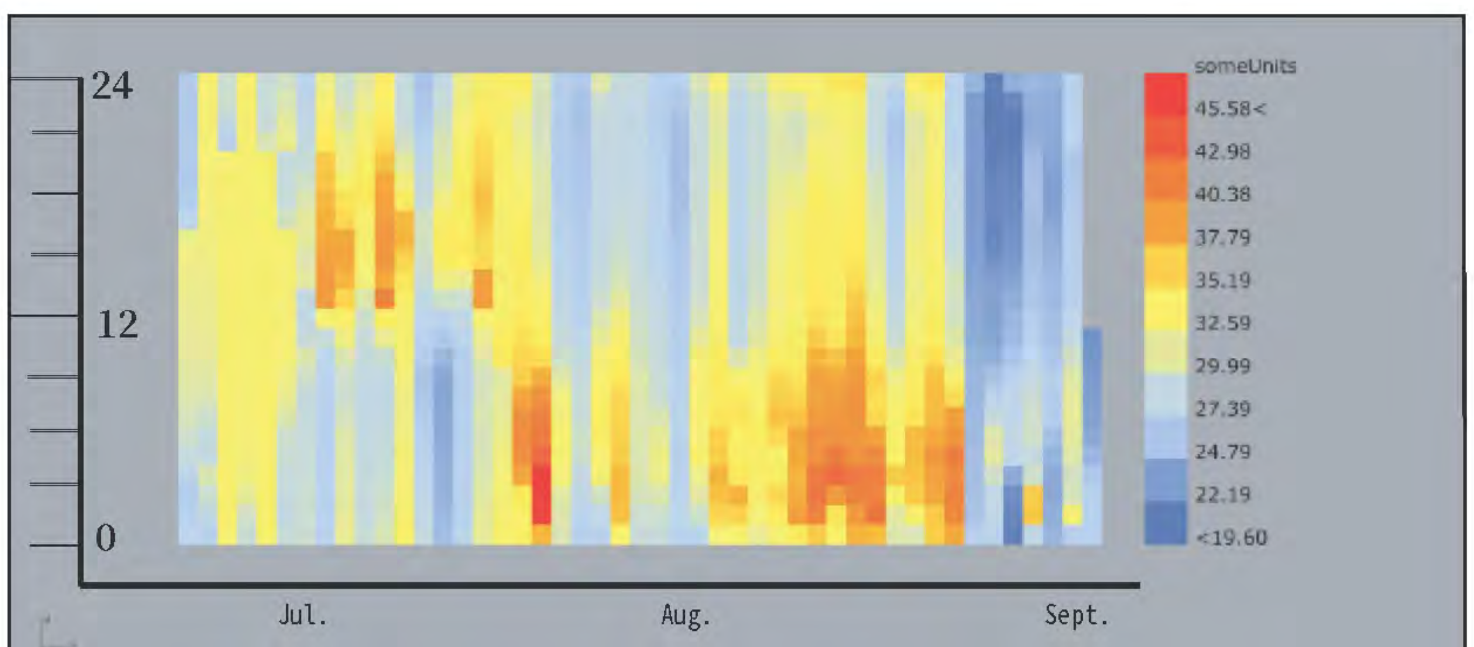
Wooden house 1
Address : 2-10-3 Kyojima Sumida-ku, Tokyo

Select building sensor adjacent to Kirakira street

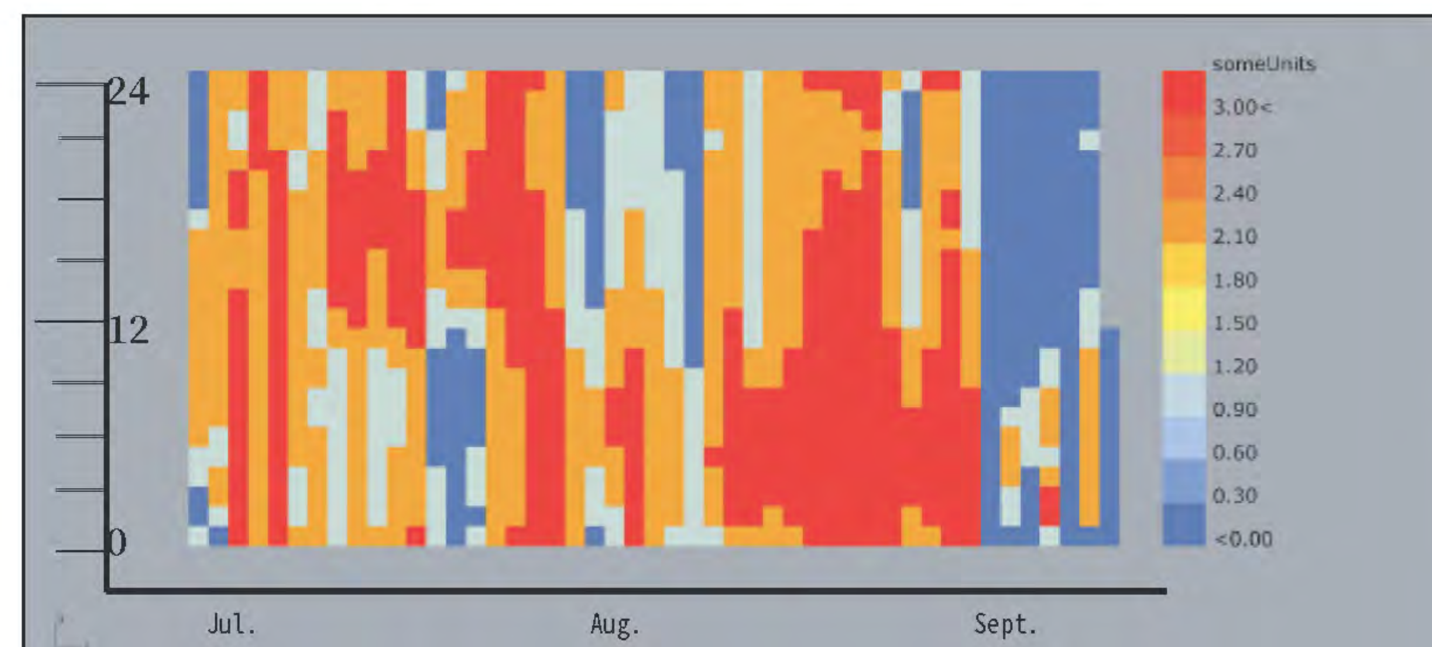
IoT sensor data of outdoor and indoor temperature

July to September 2017
(1 minute interval, aggregate to hourly data, 70 days)

Data source: Dr. Kanae Matsui

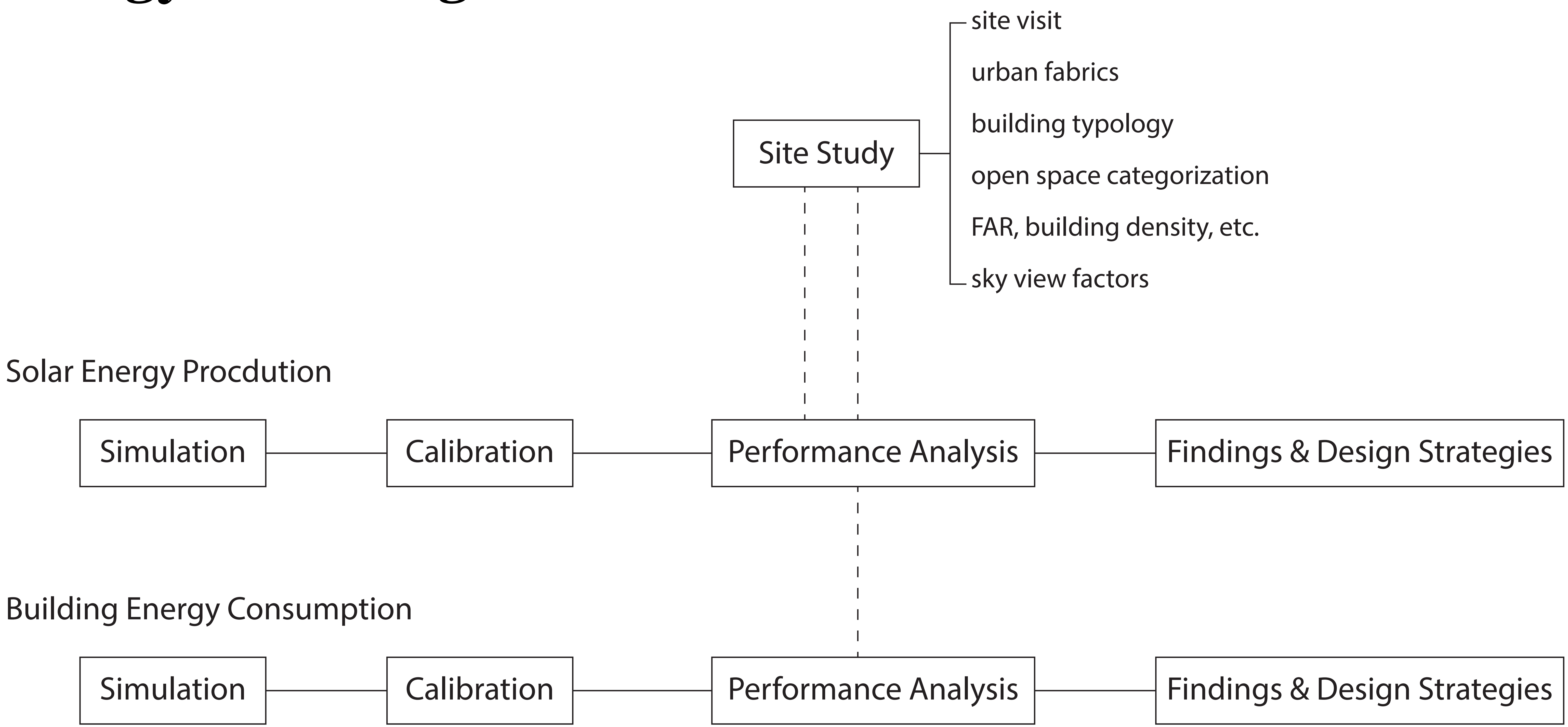


Perceived Outdoor Temperature

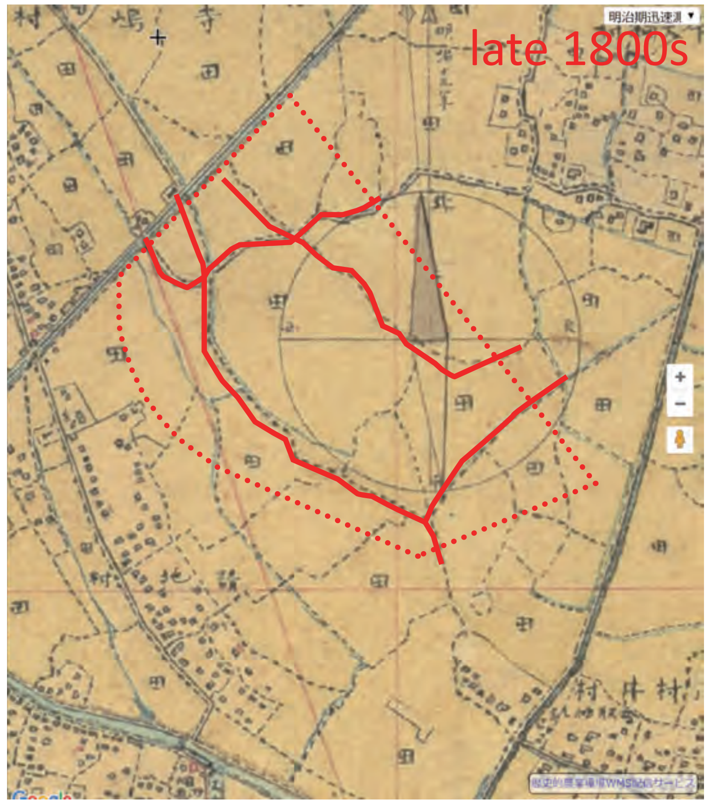


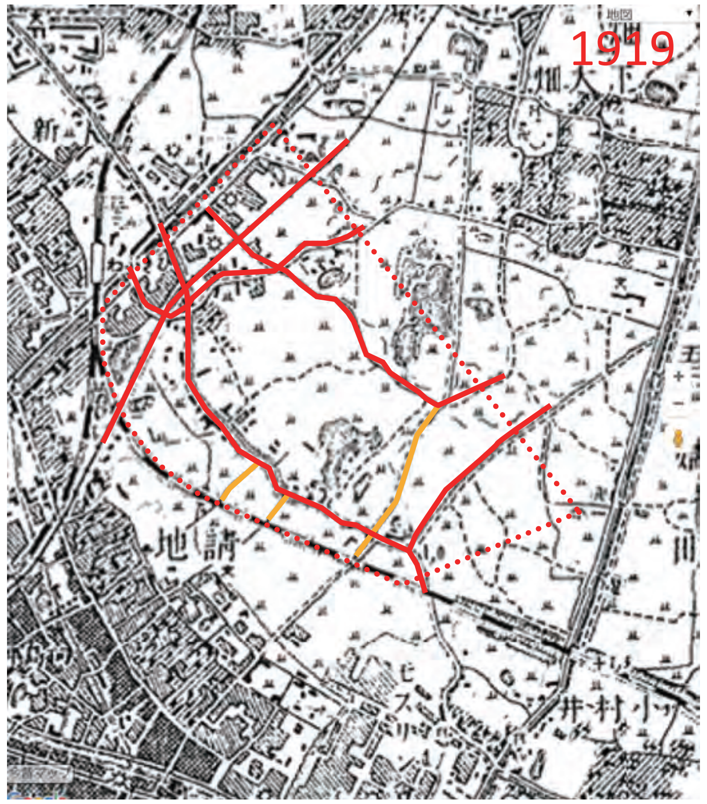
Human Comfort Index (82% outside of human comfort)
+3:Strong heat stress +2:Moderate heat stress +1:Slight heat stress 0:No thermal stress

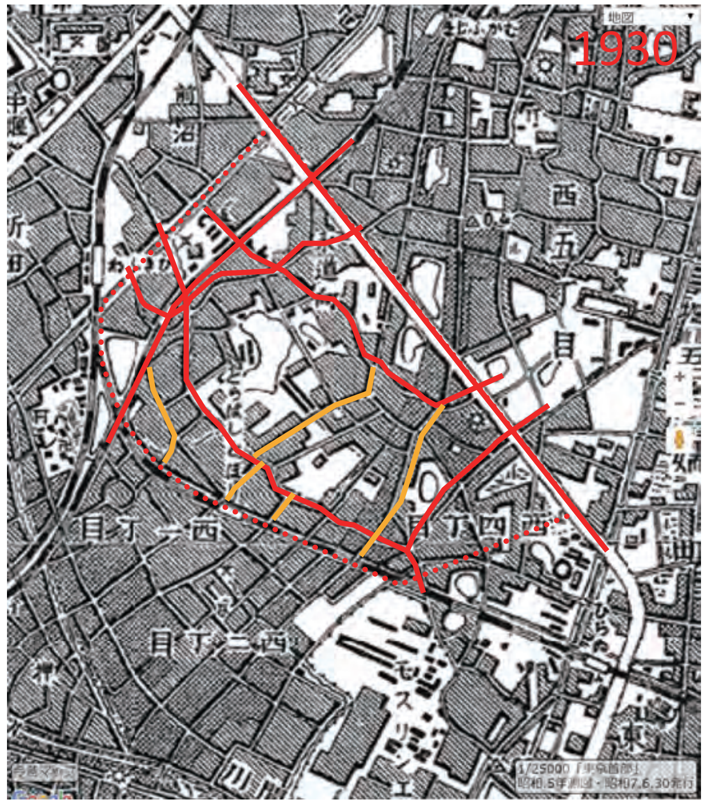
Energy Modeling Framework

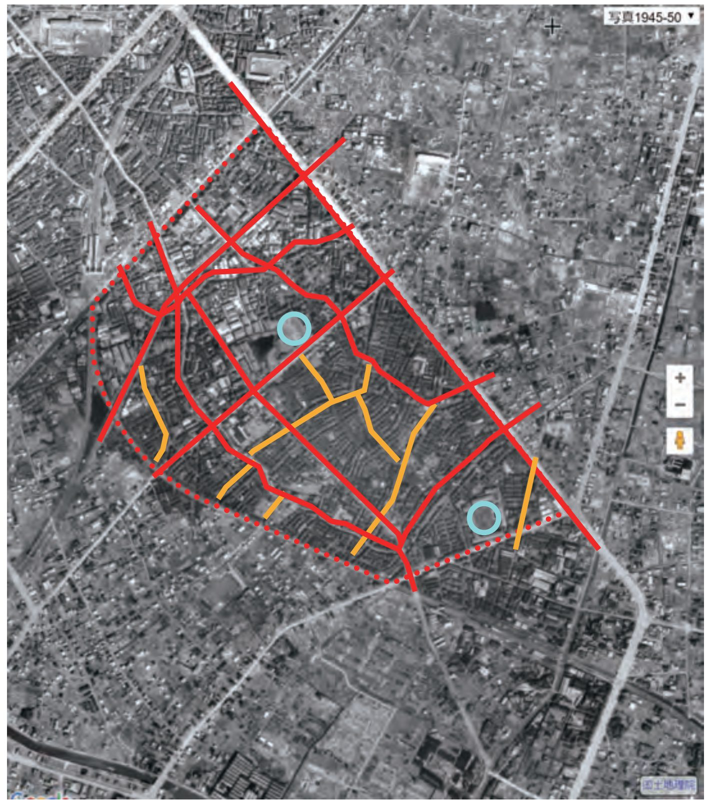


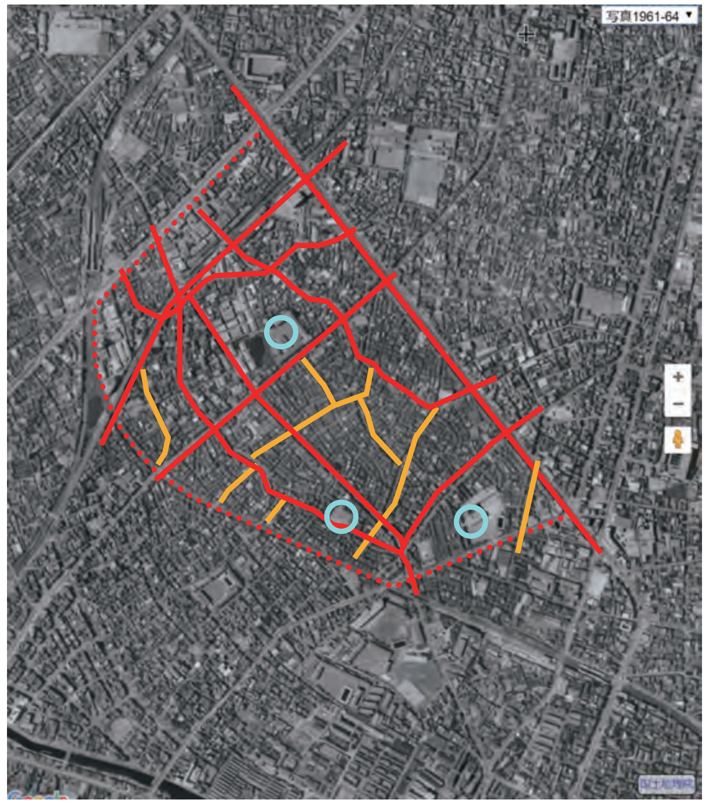
History of Organic Fabrics

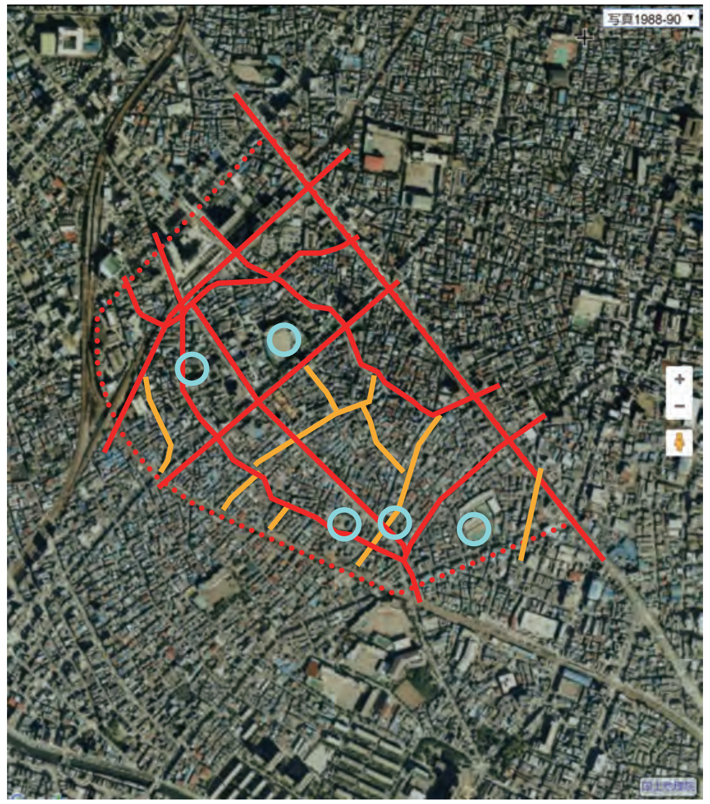












Site Visit

Open Space Categories

parks

pocket parks

school open space

affiliated open space

accessible green roof
(public or communal)

parkings

Building Typology


Detached SF House


Small Tower


Large Tower + Podium

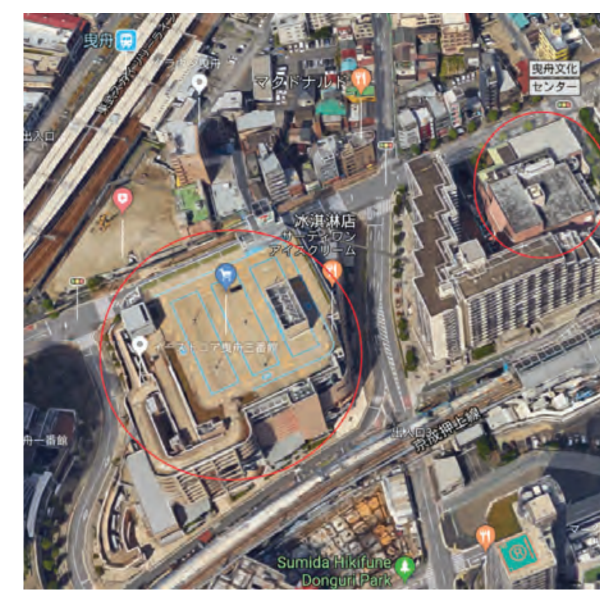

L shape

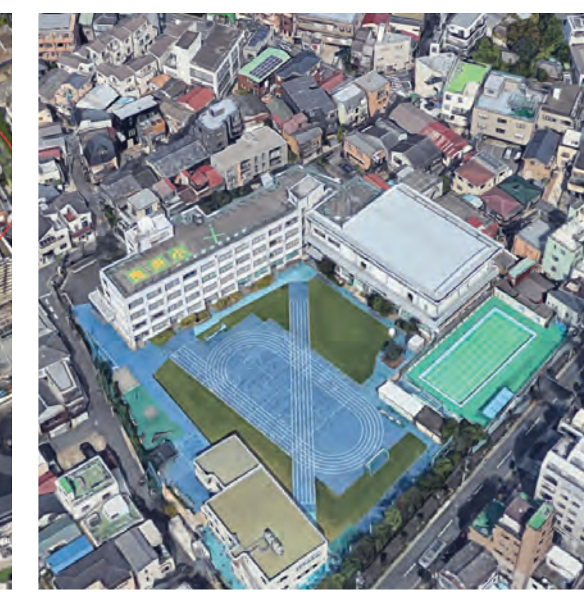

Industrial Big Box


Slab

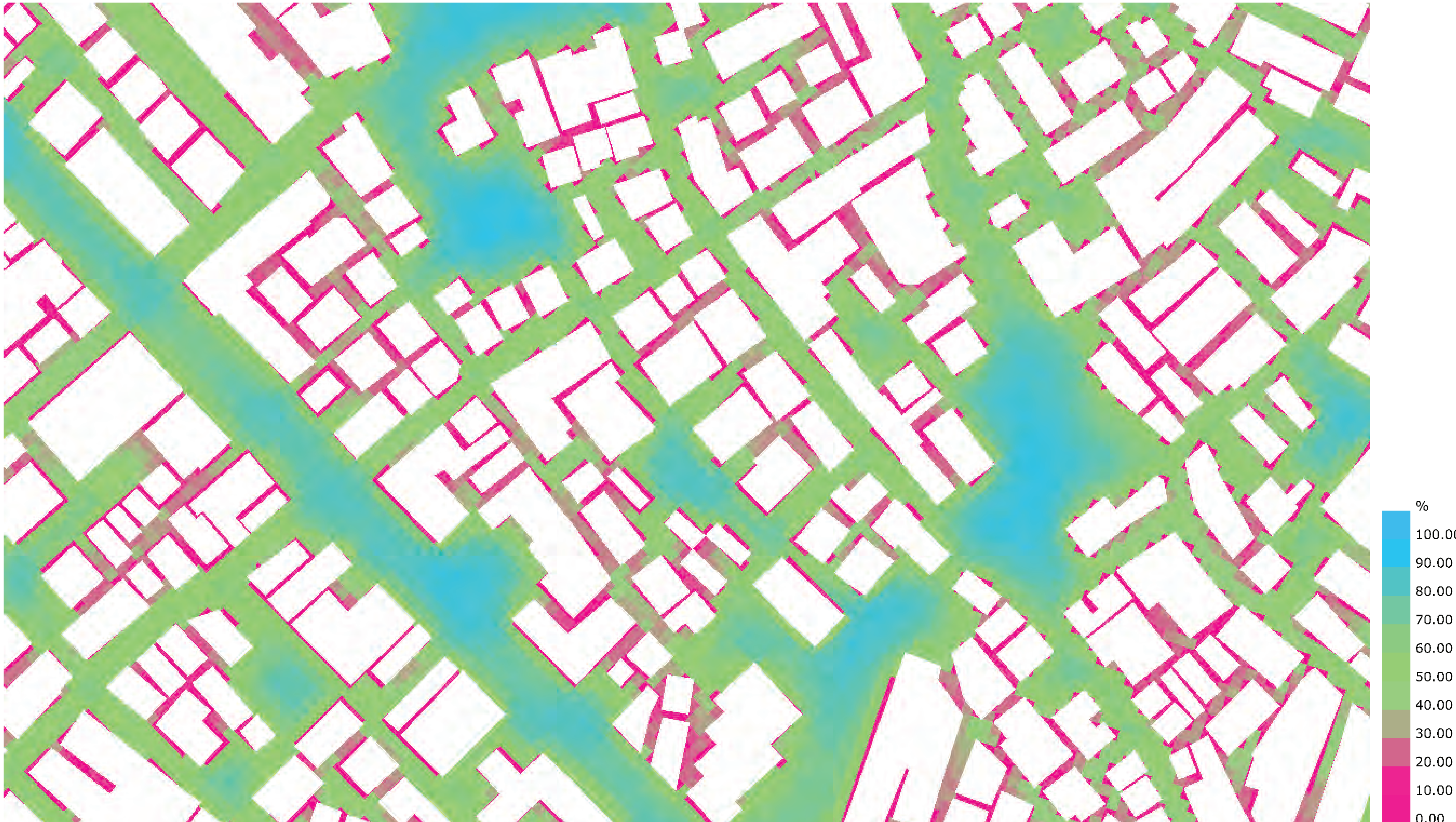

Cube


Attached SF House

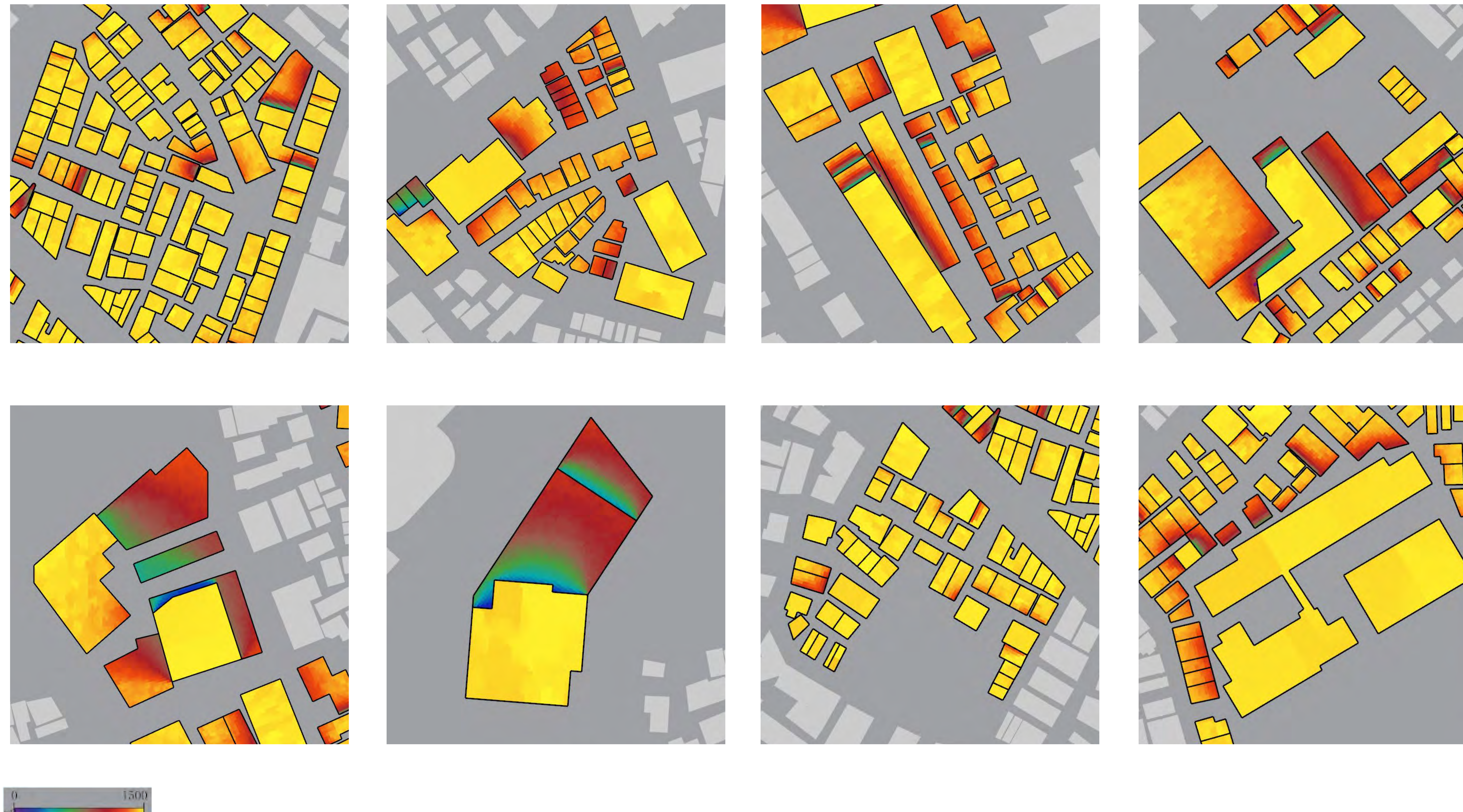

Commercial Big Box


School

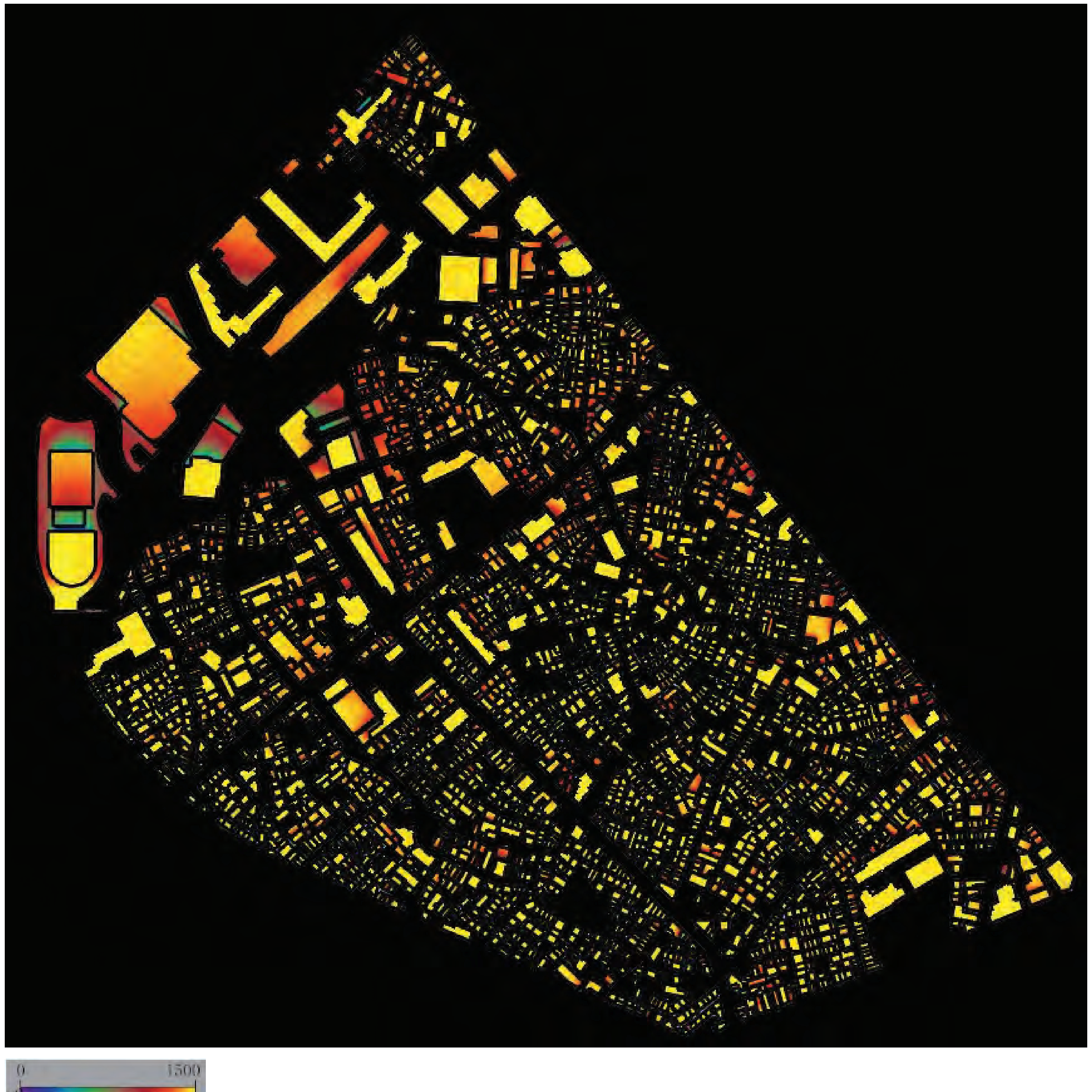
Sky View Factor

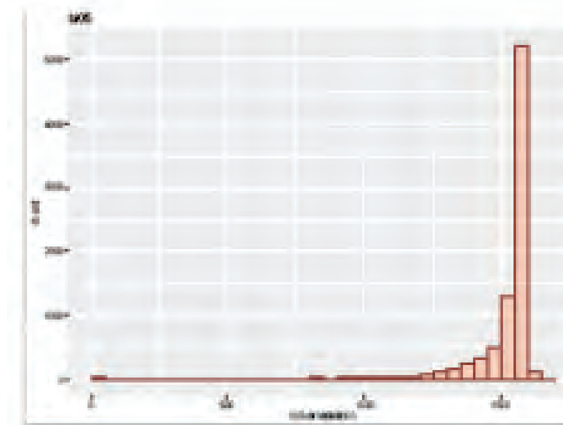


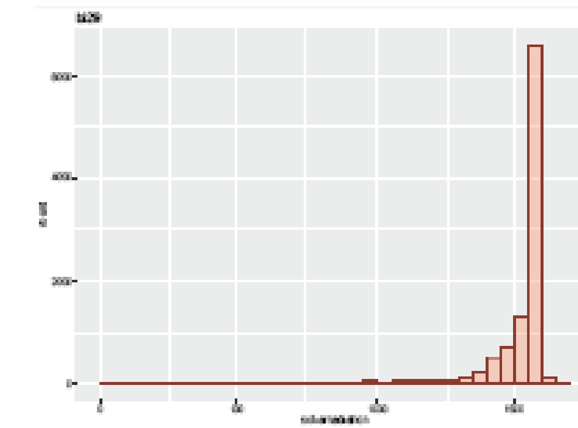
Energy Production--Simulation 1, Selected

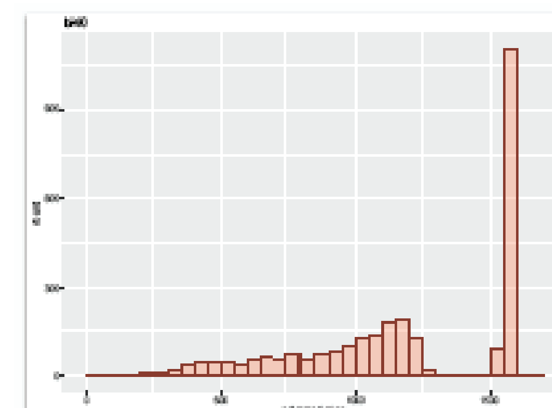


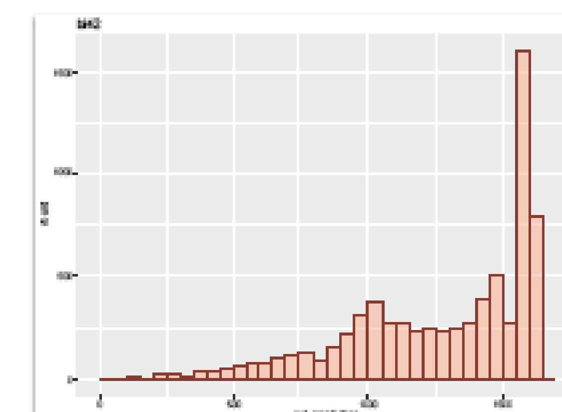
Energy Production-- Simulatin 2, Whole Site

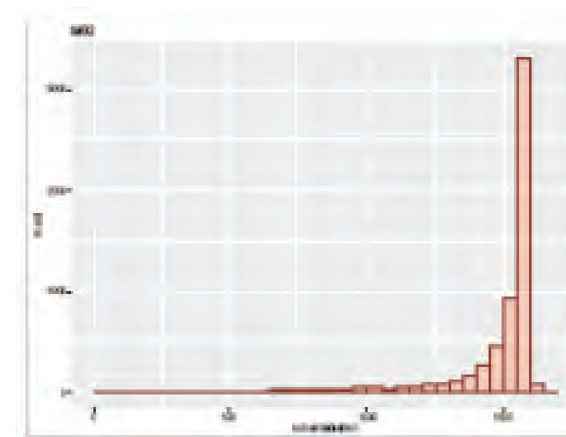


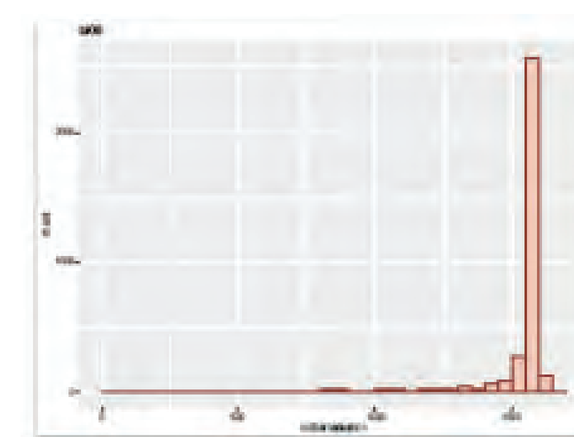

Low Dense


Mid-Rise

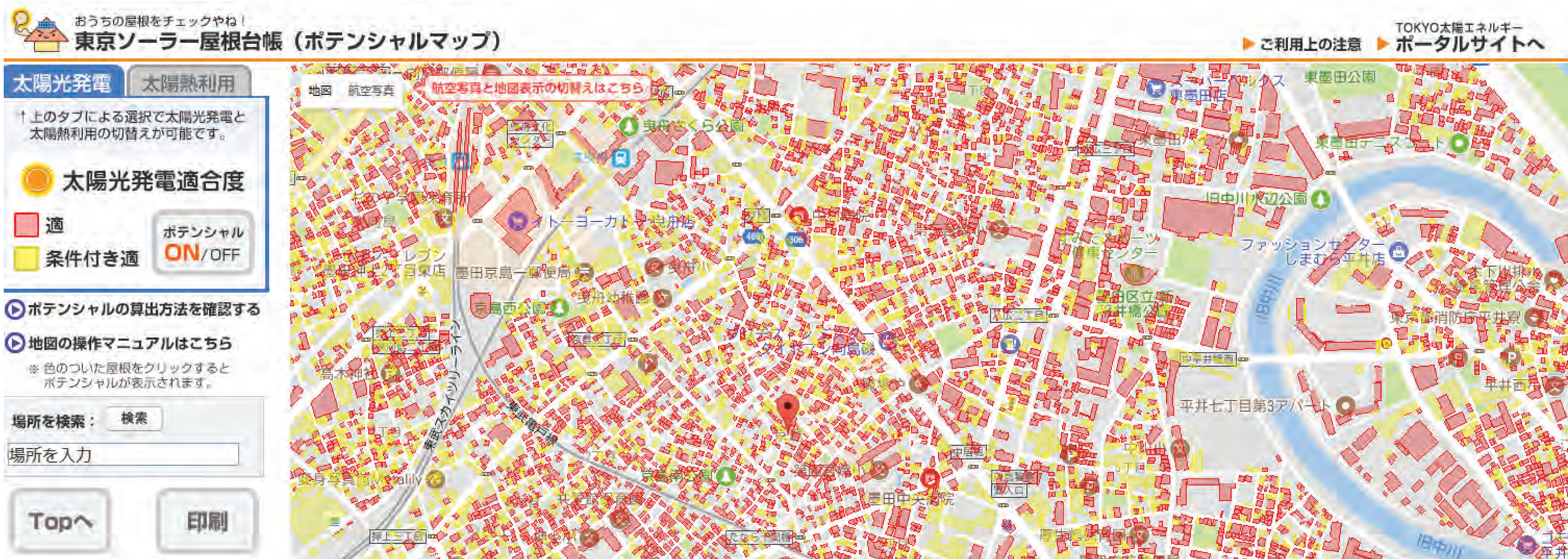

High-Rise 1


High-Rise 2


School


Park

Energy Production--Calibration



Source: Japan Solar Roof Panel http://tokyosolar.netmap.jp/map/Map.html?ll=35.7137271,139.8234059

Samples: 50 random buildings; 1100 kWh/m² as standard

Divide the average modeling resulte by the average of the samples to get the coefficient for calibration

Calibrated Solar Radiation to GFA is:

$$E = \frac{\sum_{>=1100}^{n} \left(\frac{\bar{e}_{sample}}{\bar{e}_i}\ e_i\right)}{S_{GFA}} \cdot \frac{n}{N} \cdot S_{roof}$$

Energy Production-- Results

$$PV_m(G_i) = I \times \tau \times roof^{PV}(G_i) \times \eta_{pc} \times K_{m,pt} \times T$$

The current theorectical energy production efficiency of Kyojima is

8.081 kWh/m^2/year 17.4% of the building energy consumption

Default Value:

PV placement ratio: 0.3

PV conversion ratio, τ: 0.2

Performance ratio, T: 0.89

Efficiency of power conditionner, η: 0.95

Temperature correction coefficient, K, varies by months, the average is 1.0309

Energy Production--Relationship between Production

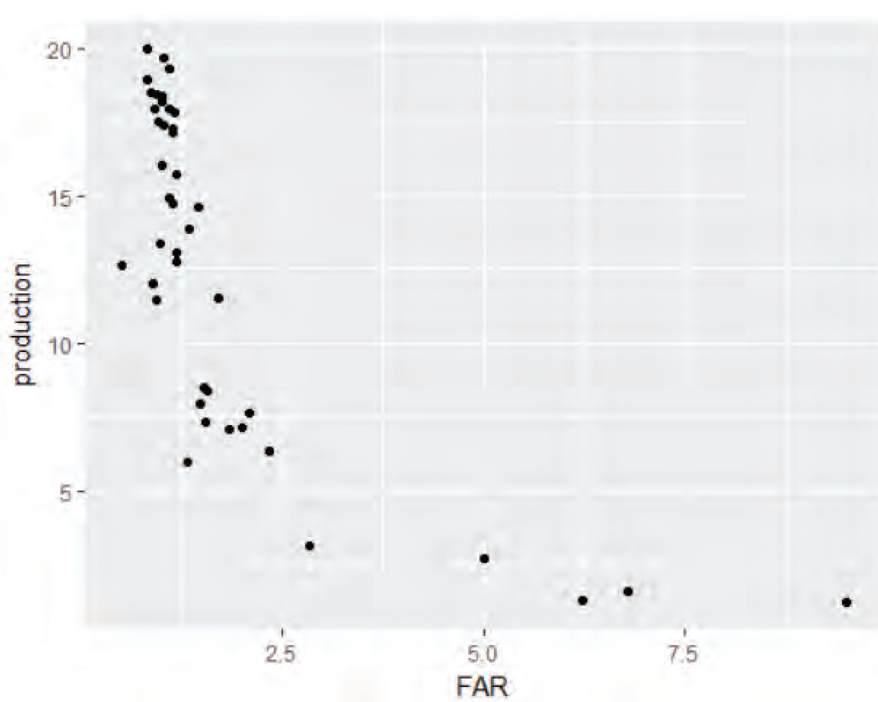
- Higher skyview factor generate higher energy production;

- Increase of FAR and percentage of regeneration cause the decrease of energy production;

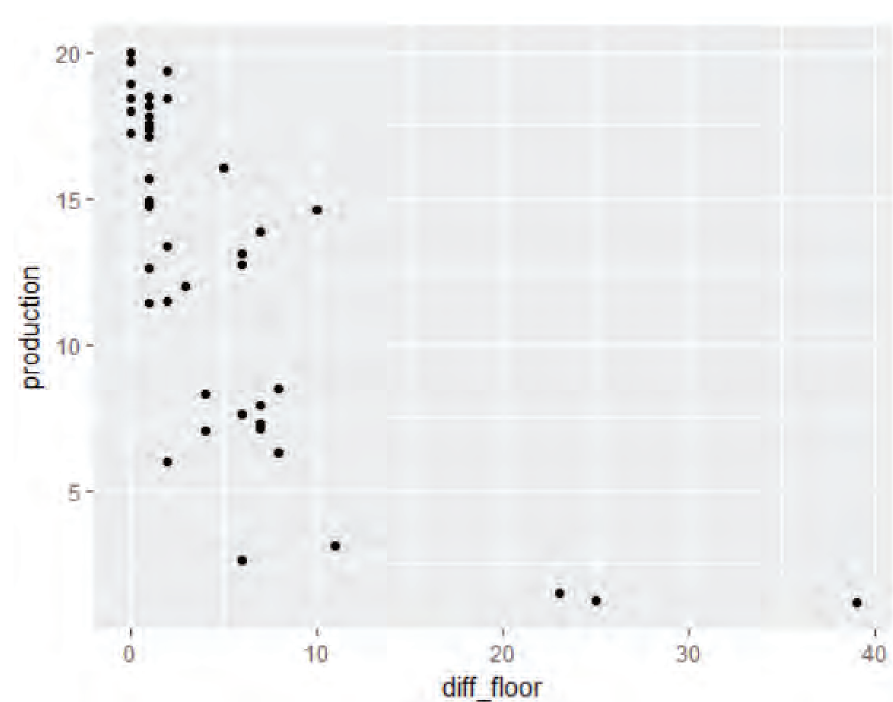
- The current regeneration typologies all have a negative relationship with the energy production.

	Estimate	Std.	Error	t value	Pr(>|t|)
constant	-7.76231	9.253382	-0.839	0.40841	
sky view factor	0.307581	0.096776	3.178	0.00351	0.01
FAR	-3.86489	1.780408	-2.171	0.03827	0.05
density	28.99874	13.76526	2.107	0.04392	0.05
% of single-family houses	-11.6065	7.164238	1.62	0.11604	
% of slabs	-20.7559	7.136805	-2.908	0.0069	0.01
% of cubes	-22.798	6.532027	-3.49	0.00156	0.01
% of L-shapes	-25.088	7.424556	-3.379	0.00209	0.01
% of towers	-18.5328	8.16646	-2.269	0.03086	0.05
% of tower-podiums	-6.57783	6.854938	-0.96	0.3452	
% of box	-17.1874	5.707603	-3.011	0.00535	0.01
% of school	-19.6531	5.802131	-3.387	0.00205	0.01
difference of floor	0.004492	0.215443	0.021	0.98351	
R-squared	0.893		Adjusted R-squared		0.8488

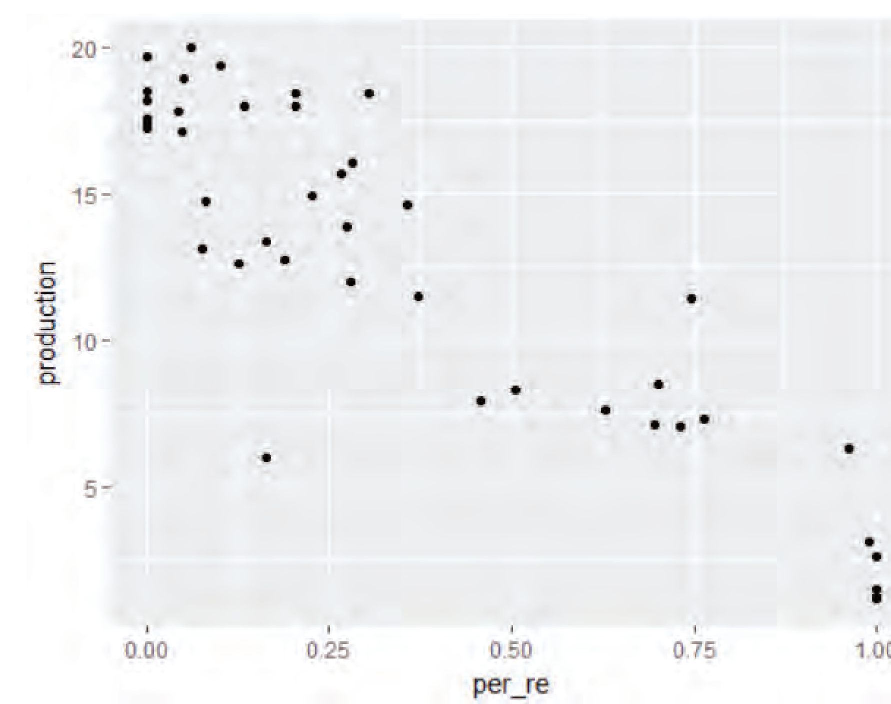
FAR-production



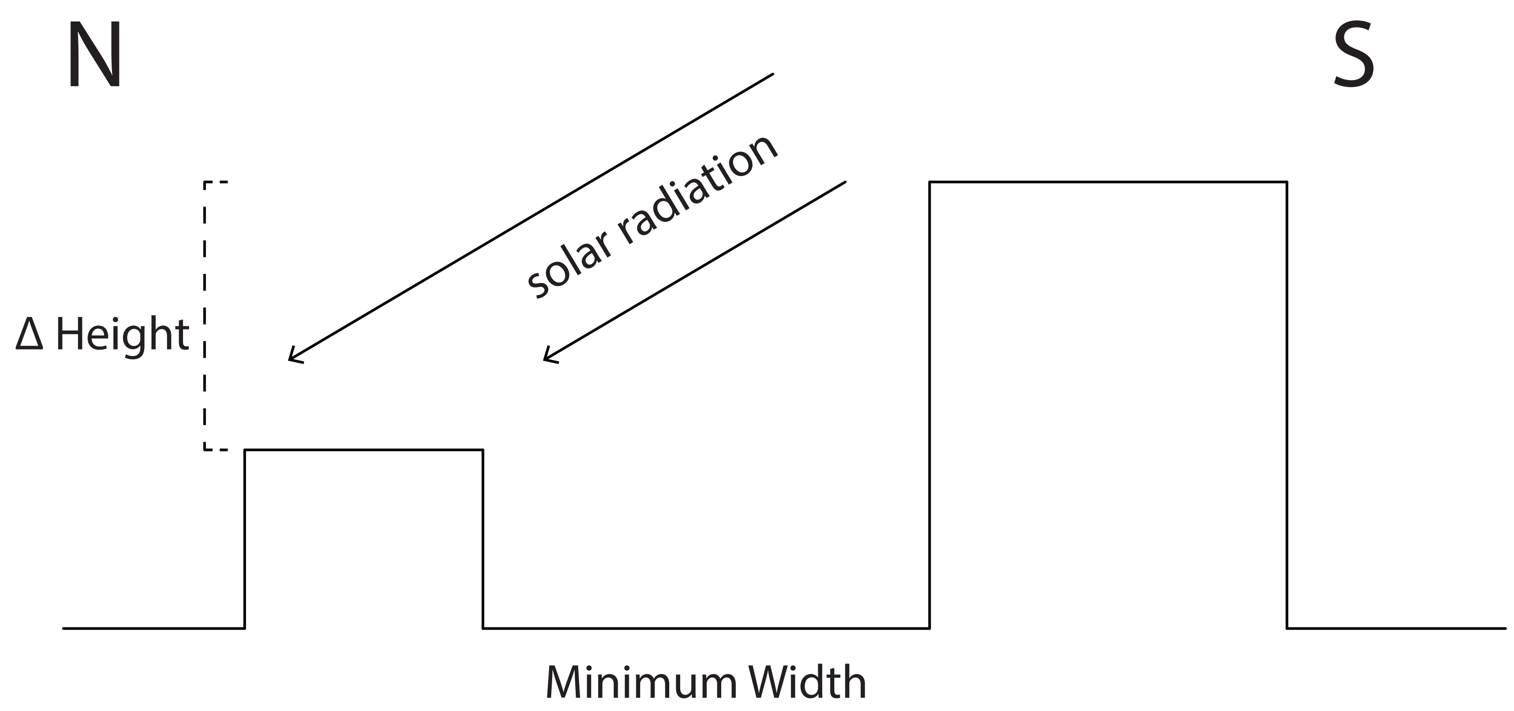
difference of floor-production

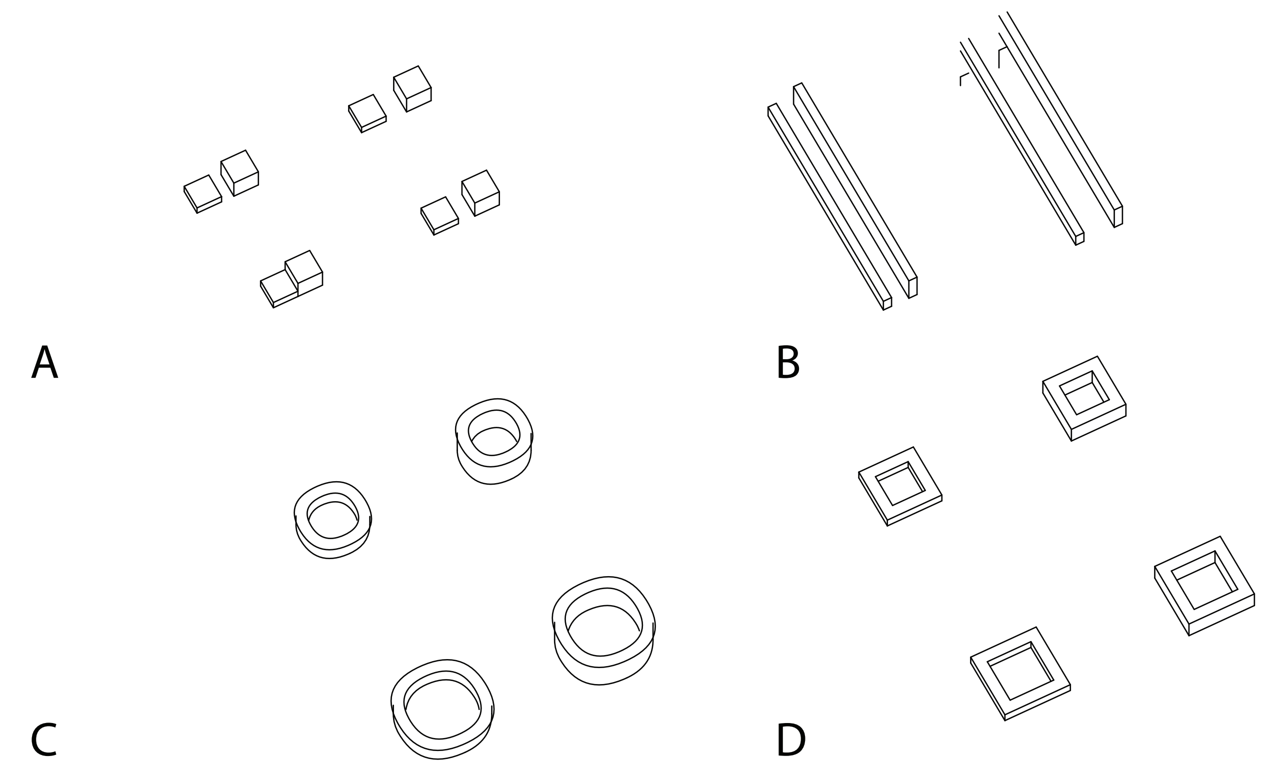


% of regeneration-production

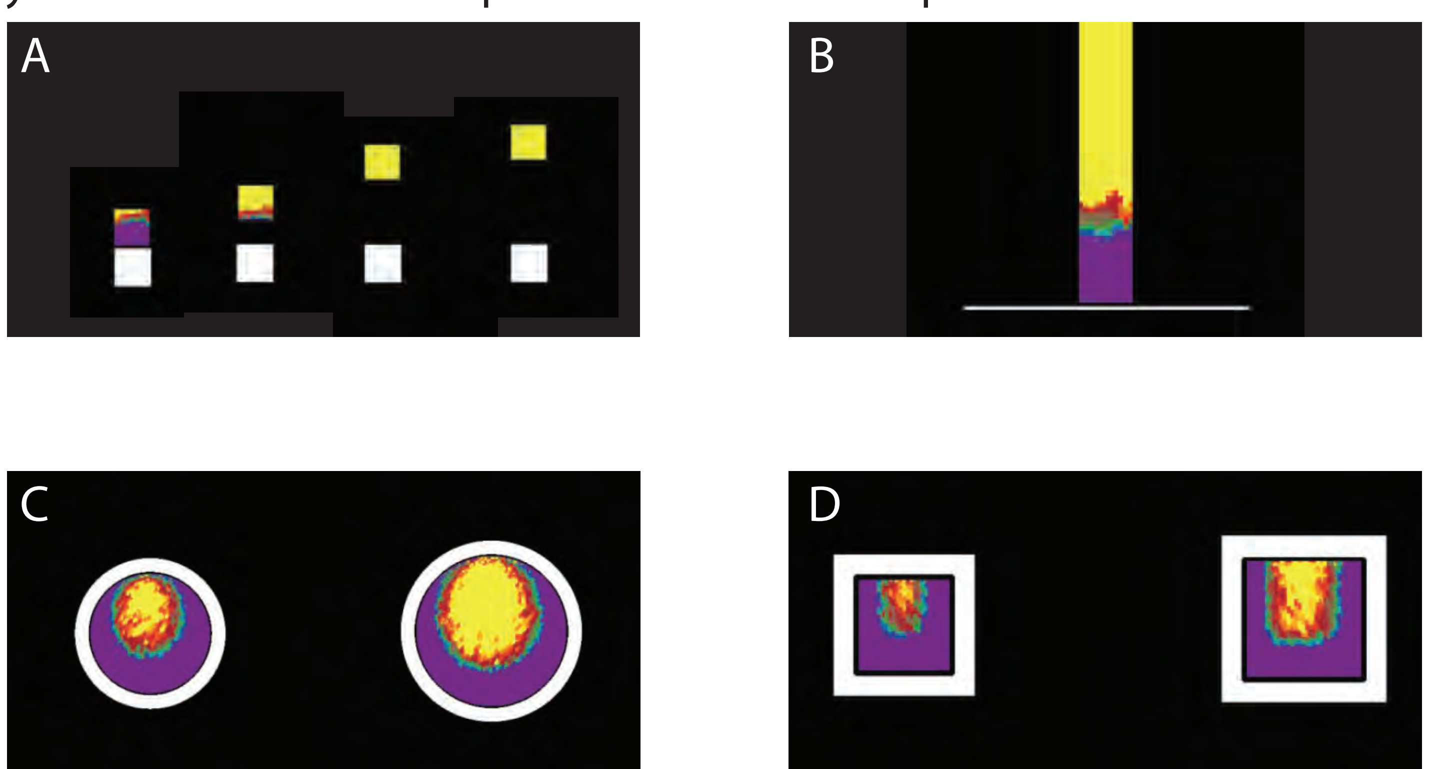


Design Recommendation





yellow areas show the optimal location for PV panels



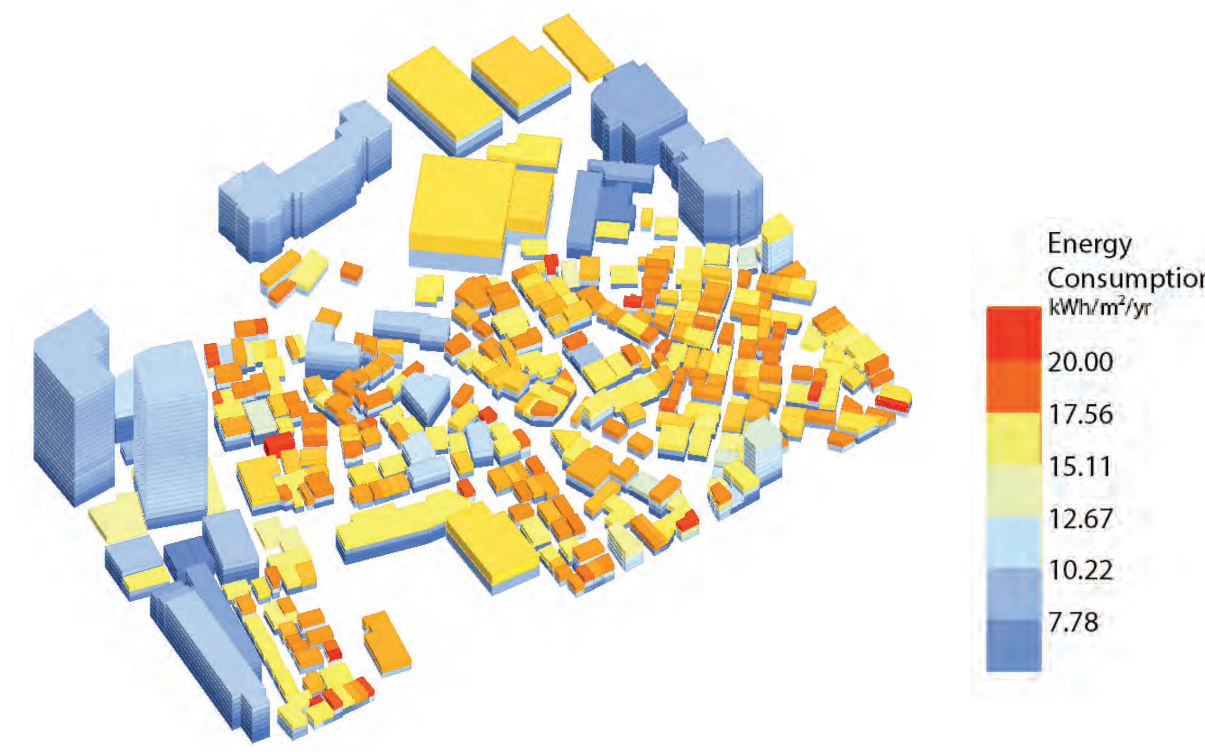
recommended minimum width for solar potential (unit: meter)

△ height	A	B	C	D
3	4	5.4	14.4	9.6
6	8	10.8	28.8	19.2
9	12	16.2	43.2	28.8
12	16	21.6	57.6	38.4
15	20	27	72	48
18	24	32.4	86.4	57.6
21	28	37.8	100.8	67.2
24	32	43.2	115.2	76.8
27	36	48.6	129.6	86.4
30	40	54	144	96
33	44	59.4	158.4	105.6
36	48	64.8	172.8	115.2

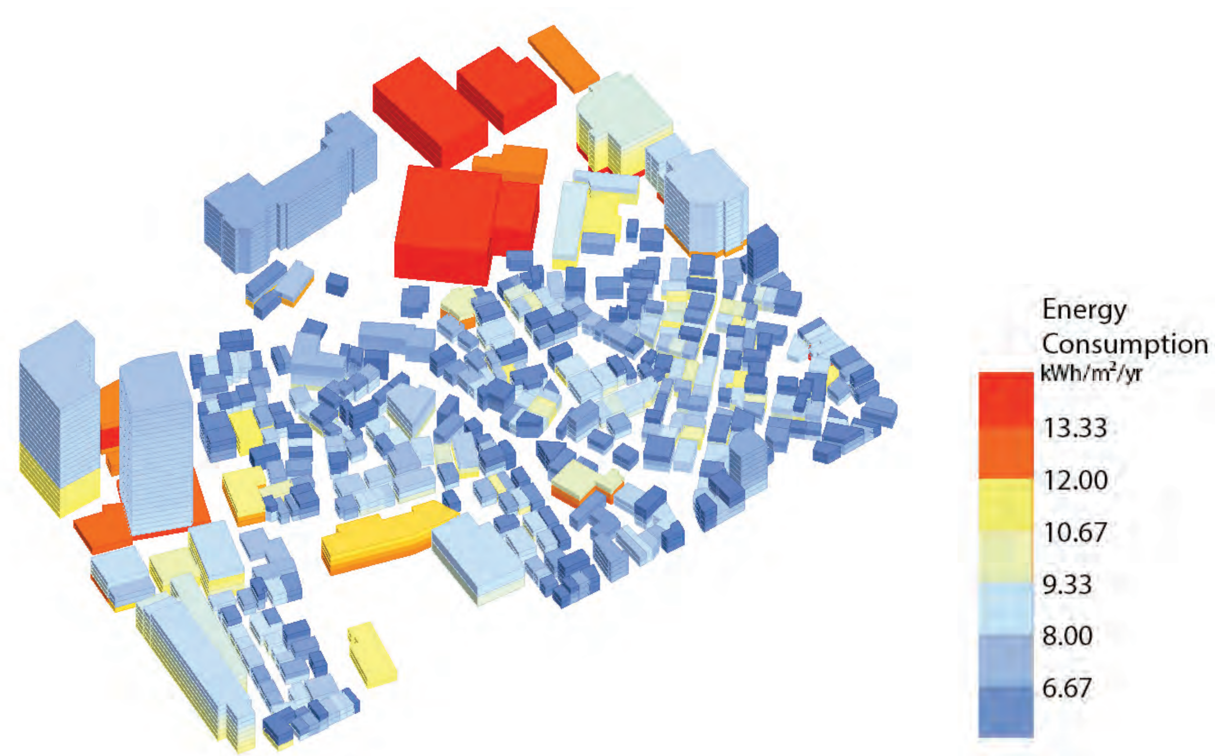
Energy Consumption--Modeling

Heating

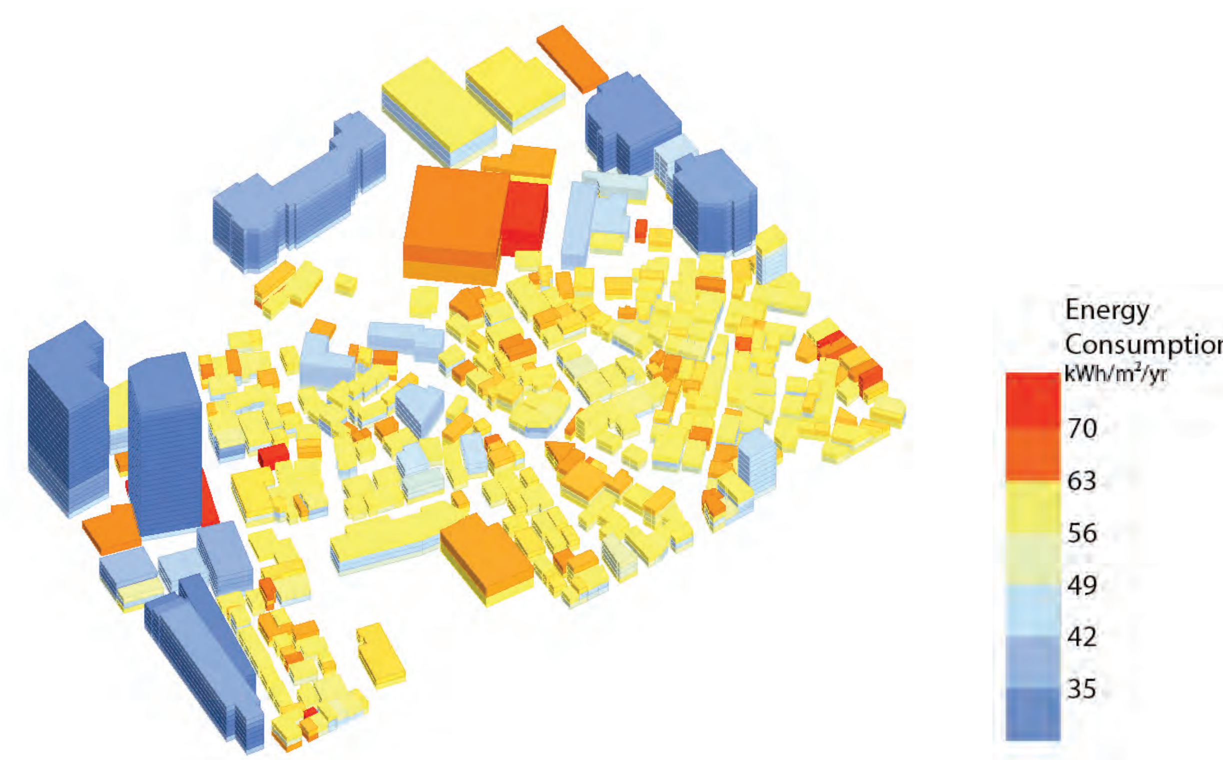
Cooling



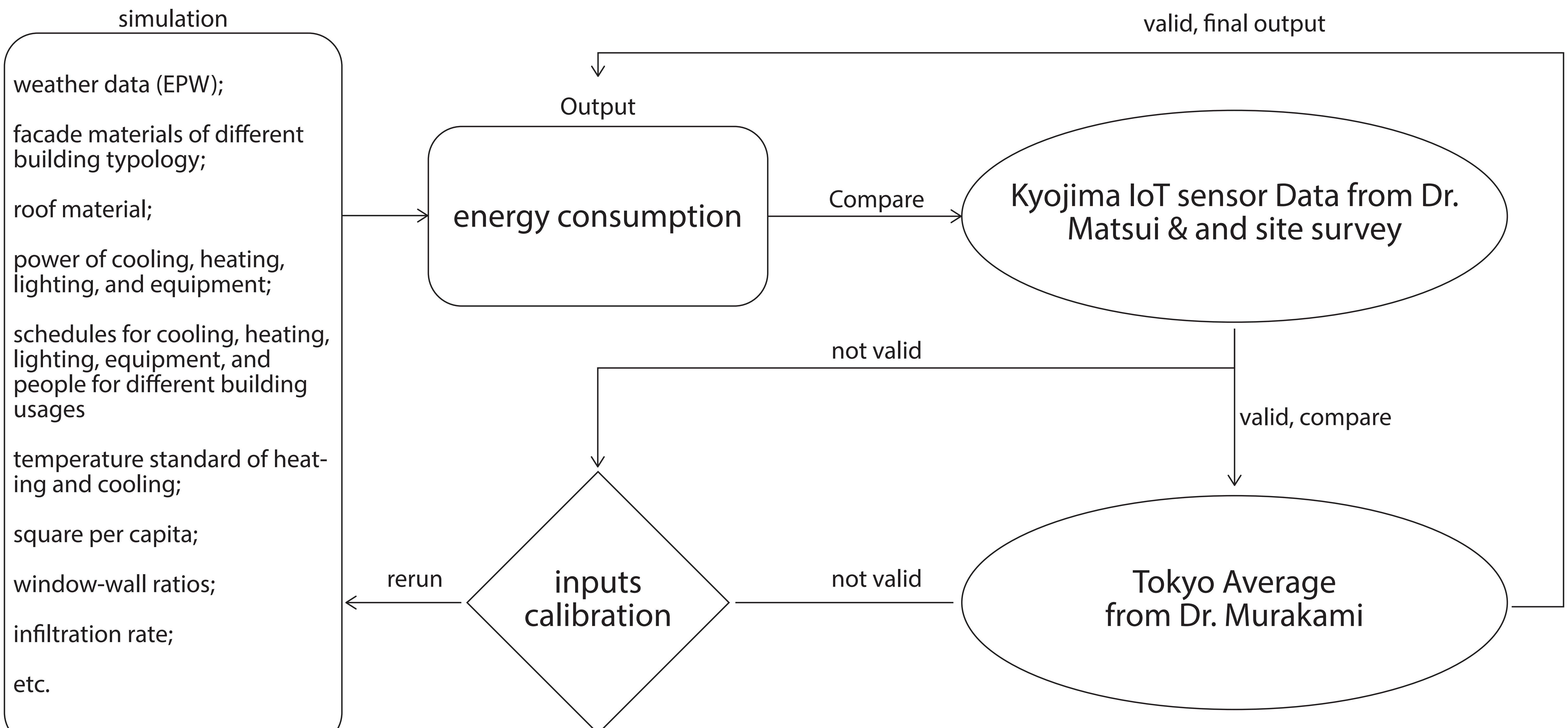
Light



Total



Energy Consumption--Calibration Iteration



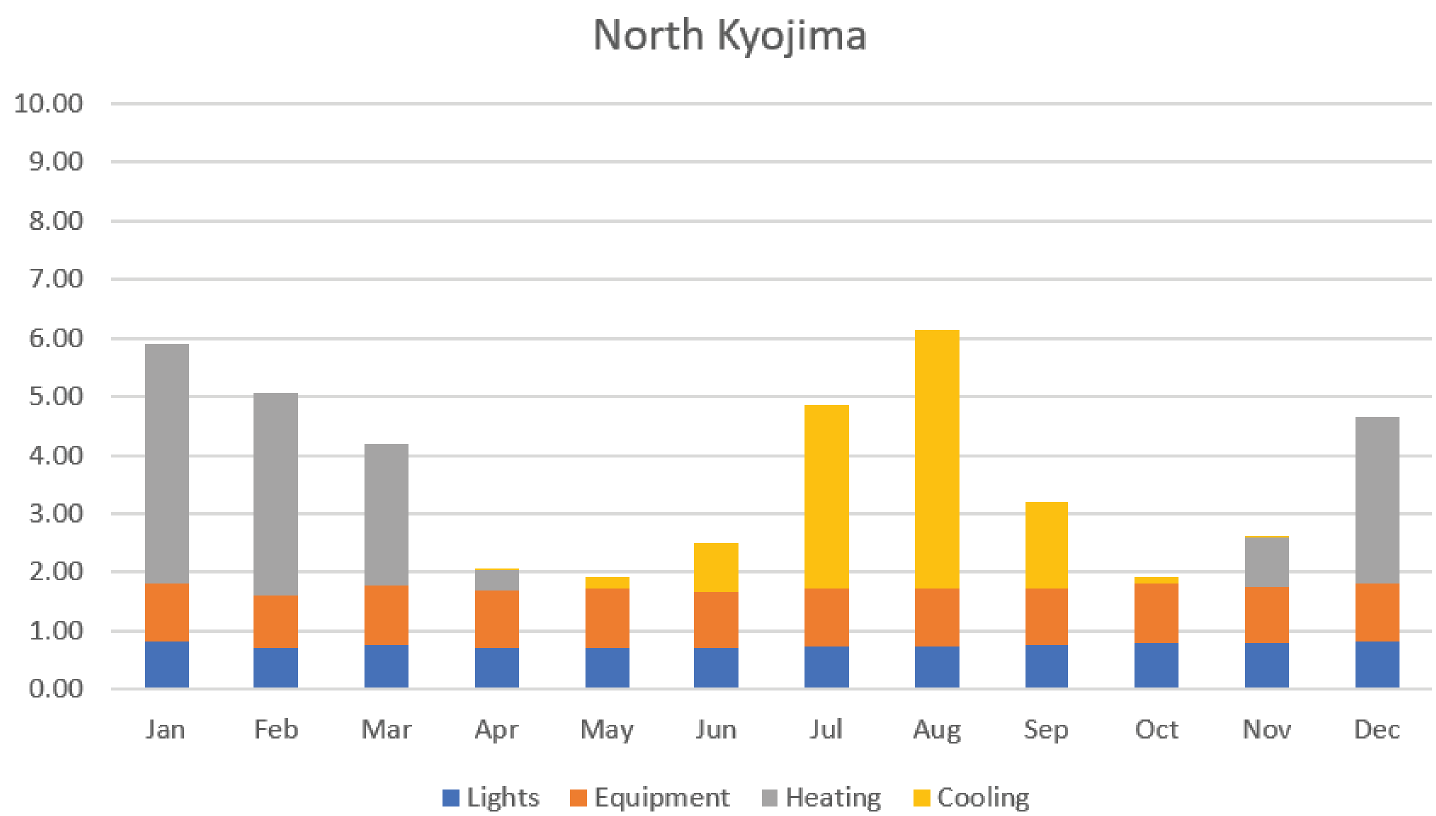
Energy Consumption--Building Types

Wooden Structure Single Family Houses

Concrete Structure Single Family Houses

Apartments

Energy Consumption--Results



Whole Site: 44.99

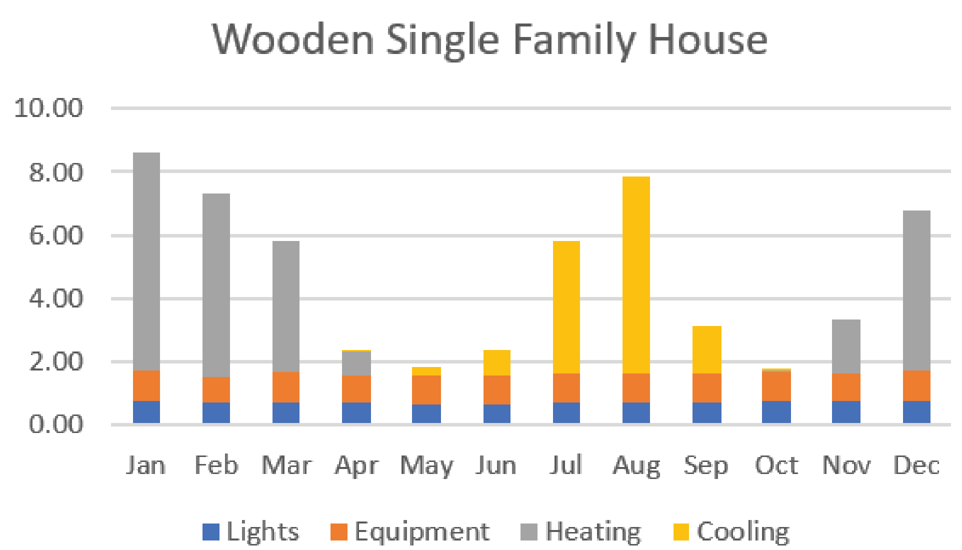
Wooden SF House: 56.99

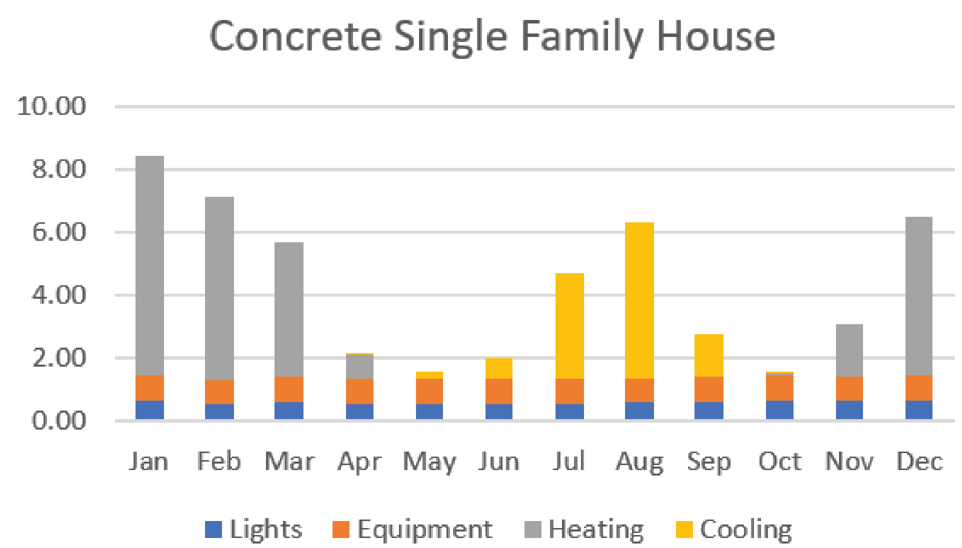
Concrete SF House: 51.84

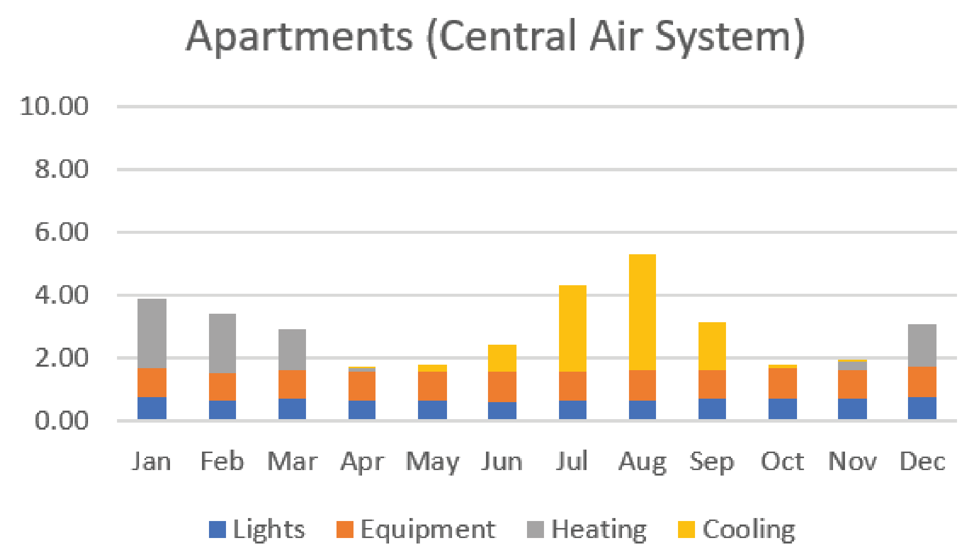
Apartment: 35.75

Tokyo Average: 52

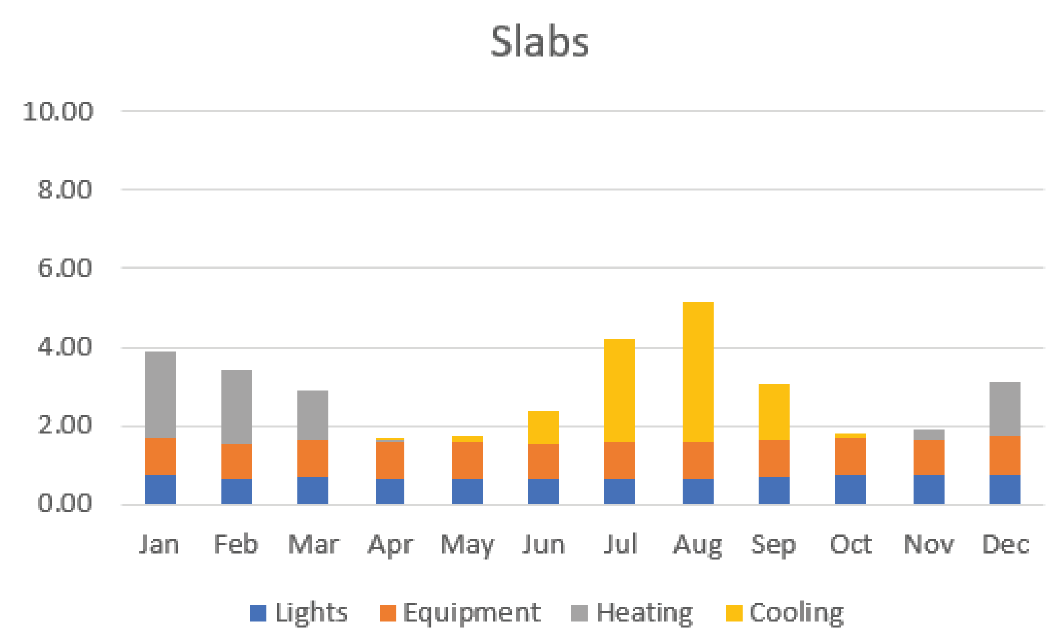
Unit: kWh/m2/year

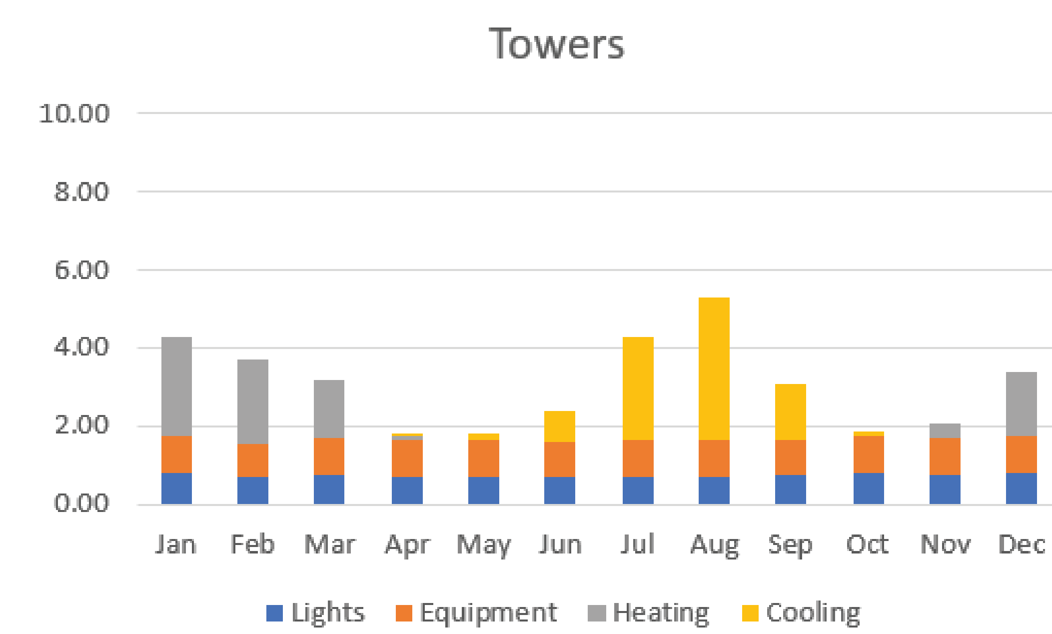


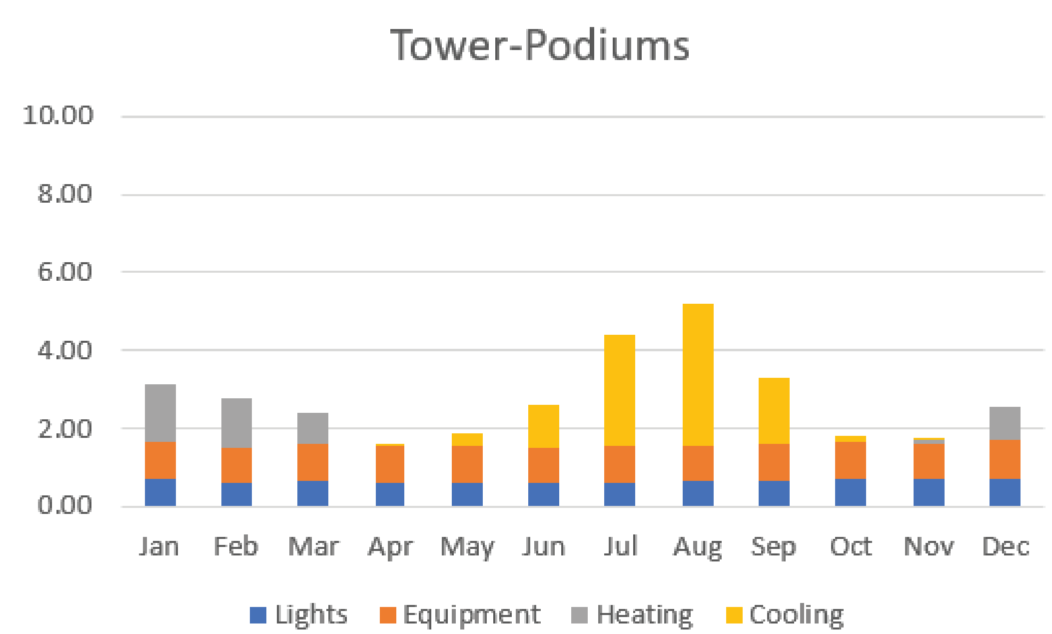


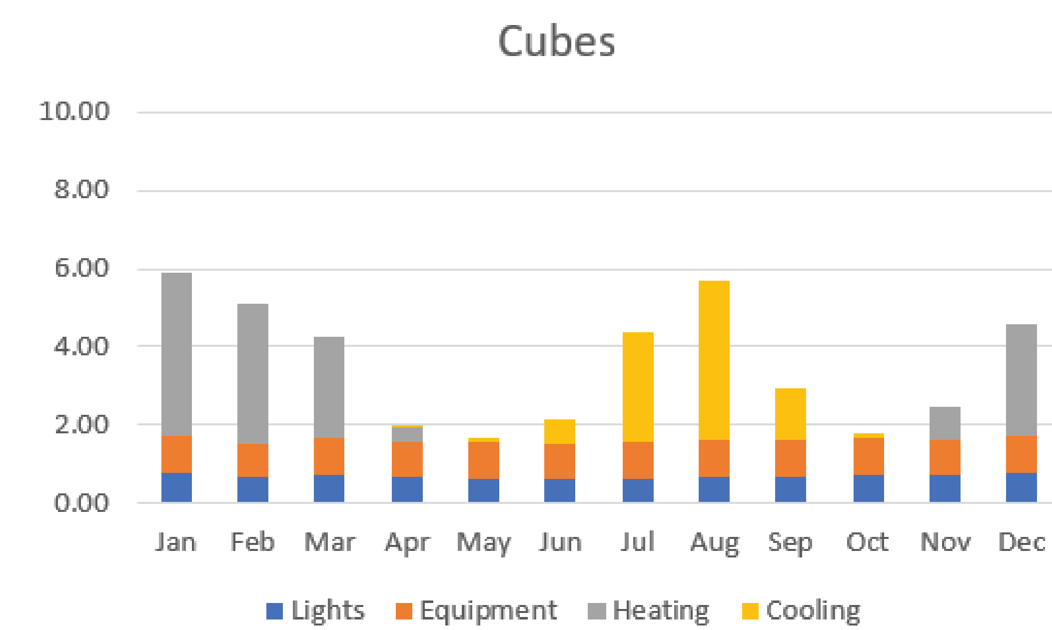


Energy Consumption--Results for Apartments









Slabs: 35.22; Tower-Podiums: 33.37; Towers: 36.99; Cubes: 42.80. Unit kWh/m^2/year

Energy Consumption--Observations and Limitations

- Energy consumption: wooden single-family house > concrete sf house > apartment; in apartment, cube> tower> slab> tower-podium

- larger building footprint generates lower consumption per square footage for all building typologies;

- high density fabrics increases the lighting consumption but increases the transmission of heats;

- N-S window orientation results in lower consumption;

- Facade material highly affects the energy consumption;

- Limitation 1: the current simulation recognizes one floor as one thermal zone, so the result of apartment assumes that the building adopts a central ventilation system;

- Limitation 2: the data from Dr. Matsui only includes the summer season, so the calibration of heating consumption with local data is absent.

Future of Kyojima

Project Timelines

過去

Past
(existing)

現在

Present
(0~10 years)

未来

Future
(10+ years)

Personas for Designs ペルソナ

The Elderly (高齢者)

Long time residents who are less active, searching for a sense of community and have history of health problems.

過去 現在

The Artist (アーティスト)

The creative spirit who wants to spread both traditional and modern artistic creations to the people.

現在 未来

The Family (家族)

Young parents with young child, who goes to elementary school and is inherently curious and looking for adventure.

現在 未来

Personas for Designs ペルソナ

The Go-Getter (起業家)

Young single professional passionate about work, his main driver is showing results, and starting a business some day.

未来

The Tourist (ツーリスト)

The visitor of the space, seeking unique experiences to remember from their trip to Tokyo for the rest of their life.

未来

Transportation

Chelsea DYESS
Daniel WALLS

Transportation

The Transportation Group assessed Kyojima's existing transportation network, identified strengths and weaknesses, and then developed a proposal and design guidelines to ensure safe and sustainable transportation options are preserved as the community redevelops.

Process

The Transportation Group first examined the data sets available and searched for areas in need of improvement. The group had access to transit routes, a digital street network, relatively recent building use data, and a pre-existing digital model of transportation movements within the neighborhood over a 24-hour period (called "Person Flow" or "PFlow" data).

The group first identified 3 separate rail transit stations serving Kyojima, vehicle parking facilities, and major attractions. Primary vehicle and freight delivery routes, bicycle/pedestrian facilities, and transportation mode split were identified using the PFlow data. Land use data was analyzed to determine accessibility to basic goods and services, for example, medical office, grocery stores, schools, and places of employment. The road network was also examined for network redundancy, walkability, connectivity, and some safety features.

During the site visit, local stakeholders were asked about the transportation network, and many analyses performed remotely were validated. Additional bicycle facility strengths were also identified.

Following the site visits and transportation analyses, the strengths and weaknesses of Kyojima's overall transportation network were identified and then incorporated into a new transportation proposal and future design guidelines.

Observations

The Transportation group found that overall, Kyojima has an excellent transportation network for a dense and vibrant urban area. No point of the neighborhood is more than a 10 minute walk to a rail station, providing excellent mobility throughout Tokyo. The Meiji Dori road along Kyojima's northeast edge is a major vehicle artery providing easy access for freight deliveries, and connection to a major expressway.

Throughout Kyojima, the organic road network is highly bicycle and pedestrian friendly. Roads are narrow and non-linear - slowing vehicle speeds and making for a safe and enjoyable pedestrian environment. Small block sizes make for a highly walkable community. On the two busier vehicle streets, guard rails provide a barrier between cyclists/pedestrians and traffic. Many residential and commercial buildings were even constructed with covered bicycle parking.

Given all of these factors, its unsurprising that the mode split is primarily rail transit (37%), cycling (25%), and walking (25%), with just 10% traveling by car. Accessibility to goods and services also likely influence the current mode split, as every part of Kyojima is no more than a short walk to medical offices, retail, restaurants, and grocery or convenience stores. While on-site, local stakeholders expressed their satisfaction with Kyojima's transportation network. In fact, they had difficulty identifying deficiencies. The only concern was that an increasingly aging local population may have difficulty walking longer distances and may benefit from more areas to sit, rest, and otherwise interact with their neighbors.

Finally, the Transportation Group identified wayfinding and safety as potential areas for improvement. While the vast majority of streets appeared safe for all road users, and the high density of intersections provide network redundancy in the event of a disaster, a few roads are too narrow for emergency vehicles, and could also be a fire risk in a disaster. Kyojima's leaders have already identified this issue as well and have implemented a long term policy to gradually widen the narrow roadways to ensure emergency vehicle access and a fire break. We support that policy. The neighborhood's non-linear streets could be difficult to navigate for non-residents and tourists.

Transportation, cont.

Ideas/Proposal

The Kyojima Connector: The studio team proposes repurposing some existing vehicle streets as a pedestrian oriented loop called the Kyojima Connector. The loop would connect each chome of neighborhood, following historic paths once established by farmers before the neighborhood developed. The Connector will begin at the Keisei-Hikifune Station, follow a winding path south to the iconic Kirakira street, then turn back north again along the eastern side of the neighborhood. The loop crosses 5 existing parks, and could serve as a catalyst for revitalizing Kirakira street and expanding economic development.

While the Kyojima Connector would not exclude vehicles, it would be designed to put pedestrians first. Design features would include raised crosswalks at every intersection, bollards at higher volume intersections, and planters or street trees where appropriate. Pedestrian benches will also be incorporated giving the elderly ample opportunity to rest and interact with the community. With the anticipated new businesses, the street would have to accommodate regular freight deliveries, potentially at designated hours of the day to minimize conflicts with pedestrians. A network of “Smart” lanterns will also be located throughout the Connector, providing wayfinding and emergency routing information when needed.

We believe the Kyojima Connector will help to maintain and promote the existing bike/ped and transit oriented culture of the neighborhood. It will also facilitate community interactions, and capitalize on Kirakira, a primary economic generator for the area.

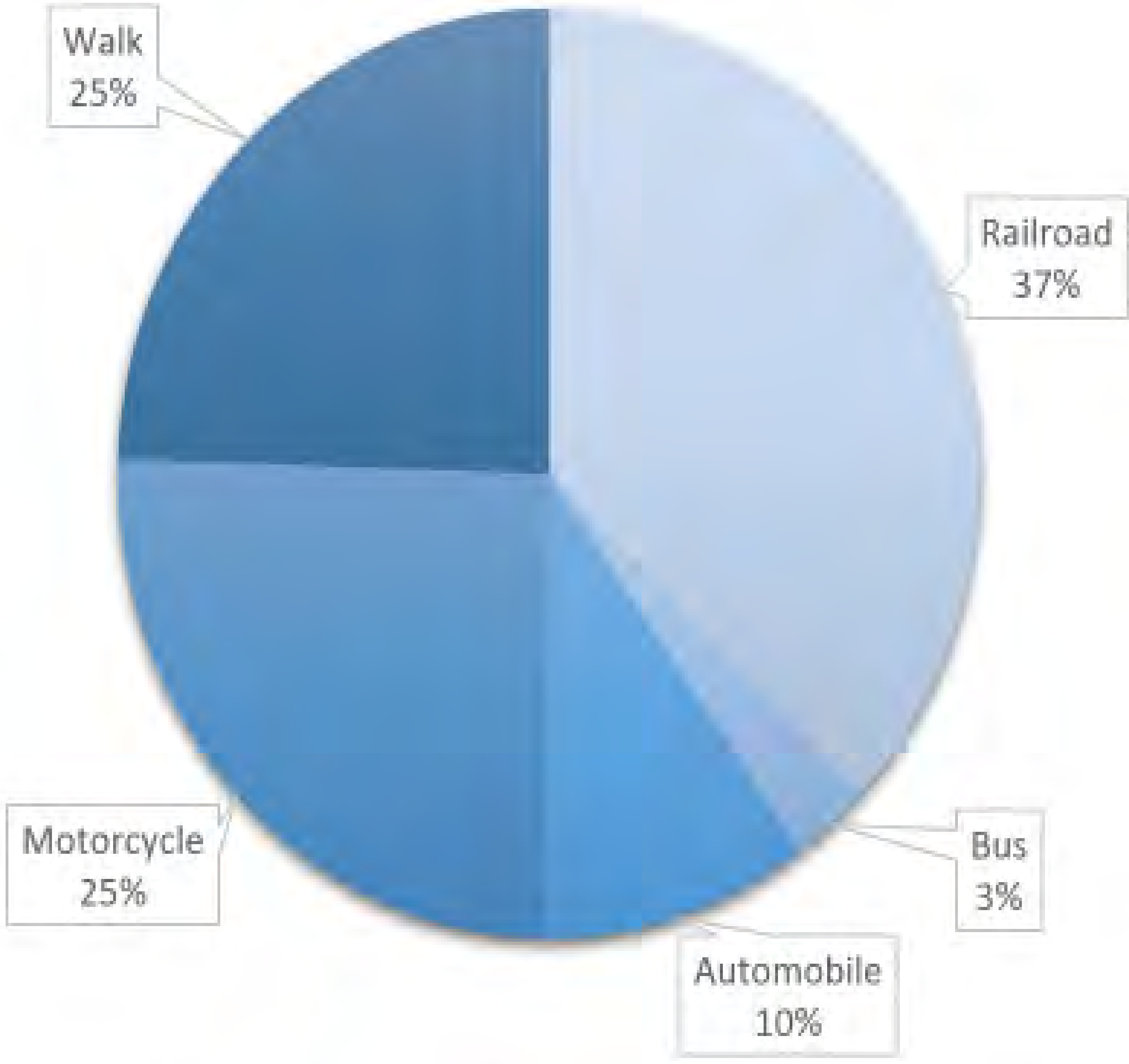
Design Guidelines

In addition to the Kyojima Connector, the Transportation Group developed a series of design guidelines for future developments. The guidelines are intended to promote safe and sustainable transportation as the community redevelops and grows. They put pedestrians first, and aim to minimize vehicle use and their associated carbon emissions. However, they also take into account the current trends of growing demand for freight deliveries and passenger pickup/dropoff locations.

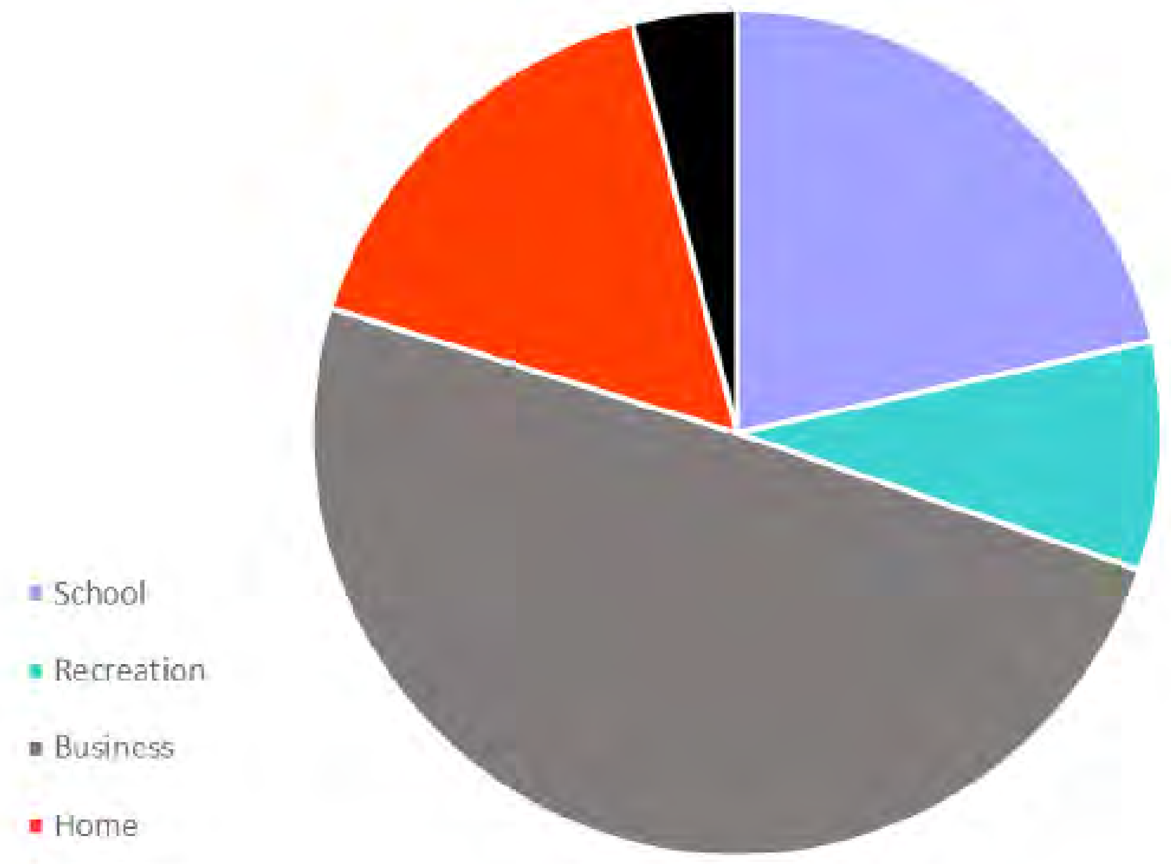
The Transportation Group’s 5 design guidelines are as follows:

1. Vehicle parking maximums: No more than 1 parking space per 1,500 sqft of new residential space or 1,000 sqft of new commercial space.
2. Covered bicycle parking: Incorporate a minimum of 2 spots per residential unit, 3 spots per 1,000 sqft of commercial space. Bike parking should not extend into the public right of way.
3. Pedestrian safety infrastructure: Incorporate pedestrian safety measures at intersections where moderate or high vehicle volumes meet a pedestrian-oriented street. Safety measures may include bollards, raised crosswalks, medians, curb extensions, or other infrastructure to shorter pedestrian crossings and increase bike/pedestrian visibility to vehicle traffic.
4. Dropoff zones: Incorporate designated space for pickup/dropoff/deliveries where appropriate for anticipated building uses.
5. Facilitate community: Where sidewalk and/or open space permits, install pedestrian benches, shade, or other pedestrian amenities to facilitate a sense of community and provide gathering or resting space for the elderly and mobility impaired.

High Level Transportation Information

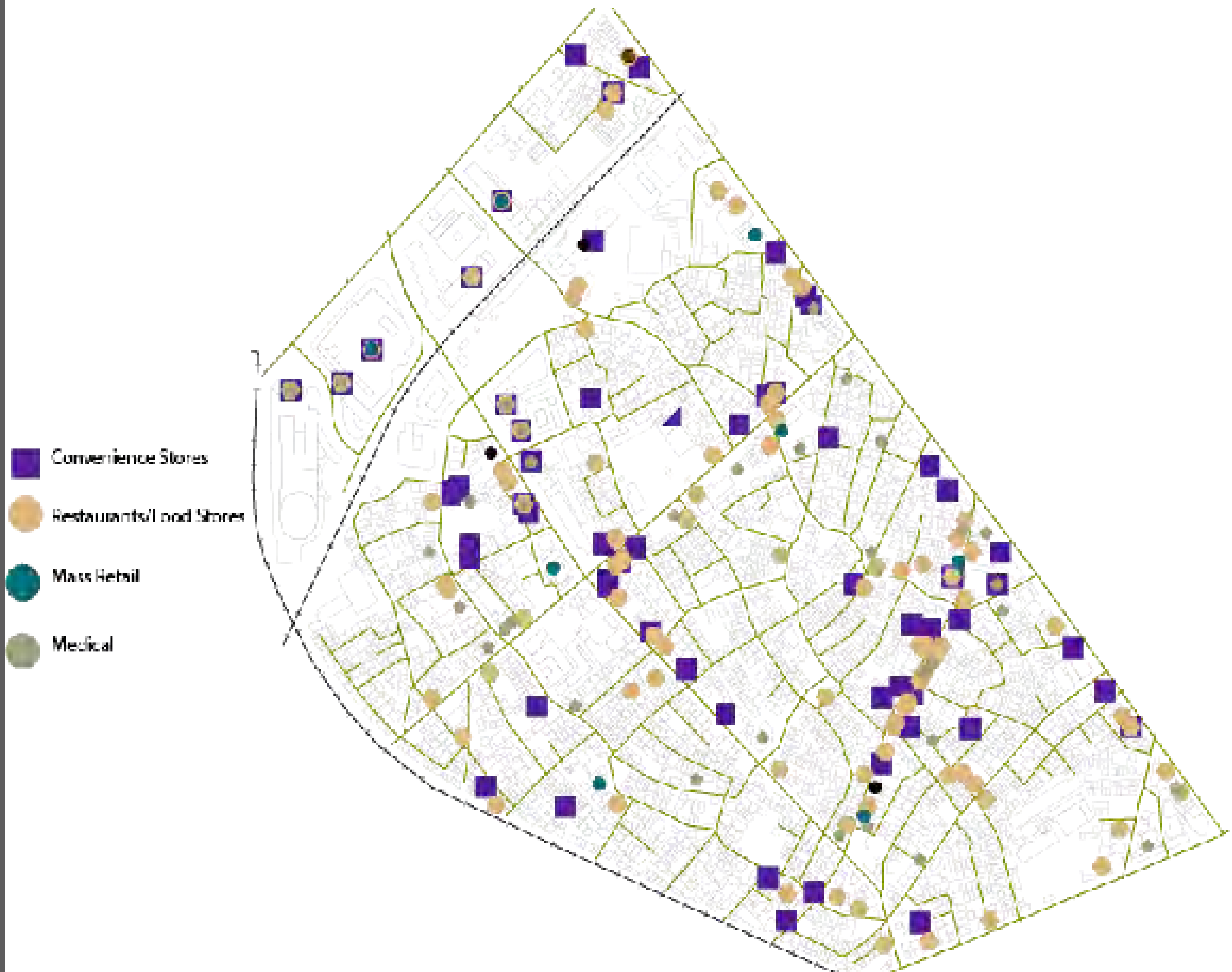


Mode Split



Trip Purpose

Accessibility



Accessibility to goods and services (such as grocery stores and medical facilities) is important for elderly residents of Kyojima

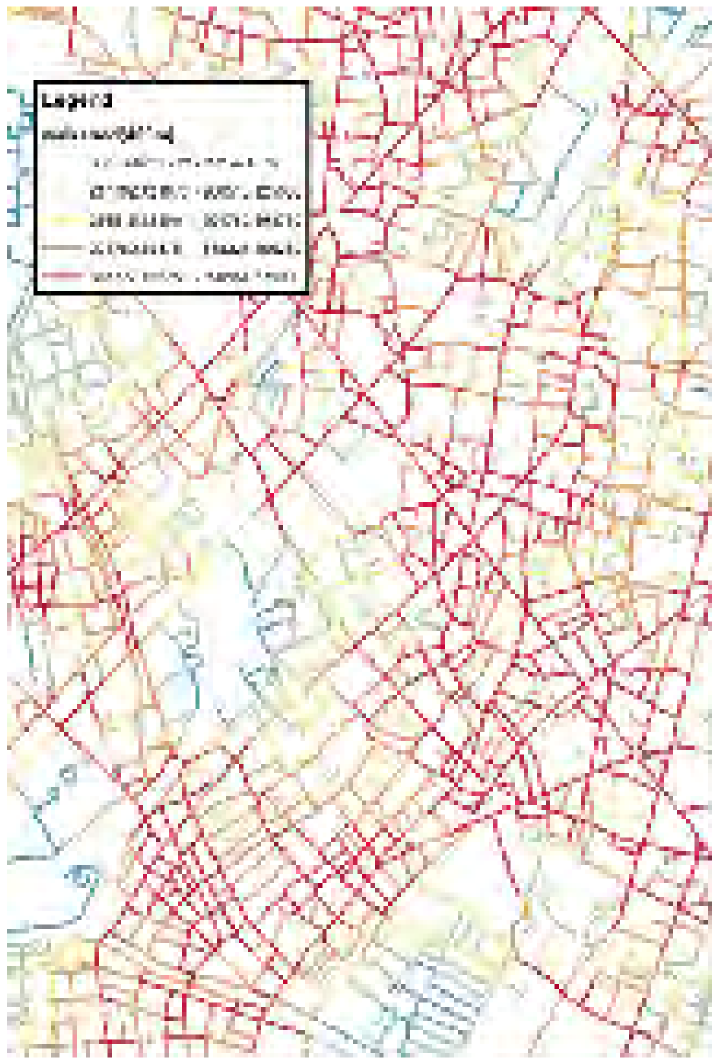
It is importnat that residents with limited mobility can access their most basic needs in an easy and comfortable way

Restaurants/Food Services:	27
Convenience/Goods:	27
Mass Retail:	4
Medical:	13

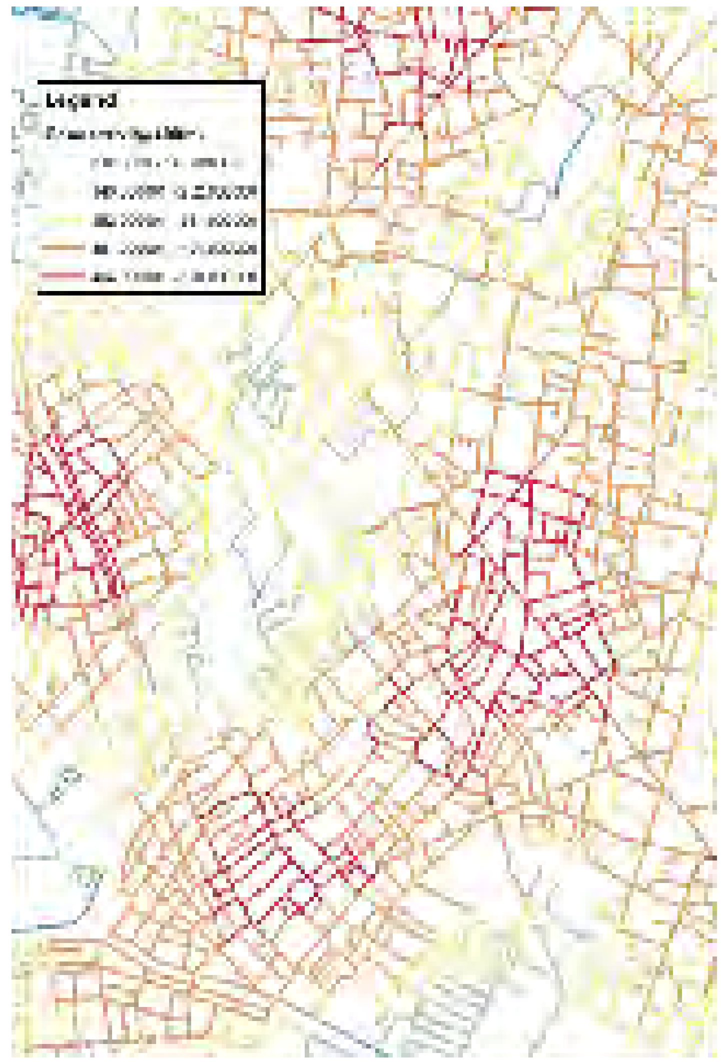
Street and Building Measures

Index	Definition
Betweenness	The fraction of shortest paths between pairs of other buildings in the network
Connectivity	The total number of links connected to each junction
Walkshed	Measure of walkability within an area
Reach	Measures the number of surrounding buildings each building reaches within a given network radius. It can be used as a measure of accessibility to jobs, residences, or other attractions.

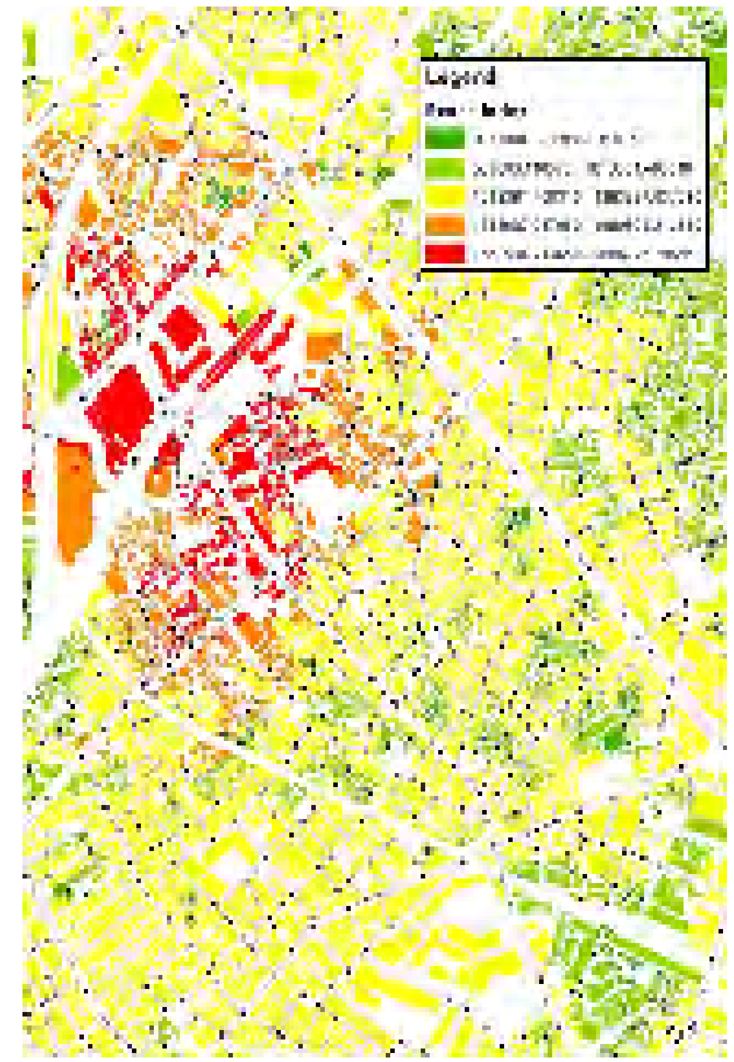
Kyojima Measures



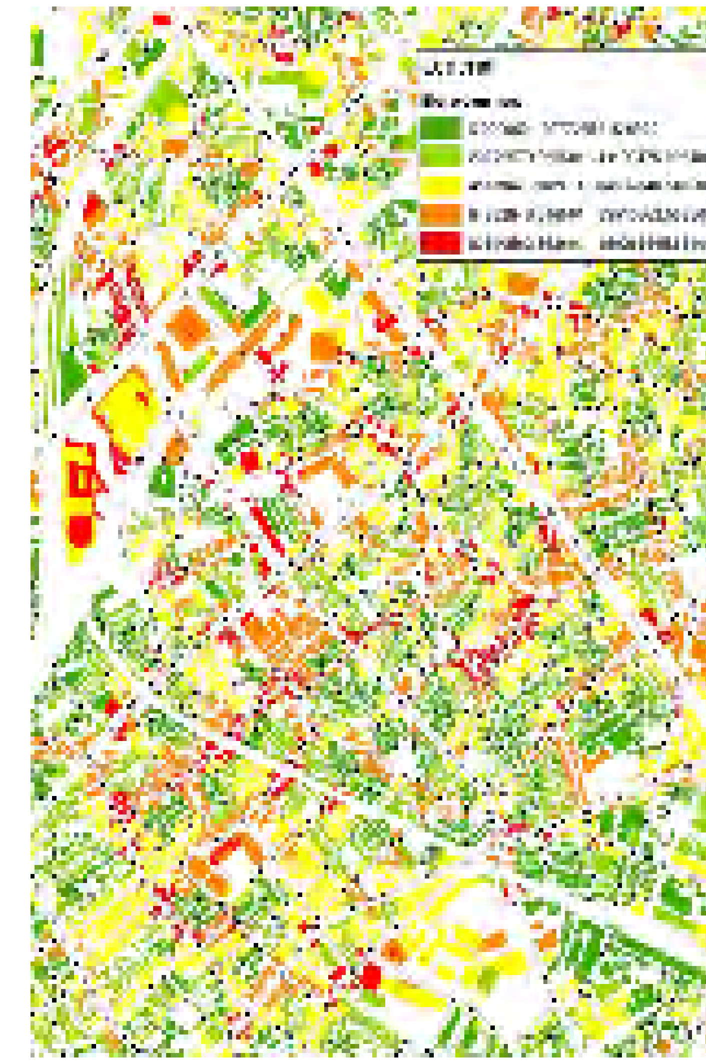
Walkshed (400m)



Connectivity (400m)



Reach Index (400m)



Betweenness (400m)

Problem Statement 現在の課題

Kyojima's transportation network should accomodate residents of all ages by achieving the following goals:

Sustaining Kyojima   s culture and history by preserving the current walkabale connections to goods, services, and local treasures, even with future developments

Creating connected multigenerational gathering places that have a variety of purposes and uses

Future developments need to enhance what is working without disrupting the transportation network

Pros and Cons 長所および短所

Kyojima is a healthy, accessible, connected, and walkable community.

Kyojima sees a high percentage of active transportation mode split (walking and biking).

Vehicle traffic, bicycles, pedestrians, trains, buses, and even delivery vehicles flow easily throughout Kyojima.

Pedestrian oriented developments and diverse transportation options are crucial to the balanced and efficient mode split.

Future developments need to enhance what is working without disrupting the transportation network

Kyojima Connector

The Kyojima Connector is a pedestrian-oriented loop that begins at Kirakira street and follows the organic roadway throughout Kyojima.

The Kyojima Connector provides a continuous path from public open space to public open space, while also connecting south and north Kyojima.

The path of the Kyojima Connector has roots in Kyojima's culture and history by highlighting a path that was once heavily used in farming and irrigation.

Kirakira street acts as the backbone of the Kyojima connector .

Emphasizing pedestrian safety and smart development along this loop can bring residents together and stimulate economic development along Kirakira street and other parts of Kyojima.

Lantern Information System

The Lantern system network will be located throughout Kyojima, mostly along the pedestrian-oriented Kyojima Connector.

The Lantern Network will be near areas of cultural, economic, social, and residential interest.

The purpose of the lantern network is to inform residents of activities, disasters, or other relevant information.

Initially, there will be 20 lanterns throughout Kyojima, with a focus on the new connector.

The lantern network can be implemented within the next two years.

Design Guidelines

James WALDON

Design Guidelines

During the onset of the semester, we analyzed the studio across different scales; L, M, S, and XS (Japan, Tokyo, Sumida, and Kyojima). Once our attention was focused on Kyojima, the typologies and the relationship between residential and certain amenities such as healthcare, food sources and education became a focal point. Simultaneously, the spatial density regarding the urban fabric of Kyojima was explored. This fabric, presenting challenges over time such as an aging population living in dilapidated wooden houses and scoring low for disaster preparedness became the framework for understanding necessary interventions for future redevelopment. Learning from these existing conditions and applying concepts from urban metabolism, new urban typologies emerged.

Urban Metabolism

Urban metabolism began as a model to understand the flows of not only people but resources within the urban context. Given the density, dynamic history and culture of Japan, this theory became a central framework for new typological design solutions for the study area, Kyojima. Void metabolism, a facet of urban metabolism focuses on sustainability in its horizontal form. Applying these concepts, several interfaces such as solids vs. voids, public vs. private, and built vs. natural environment begins to emerge. The challenge was to design an intervention that did not immediately disrupt the existing conditions, instead, to find ways to strategically infill open space under a set of guidelines that enhances what is already working while providing a module for new implementation.

To make informed design decisions, it is imperative for the architect to understand the role of the planner. Much consideration early in the studio was to create a platform for dialogue between the two professions to come up with the most suitable metrics. Oftentimes throughout the course of an architectural education, the urban conditions are an afterthought. Here, transportation and mobility were placed in the forefront of analysis and as a result, generated a transit-oriented typology.

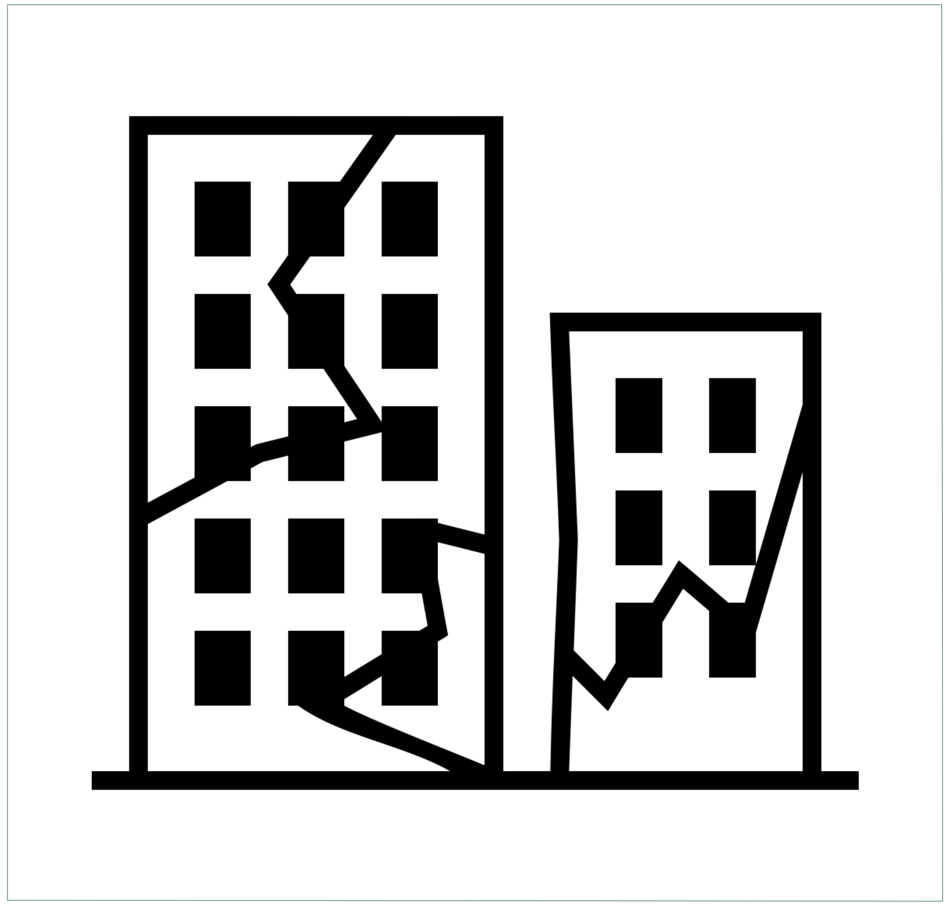
Kyojima Connector

1. People flow: Enhance what is already working
   a. After running initial analyses, we realized that transportation systems in Kyojima worked well. Not just traffic, but also bicycles, pedestrians, trains, buses, even delivery vehicles seemed to flow easily through Kyojima. Pedestrian oriented developments and diverse transportation options appeared crucial to the balanced and efficient mode split.
   b. One of the goals of intervention was to enhance what was working without disrupting the transportation network. After visiting the site, the scale of our project became more focused on the user experience from the urban scale which led to additional urban design guidelines.
2. Tourist solutions for 2020 Olympics
   a. Most of the proposed development for Kyojima takes place on a lengthier timeframe (5 years and up). With the 2020 Olympics in mind, we sought to find a typology that would provide solutions that can be implemented within a year.
   b. Following the historic and organically formed street pattern that forms a loop that links what has been identified as north and south Kyojima, the Kyojima Connector became a pedestrian and transit-oriented development typology. Like the architectural proposals, this development came with its own set of Urban Design Guidelines.

Design Guidelines

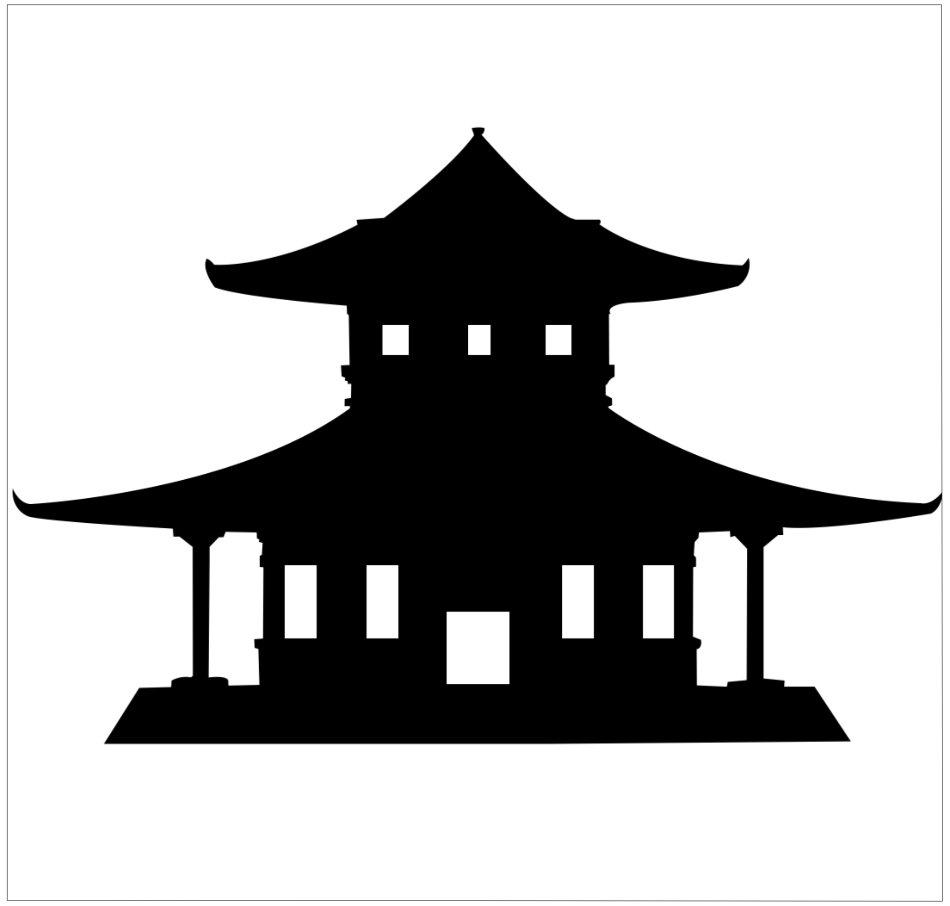
Scale = 1:5000

General



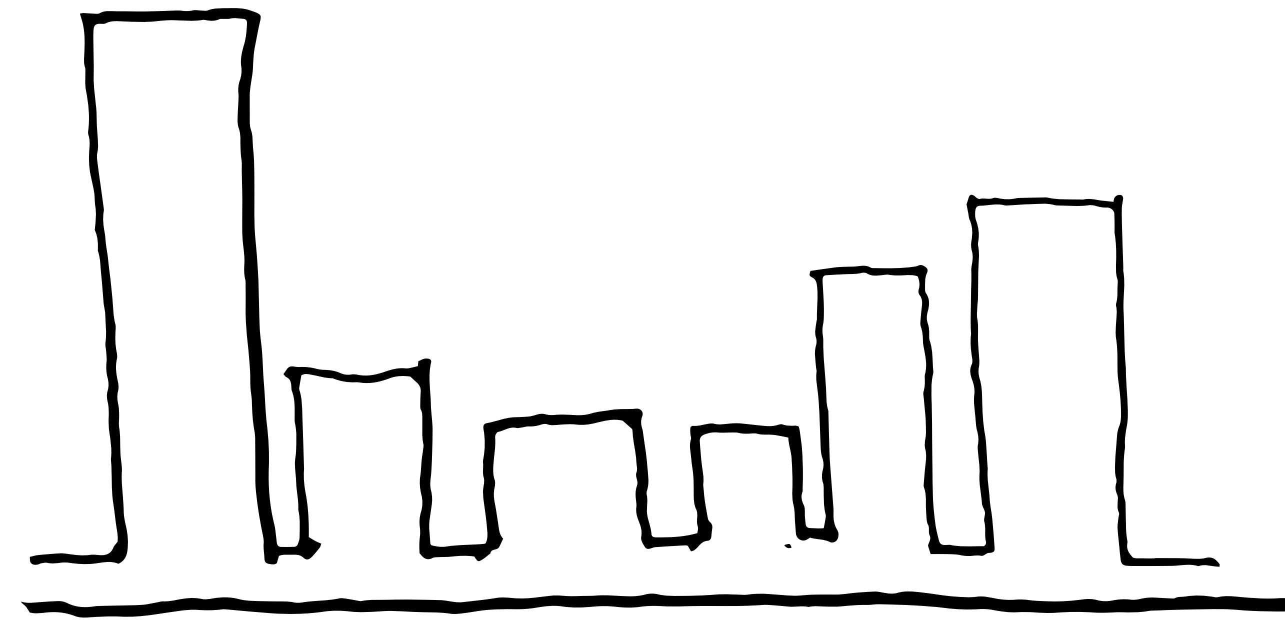
Disaster Resilient Architecture

Create More Community Engagement

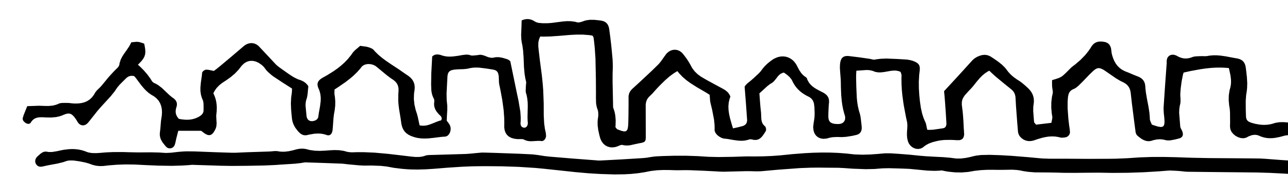


Preserve Traditional Aesthetic

Understanding Context



Kyojima North

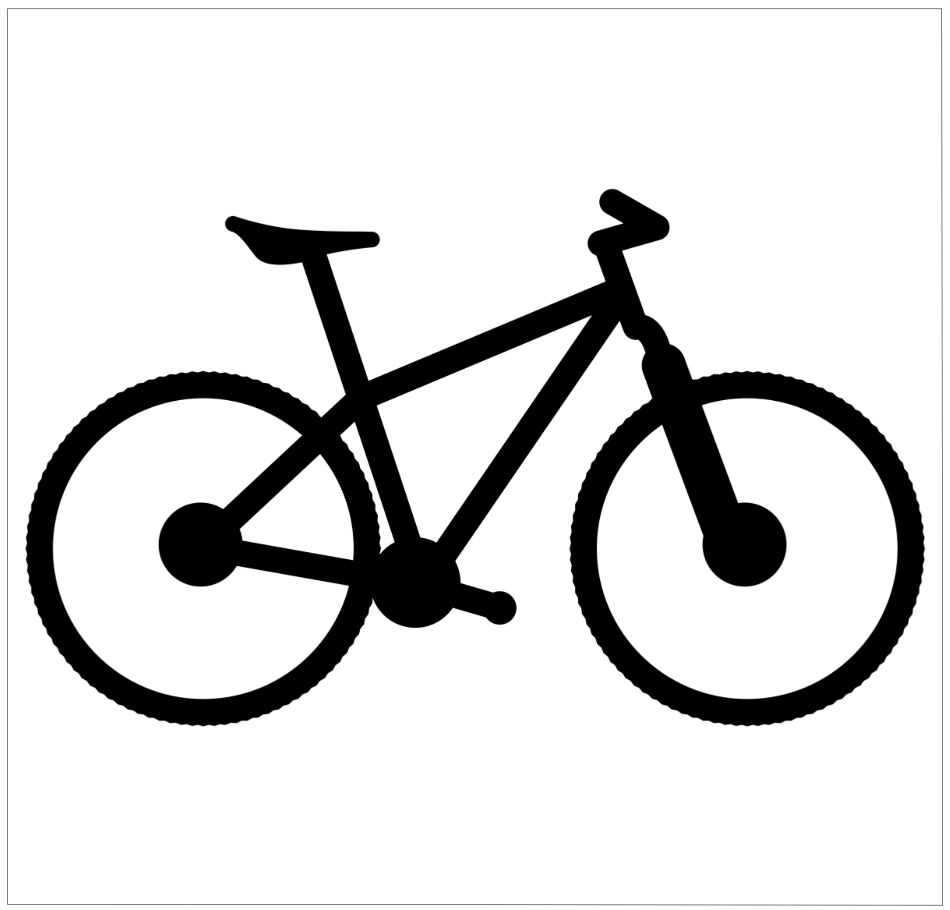


Kyojima South

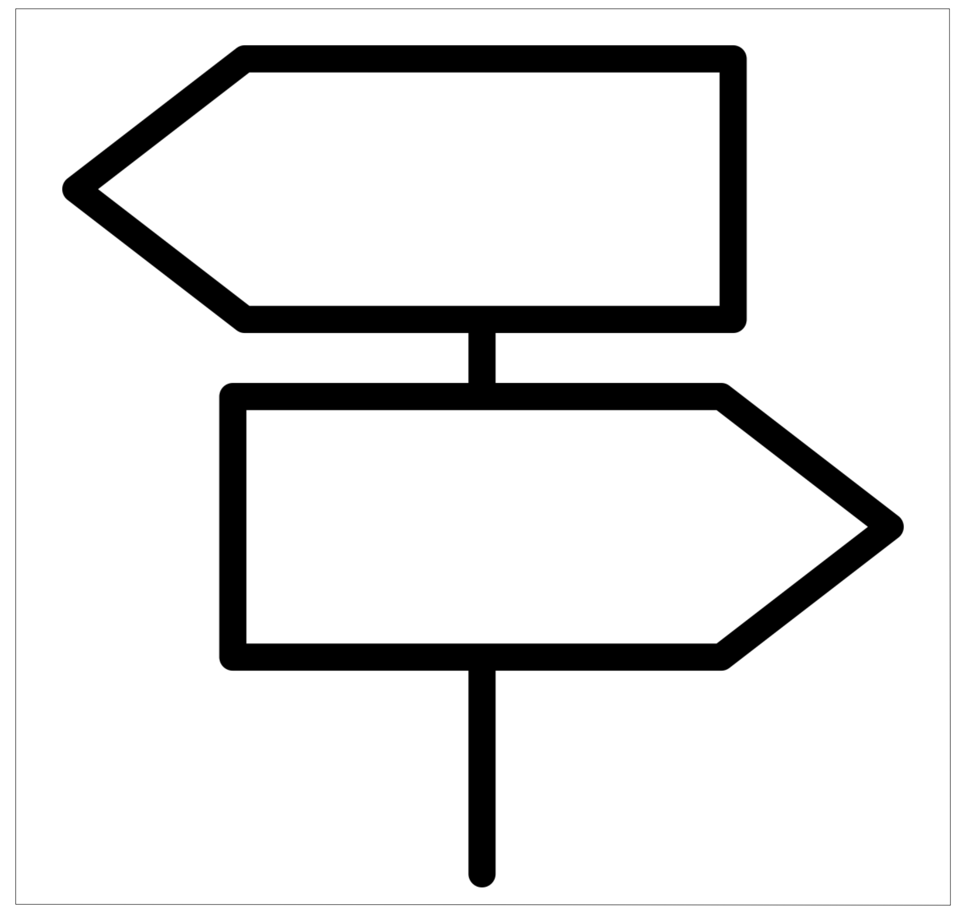
After collaborating between Atlanta and Tokyo groups, Kyojima was divided along a major axis.

The north is characterized by taller buildings while the south is mainly older structures more densly distributed.

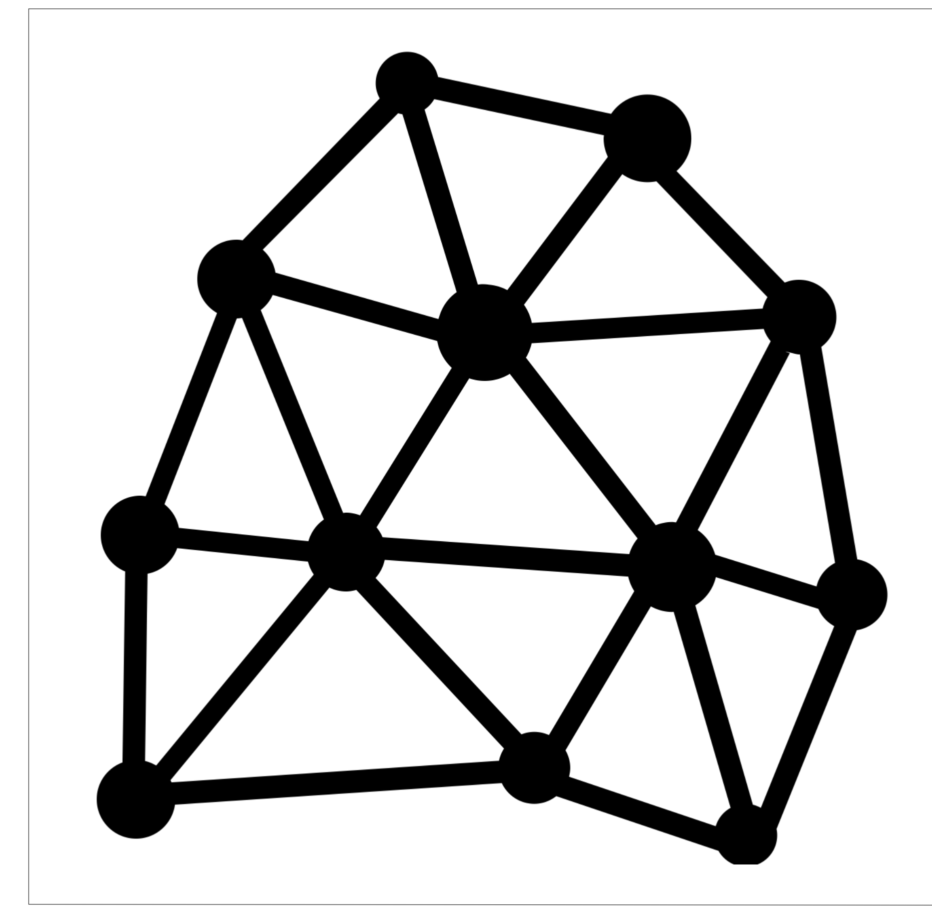
Initial



Active Transportation System



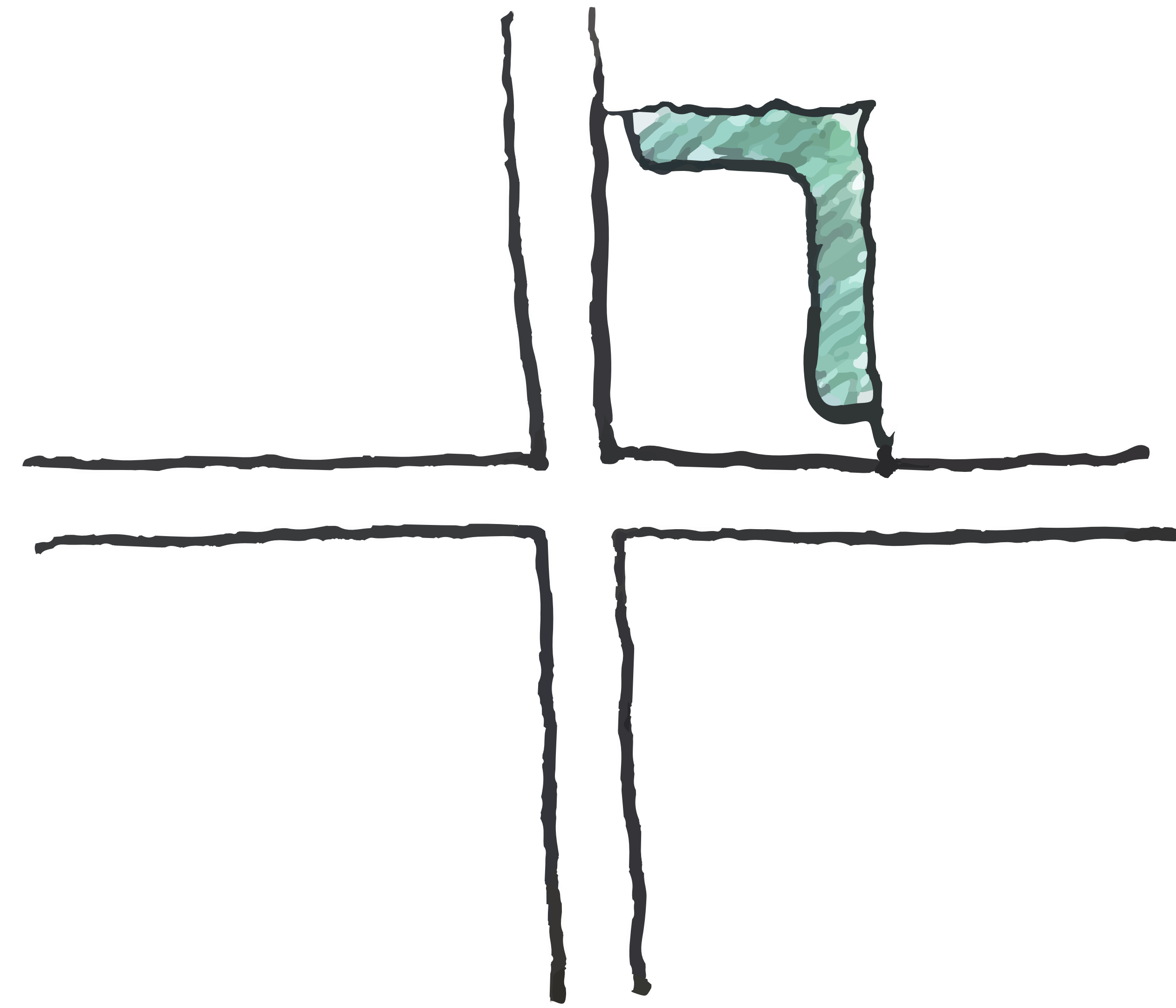
New Wayfinding Solutions



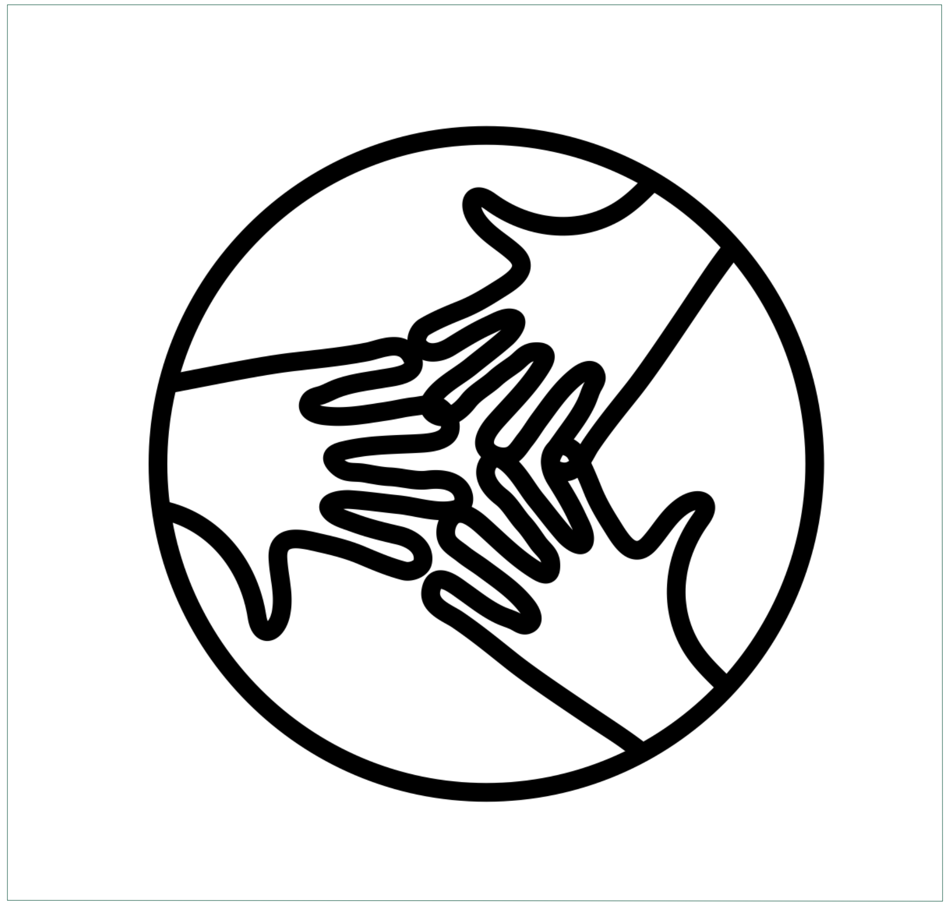
Enhance Existing Network

Urban Design Guidelines: Increase Green in Open Spaces

Hara Park

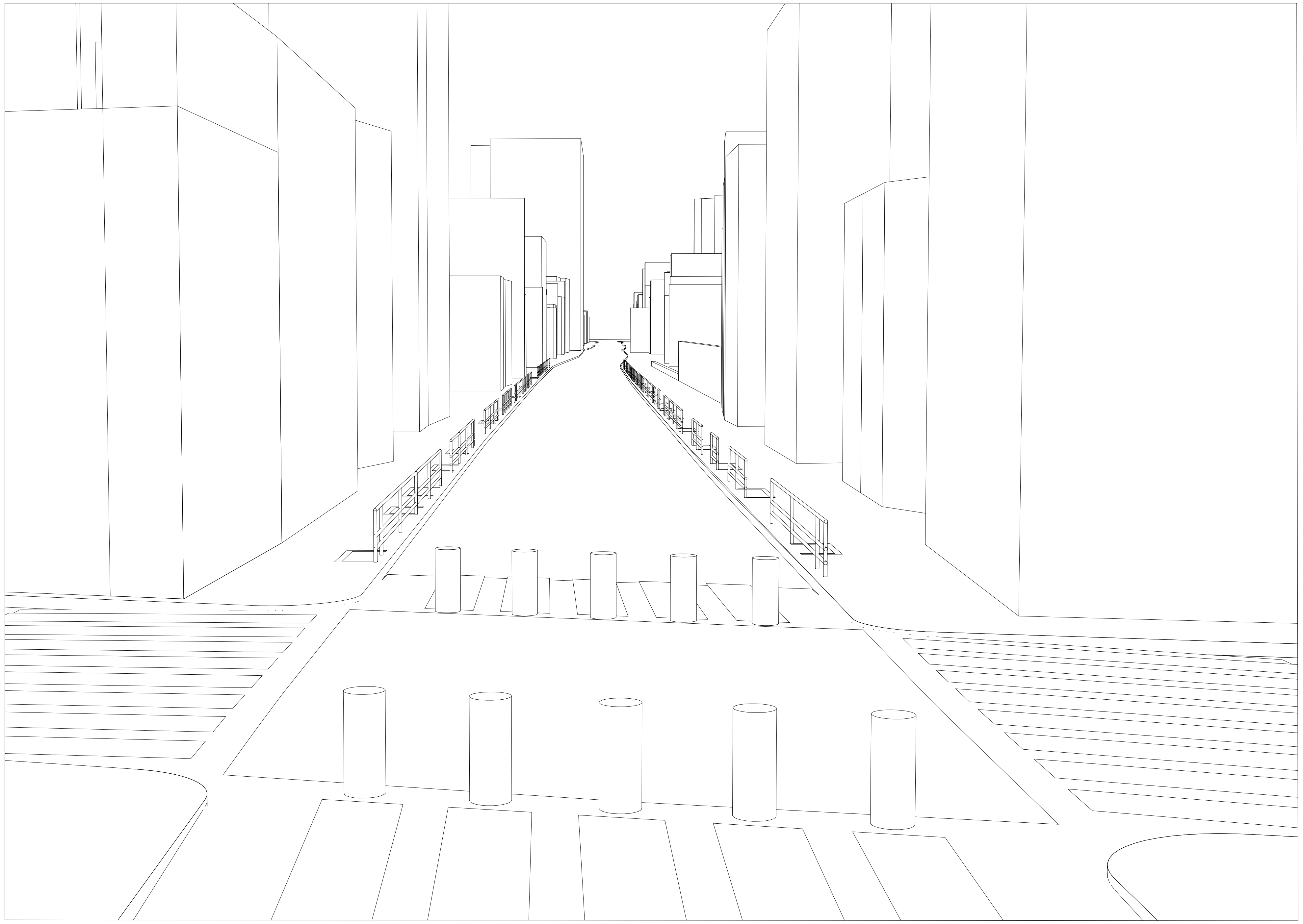


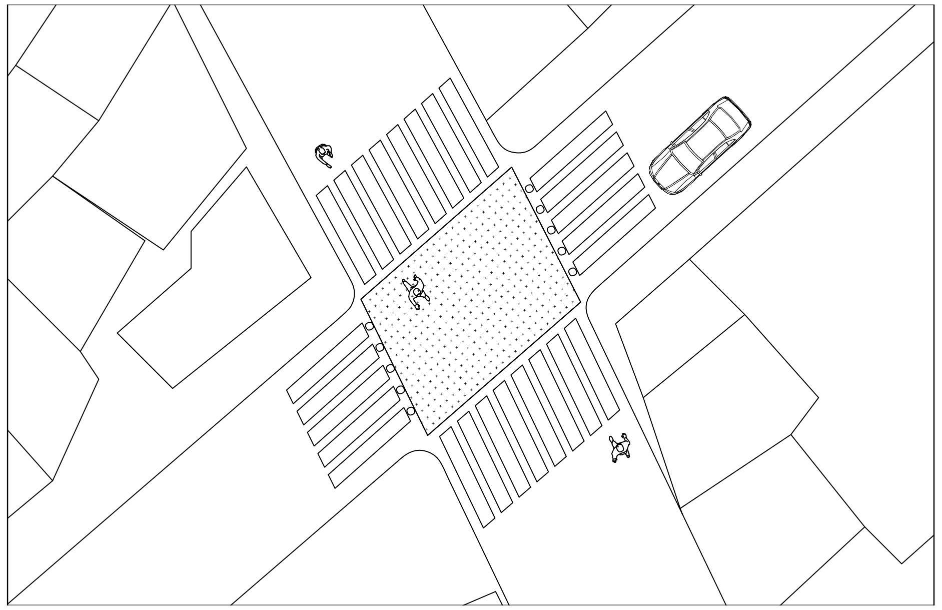
Facilitate Community



Where sidewalk and/or open space permits, install pedestrian benches, shade, or other pedestrian amenities to facilitate a sense of community and provide gathering or resting space for the elderly and mobility impaired.

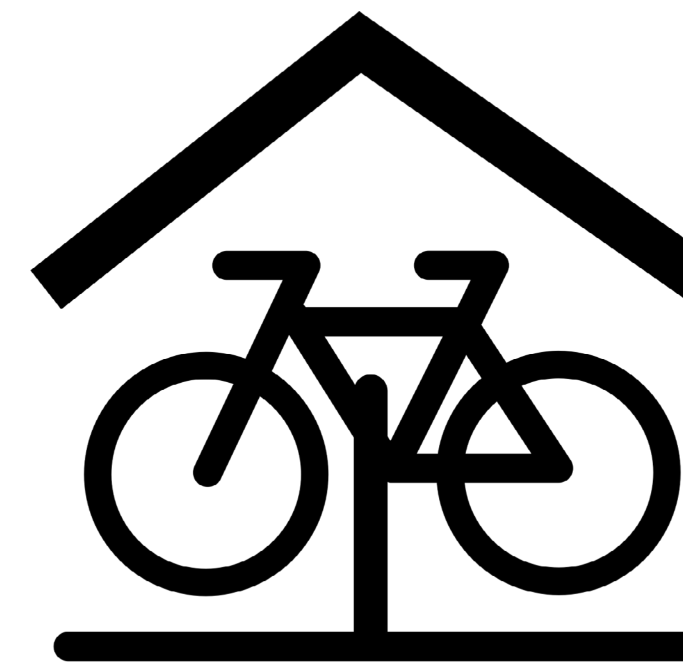
Pedestrian Safe Infrastructure





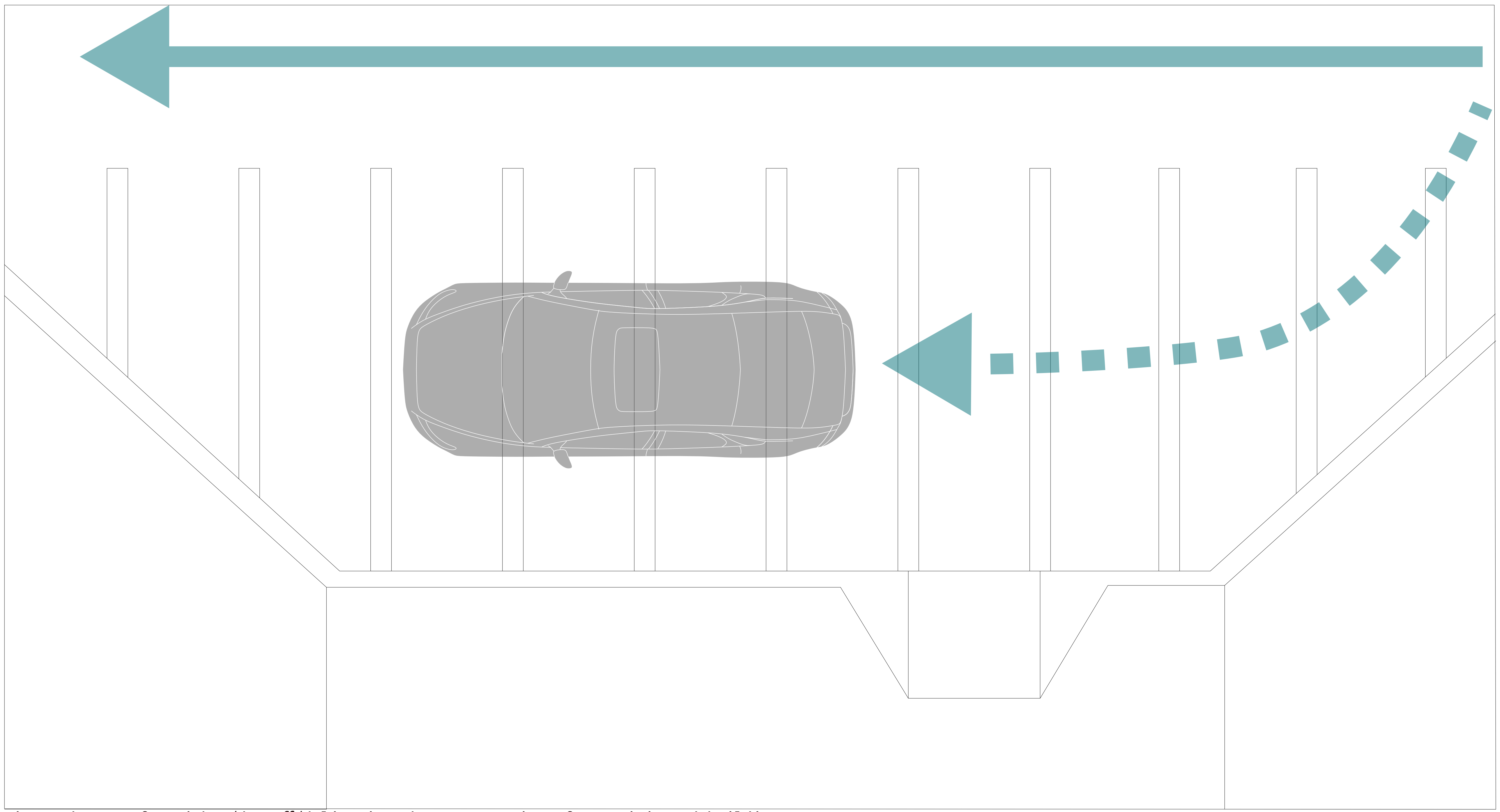
Incorporate pedestrian safety measures at intersections where moderate or high vehicle volumes meet a pedestrian-oriented street. Safety measures may include bollards, raised crosswalks, medians, curb extensions, or other infrastructure to shorter pedestrian crossings and increase bike/pedestrian visibility to vehicle traffic.

Covered Bicycle Parking



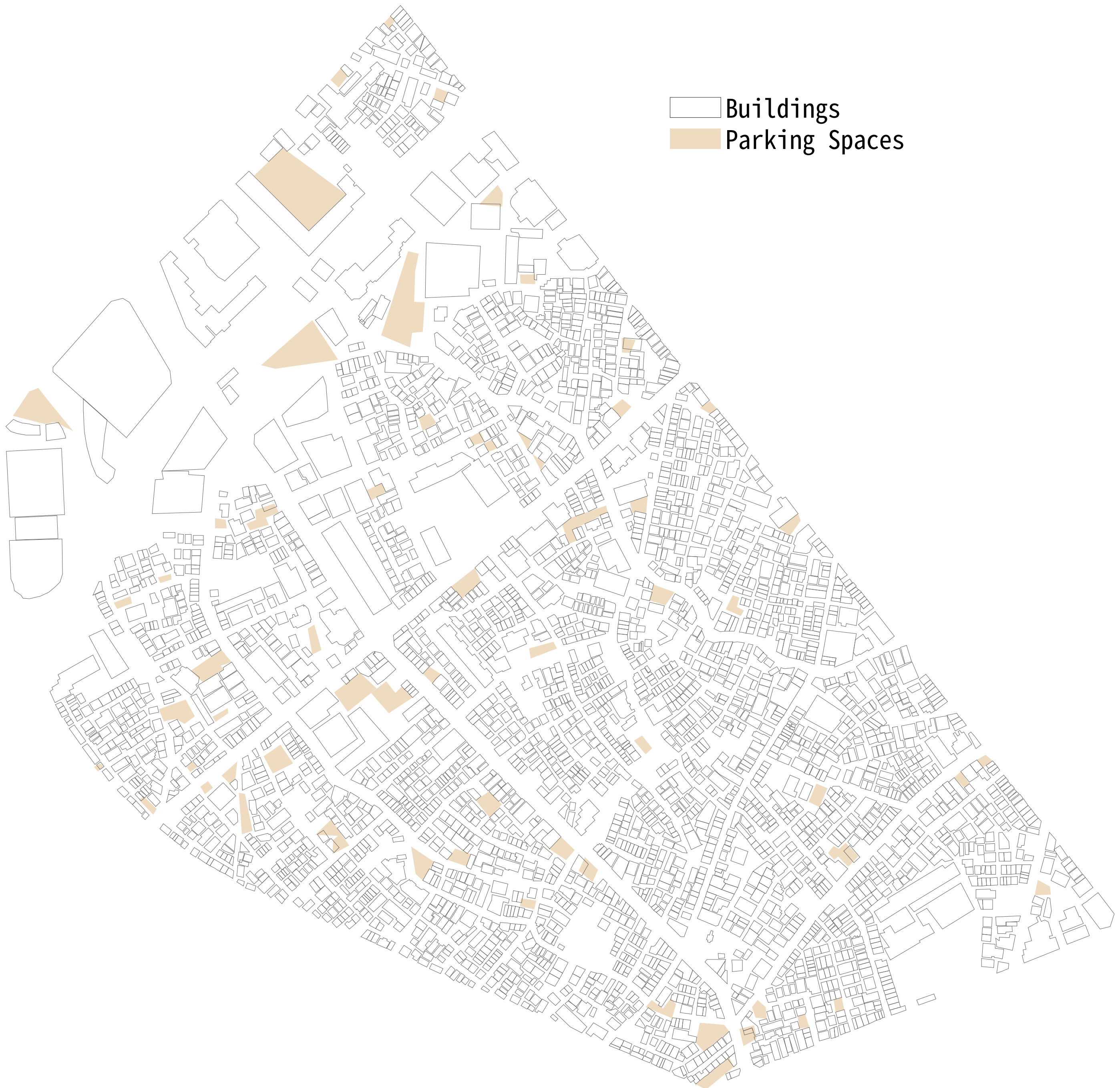
1. Incorporate a minimum of 2 spots per residential unit, 3 spots per 1,000 square feet of commercial space. Bike parking should not extend into the public right of way.

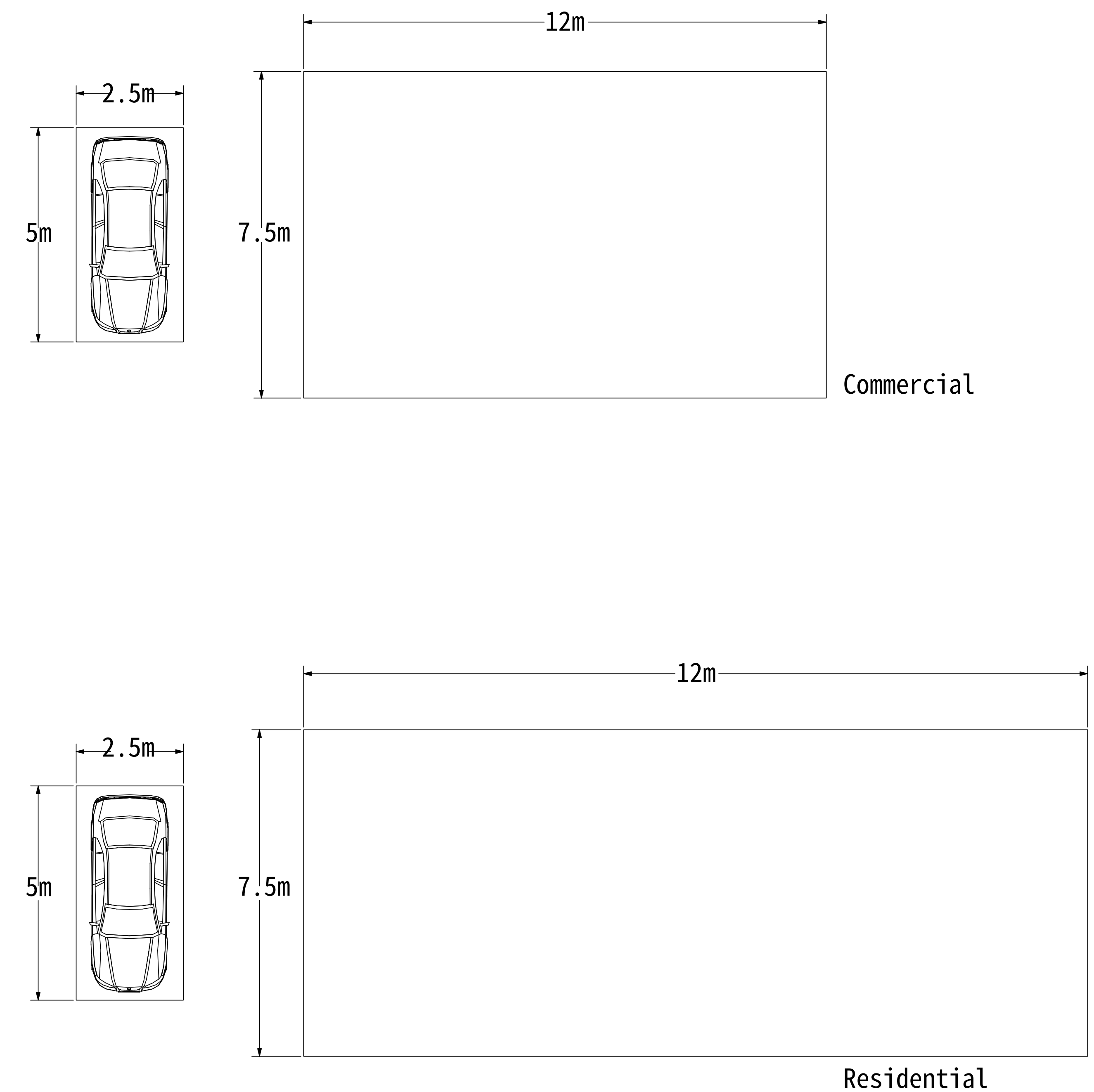
Dropoff Zones



Incorporate designated space for pickup/dropoff/deliveries where appropriate for anticipated building uses.

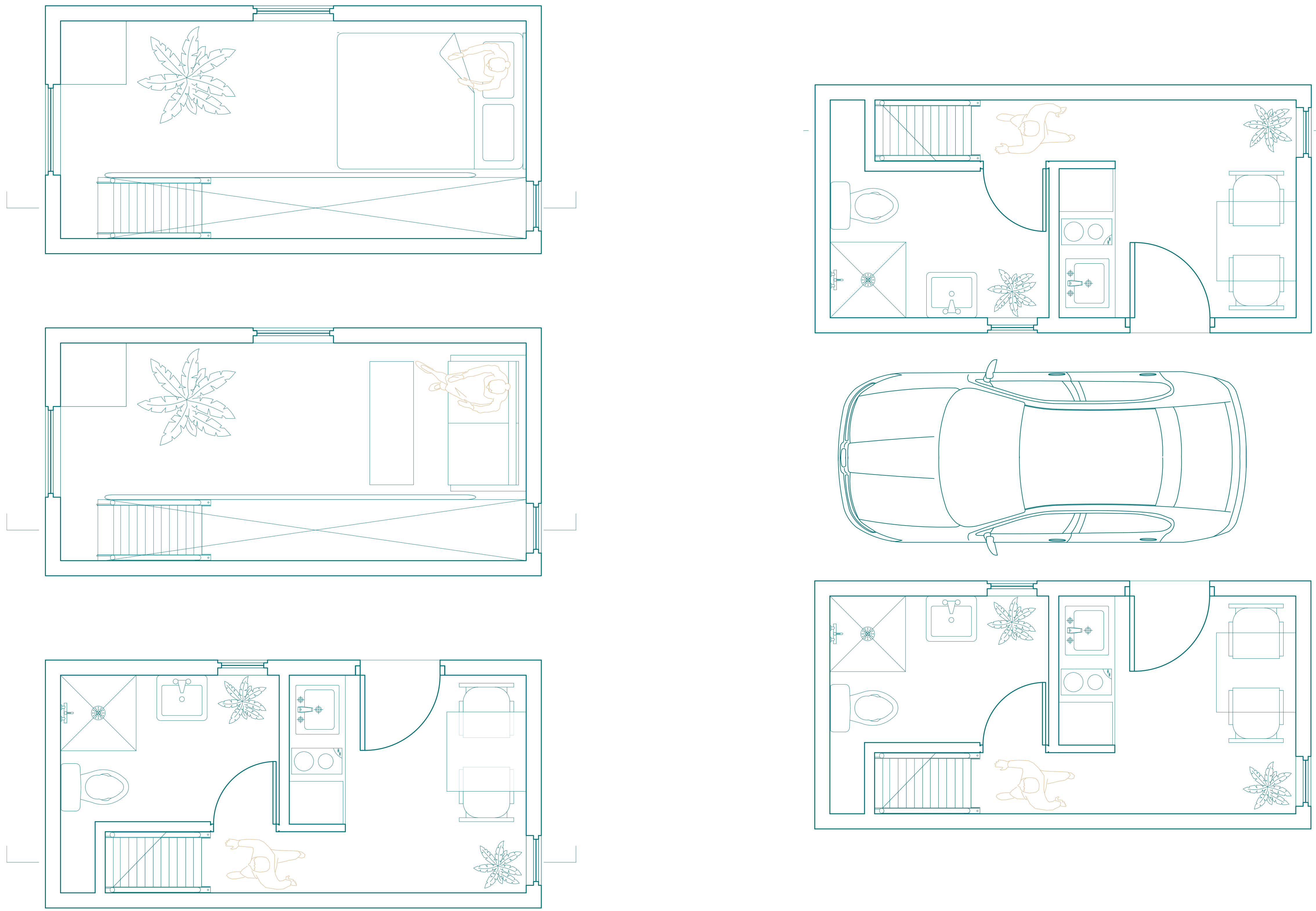
Vehicle Parking Maximums



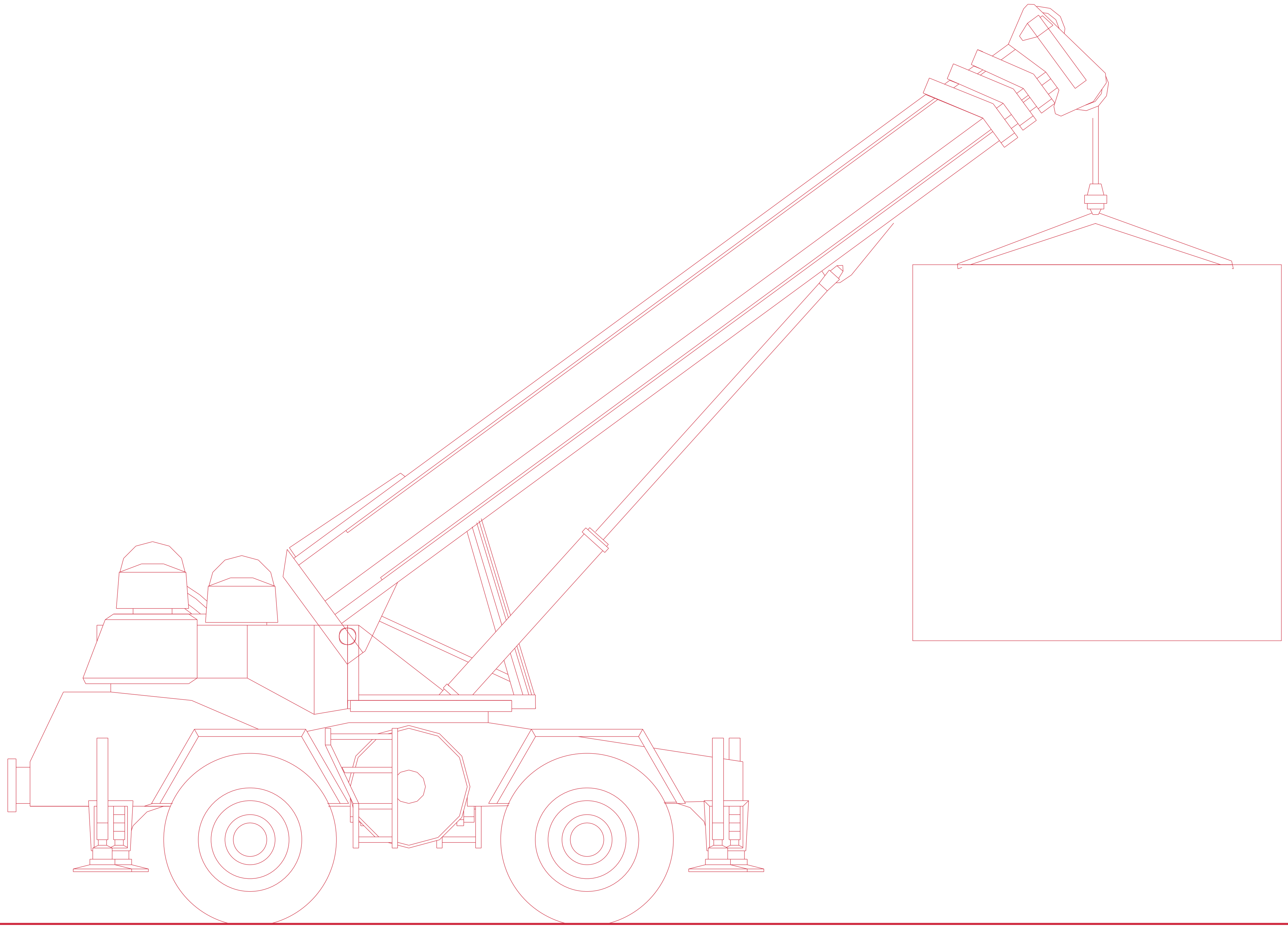


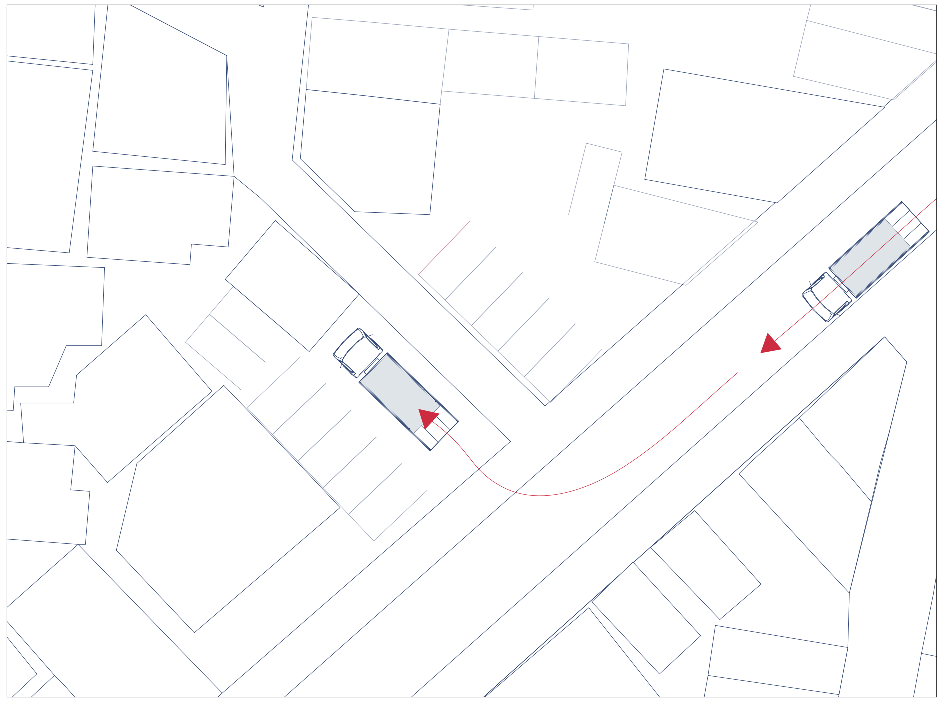
Vehicle parking maximums: No more than 1 parking space per 1,500 sqft (450 m^2) of new residential space or 1,000 (300 m^2) sqft of new commercial space.

Void Metabolism



Prefab Construction





Smart Community Framework and IoT Design

Nathaniel HORADAM

Philippe KIMURA-THOLLANDER

Smart Community Framework and IoT Design

Data Governance
Any “smart cities” framework needs a data governance model for collecting, managing, and protecting any data generated by devices connected within a geography’s network architecture. This framework may incorporate measures ranging from organizational protocols to technical design that ensure the responsible entity or entities can enforce those governance objectives.

In an era where tech giants are increasingly under fire for poor practices related to their collection and management of user data, and private firms and public agencies are suffering massive data breaches, these governance measures are critical for ensuring responsible stewardship. Three objectives define the “Kyojima Smart City” data governance model proposed in this project:

1. Ensuring citizens can trust that all data collected and devices operated serve the public interest, and have appropriate institutional safeguards in place to ensure responsibility.
2. Protecting any all data collected through robust information security policies and mechanisms.
3. Demonstrating the value of investing in new data collection and management infrastructure, either through financial returns or quality of life improvements.

All digital infrastructure deployed in Kyojima should address all three, whether they are sensors used for collecting energy, health, and transportation data, or devices used to provide greater connectivity and mobility.

Network Architecture
The past decade has seen a significant increase in devices connected to telecommunications networks, both wired and wireless. Smartphones, vehicle telematics, and the “Internet of Things” (IoT) are ubiquitous in developed economies, and networked devices now produce more than 2.5 quintillion bytes of data daily.

Most of this data is processed and stored in cloud computing architectures, which lower the cost operations for managing large quantities of data. Processing power and storage is centralized at scale, allowing data centers to overcome the inefficiencies created by the distributed networks that defined the first decades of personal computing. Cloud providers use those capabilities to run virtual machines loaded with the various applications needed to utilize data collected and stored in the network.

However, the sheer enormity of data expected to be collected in the future has raised questions about whether the cloud architecture model is ideal or even sufficient for managing that data. Also, as more devices are deployed under a Smart Cities framework that require active monitoring and management, latency increases as a primary network concern. For instance, unmanned aerial systems (i.e. drones) and automated vehicles that require real-time communications on the order of milliseconds cannot rely on cloud architecture for management. These transactions require very low latency and in some cases very high bandwidth, and even 5G cellular communications will be unable to reliably deliver these requirements for many years.

Furthermore, the sheer number of data sources connected wirelessly may lead to inefficient transmissions of huge quantities of data to the cloud, where it will need to be stored and processed. Without some means of screening this data, processing requirements at central data centers may spiral out of control.

Edge and Fog Computing
The still-emerging era of Big Data and the Internet of Things has returned the focus of information architects to local computing, frequently referred to in large network architectures as either “edge” or “fog” computing, depending on the processing center. Edge computing can refer to different types of network components, but generally encompasses any data processing performed at the collection point and by a component of the same device. For instance, an automated vehicle equipped with sensors and cameras processes that imaging data in an on-board computing unit, so it can respond near-instantaneously. While it may send some or all data to a central network for storage and/or further analysis, there is still a local processing capability.

Fog computing is a newer concept, with the taxonomy derivative of cloud architecture. Where cloud infrastructure tends to be remote, fog implies the computing center is more proximate to the devices exchanging data. Cloud data centers require scale for cost efficiencies, and are therefore land-intensive operations, but fog computing sites data centers prioritizing latency and dedicated bandwidth for local devices.

Smart Community Framework and IoT Design, cont.

Fog addresses latency through proximity, and would therefore be sited in a city or even at the neighborhood/district level. Any local internet traffic could be routed through a fog data center to guarantee a level of service a more remote and congested cloud network could not. Also, fog data centers could be a front line of communications, rapidly processing any incoming data before sending to a cloud storage facility. Likewise, it could have the “hot storage” capacity to serve as a fast-recall repository.

The Kyojima Model

For the Kyojima Smart Cities framework, a local data center will manage all devices deployed in the district in a fog/edge computing architecture. While some devices may directly interface with external cloud networks, be they private or public, all will have a link to the local fog network. For instance, his processing capacity would allow the local hospital to control drones carrying automatic external defibrillators (AED) to patients suffering from cardiac arrest, ahead of any emergency medical services dispatch. Other drones used for delivery or disaster relief could also utilize the fog network to allow low latency operations. Any automated vehicles deployed in the neighborhood for last-mile connections to bus and rail transit lines would be edge computing platforms, able to operate independently of cloud networks.

This model provides multiple benefits, beyond just better latency and bandwidth for local devices. Building a small computing center in Kyojima would add a redundant layer to municipal data architecture, offering a disaster recovery component in the instance other municipal network infrastructure is disabled or destroyed in an earthquake or fire. It would also add a layer of security to any cloud repository for local data. Customers of utilities or medical services could have personally identifiable information (PII) stored at the Kyojima data center, with their data anonymized before sending to any cloud service. Moreover, with this data center serving a few thousand people, rather than the potentially millions in other central repositories, it would offer a much lower value target for cybersecurity threats.

Finally, there is a symbolism associated with putting a data center in Kyojima. Rather than a remote and abstract cloud acting as the primary interface between residents and their devices and data, this computing platform would be better integrated into the Kyojima community. This framework, if successful, could expand to serve other districts in the Sumida Ward, or even as a model for other districts in Tokyo.

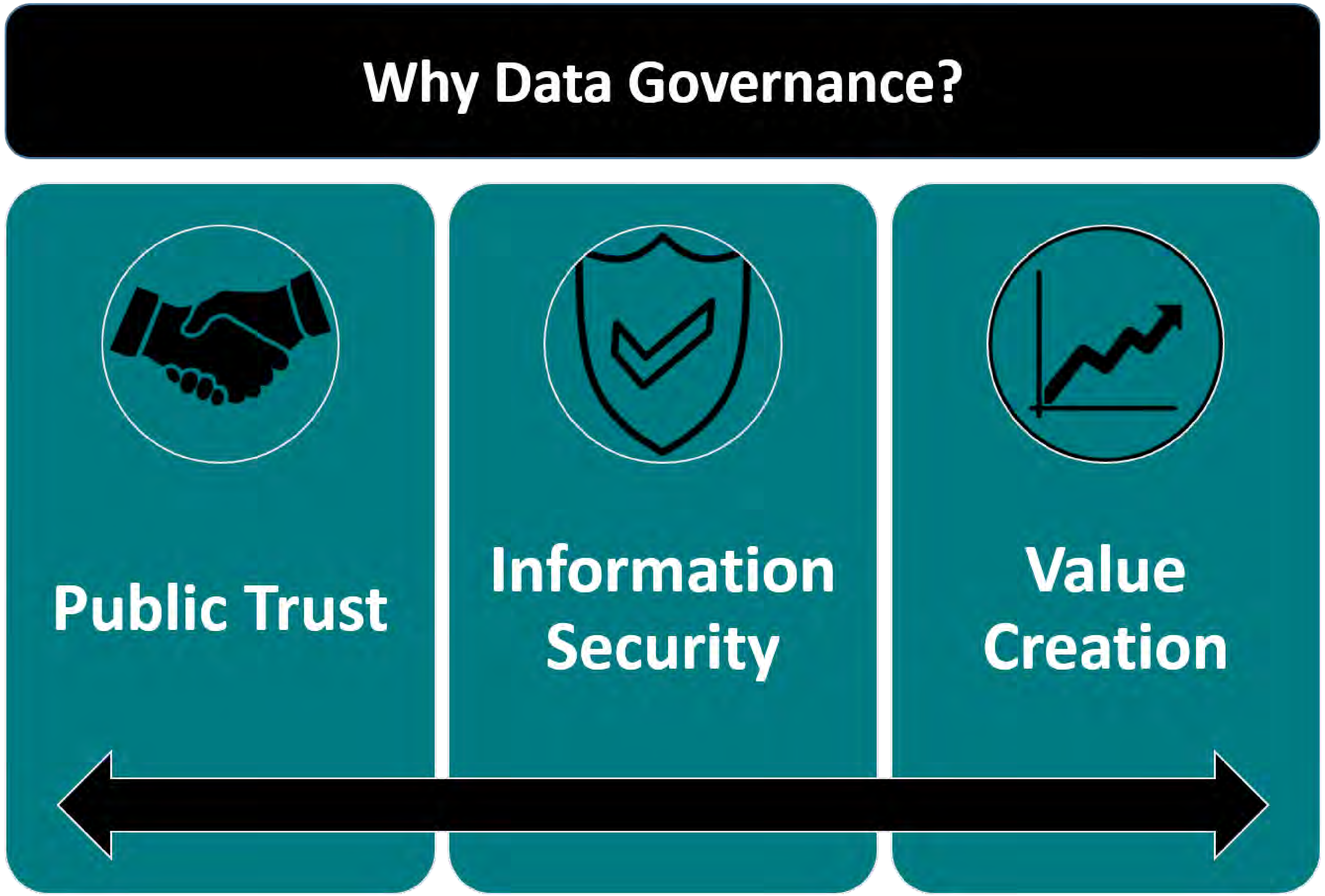
References:

1. Watson Marketing. 10 Key Marketing Trends for 2017. IBM. (2017).
2. Pan, Jianli and McElhannon, James. (2017). Future Edge Cloud and Edge Computing for Internet of Things Applications. IEEE Internet of Things Journal DOI 10.1109/JIOT.2017.2767608, pp 1-11.
3. Chen, Songqing, Tao Zhang, and Weisong Shi. (2017). Fog Computing. IEEE Internet Computing. March/April 2017: pp 4-6.

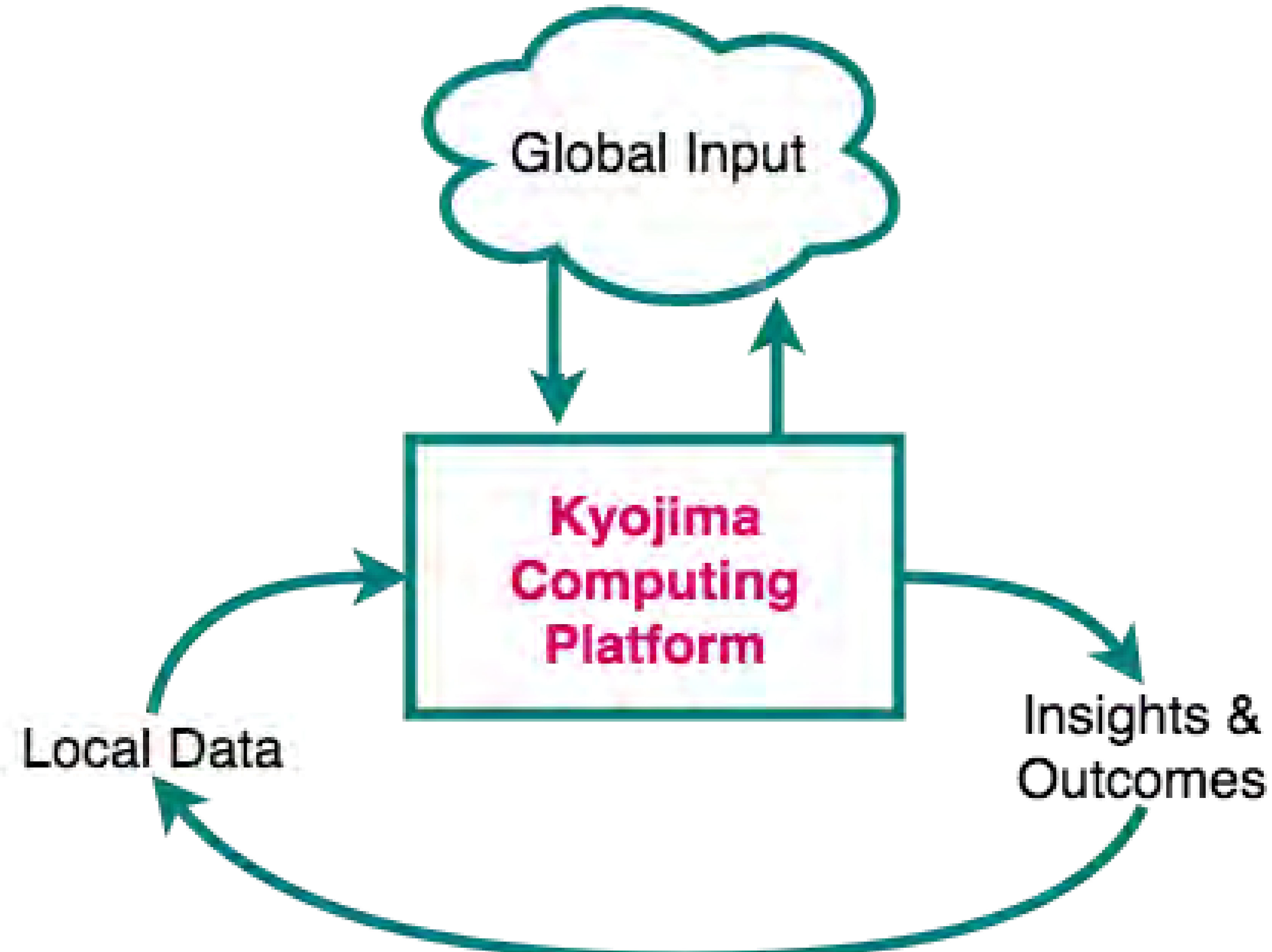
What is a Smart City?

A ‘smart city” is one the leverages information and communications technology to achieve policy objectives and improve residential quality of life.

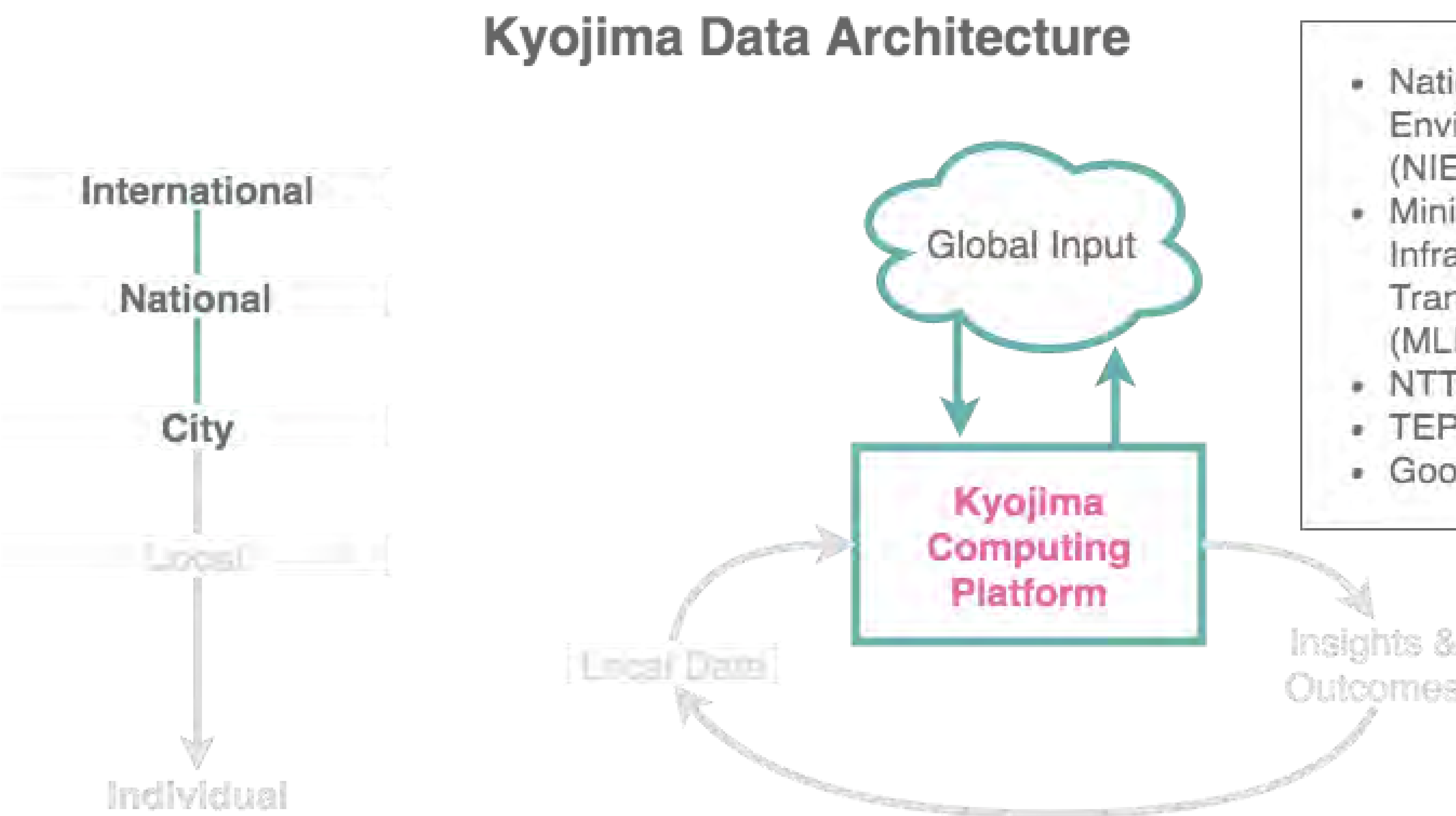
Why is data governance important?



Kyojima Data Architecture

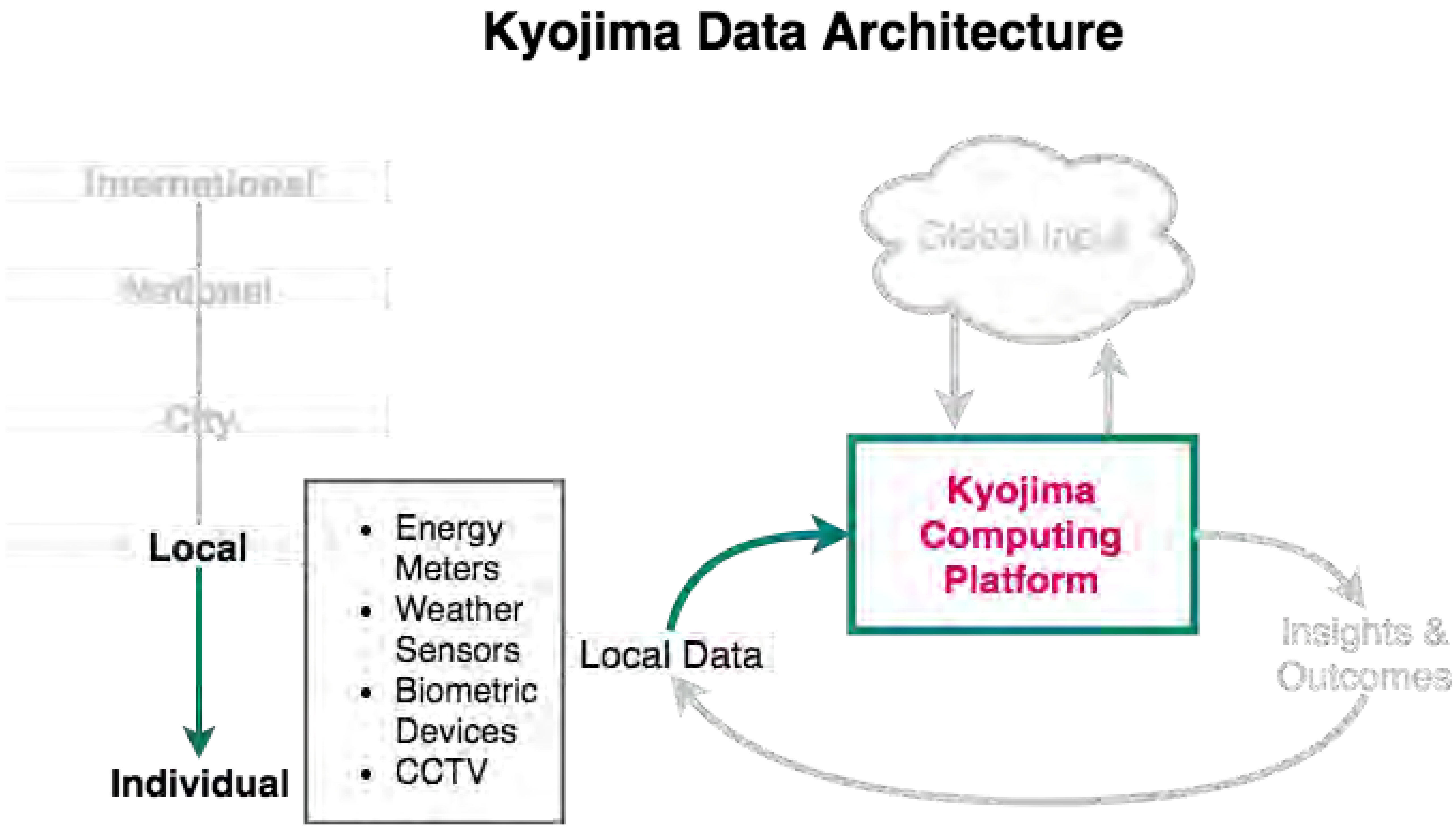


Kyojima Data Architecture

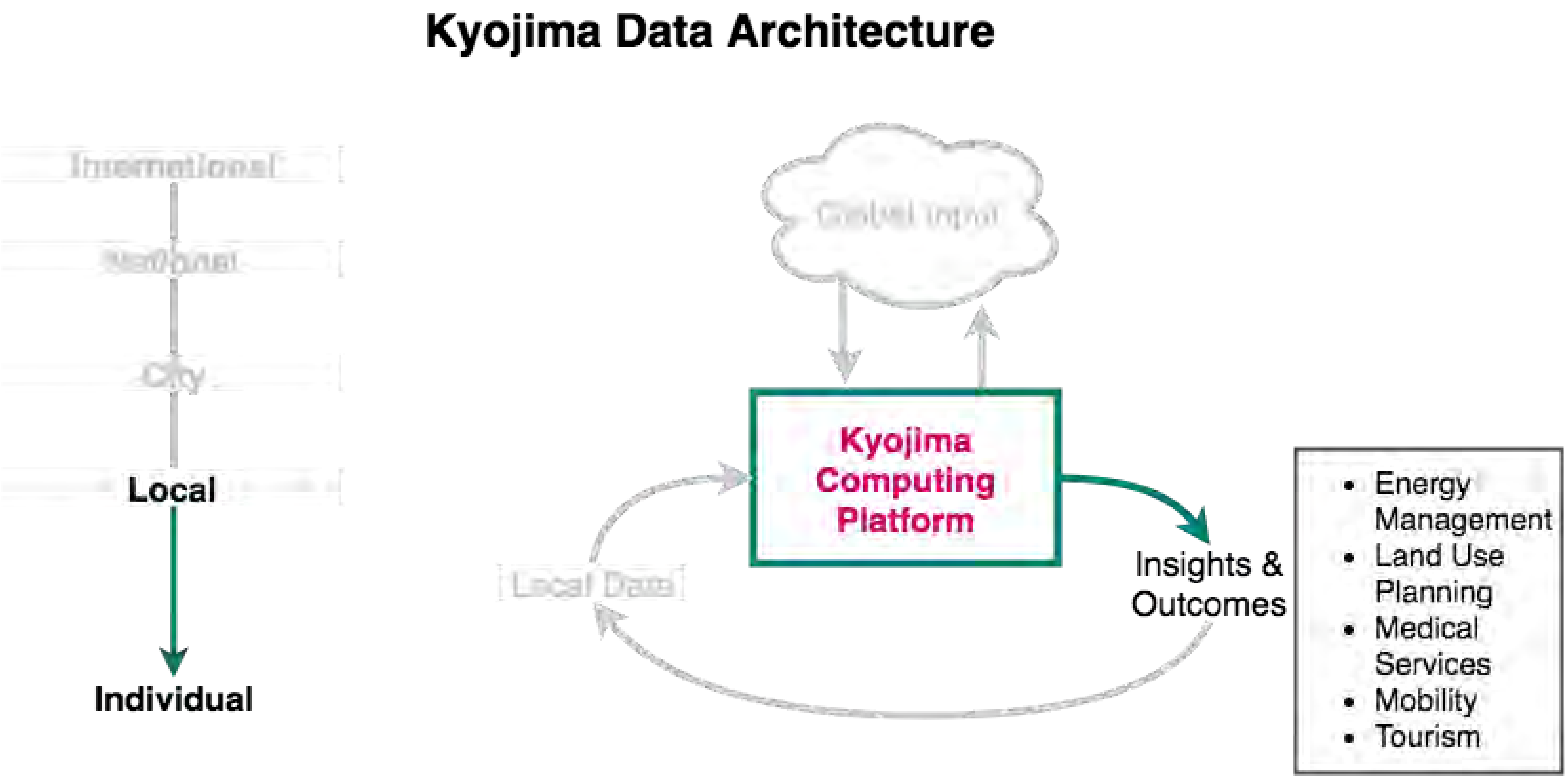


- National Institute for Environmental Studies (NIES)
- Ministry of Land, Infrastructure, Transport, and Tourism (MLIT)
- NTT DoCoMo
- TEPCO
- Google API

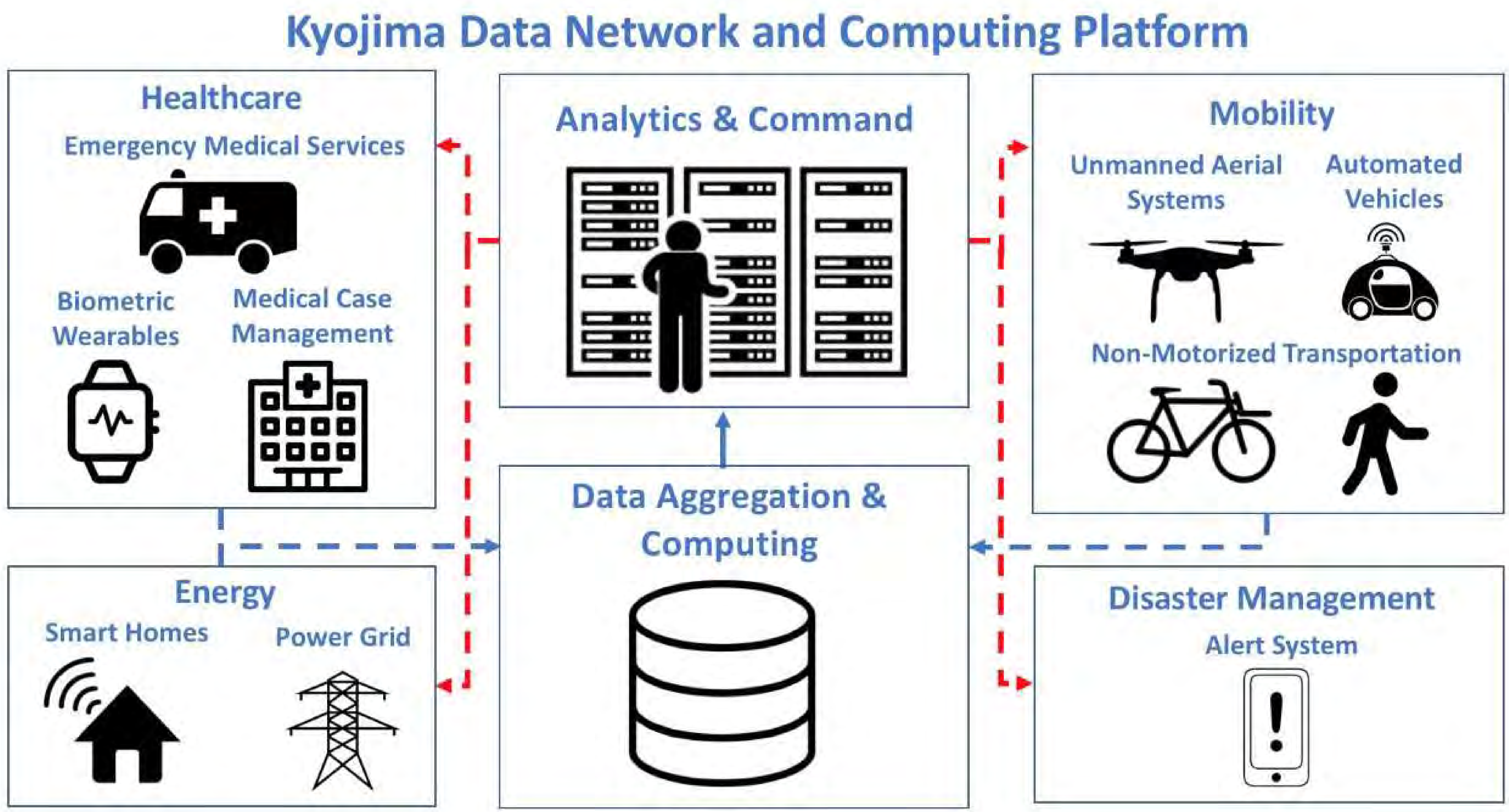
Kyojima Data Architecture



Kyojima Data Architecture



Kyojima Data Network and Computing Platform



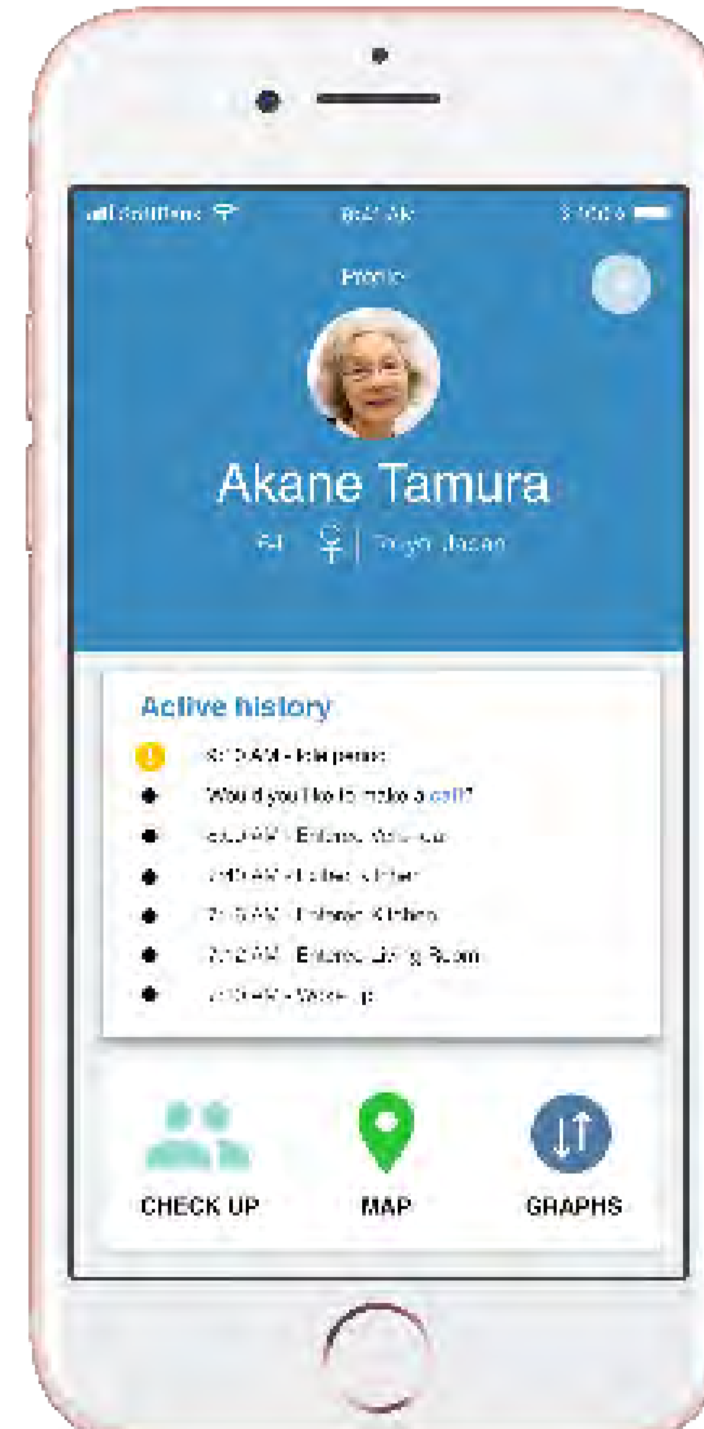
Energy Management

Smart meter

Energy management app

Medical Services

AED drones

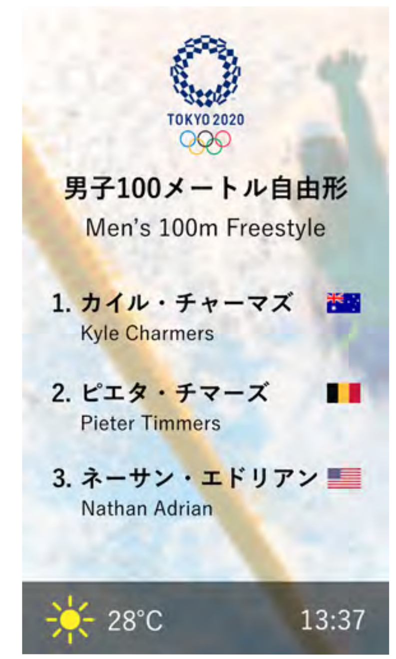


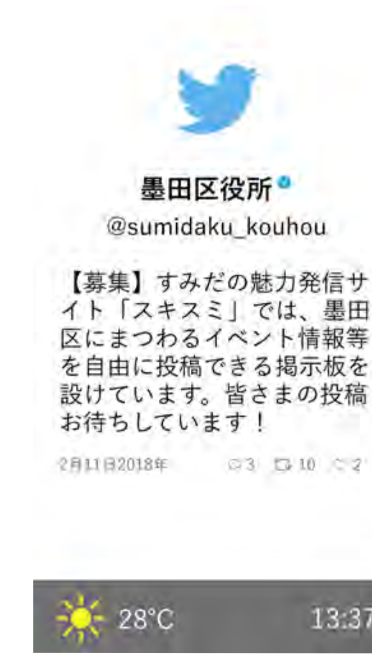
Elderly health tracking apps

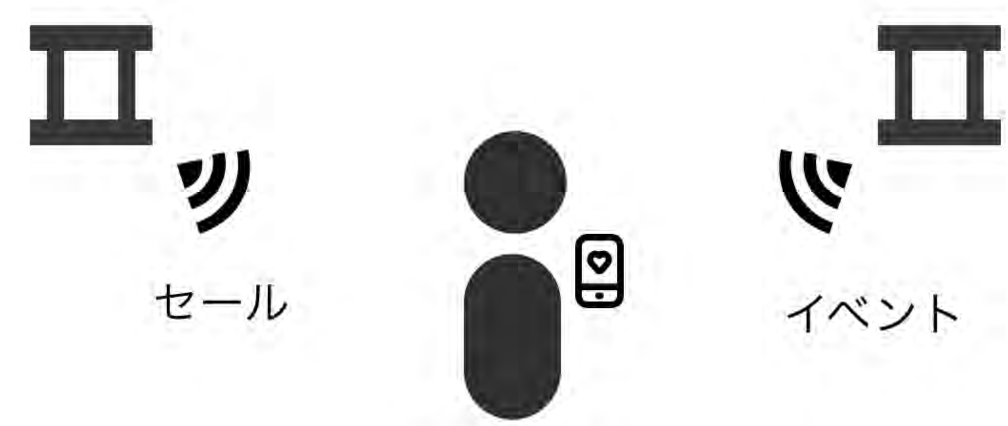
Tourism

Pushing tourist information to phones

Smart Lanterns







Smart lantern concept to display relevant IoT data

These lanterns can send signals to pedestrian phones to advertise local events or stores and provided hyperlocalized information as a kind of “Spacebook”, localized SNS

Architecture Typology Design

Ghazaleh COULTER

Abaan ALI

Ricardo GARCIA BAEZ

Alyssa MCKAY

Mick TANGLAO

The Beacon

Ghazaleh COULTER

The Beacon

Kyojima Smart City Center

The connection of things is at the center of the Beacon through smart networks, IoT, and data. The smart network will be controlled by the Beacon's control center where the smart Lantern system connects the streets and other typologies to the Beacon. The Beacon, as the control center for the Lanterns, can control the streets to create smarter pedestrian areas, display updated conditions and updates to the latest alerts. Through IoT and data output, other typologies can be linked to the Beacon by sensors. The sensors will help better serve the community by collecting data, directing the distribution of energy, directing drone services, and providing rescue sound and visual communication. Kyojima has pockets of underused and underutilized land and distressed and decaying urban areas. These pockets of underused land weaken the neighborhood and provide an opportunity to answer to the key challenges faced by the residents. Within one of these pockets is The Beacon which gives the first center to Kyojima and a base for community engagement. Within the Fold of the Beacon, the image, livability, and productivity of the Kyojima can be tied together as a community center. Shops, specific medical services and community participation and activity can be programed within the Fold. The Beacon is the smart way of connecting Kyojima without impacting the existing infrastructure. The frontier for the Beacon as a system can be distributed throughout the 23 wards to give each ward its own smart center.

The Beacon
情報で変える

Modeling

Viewshed Analysis

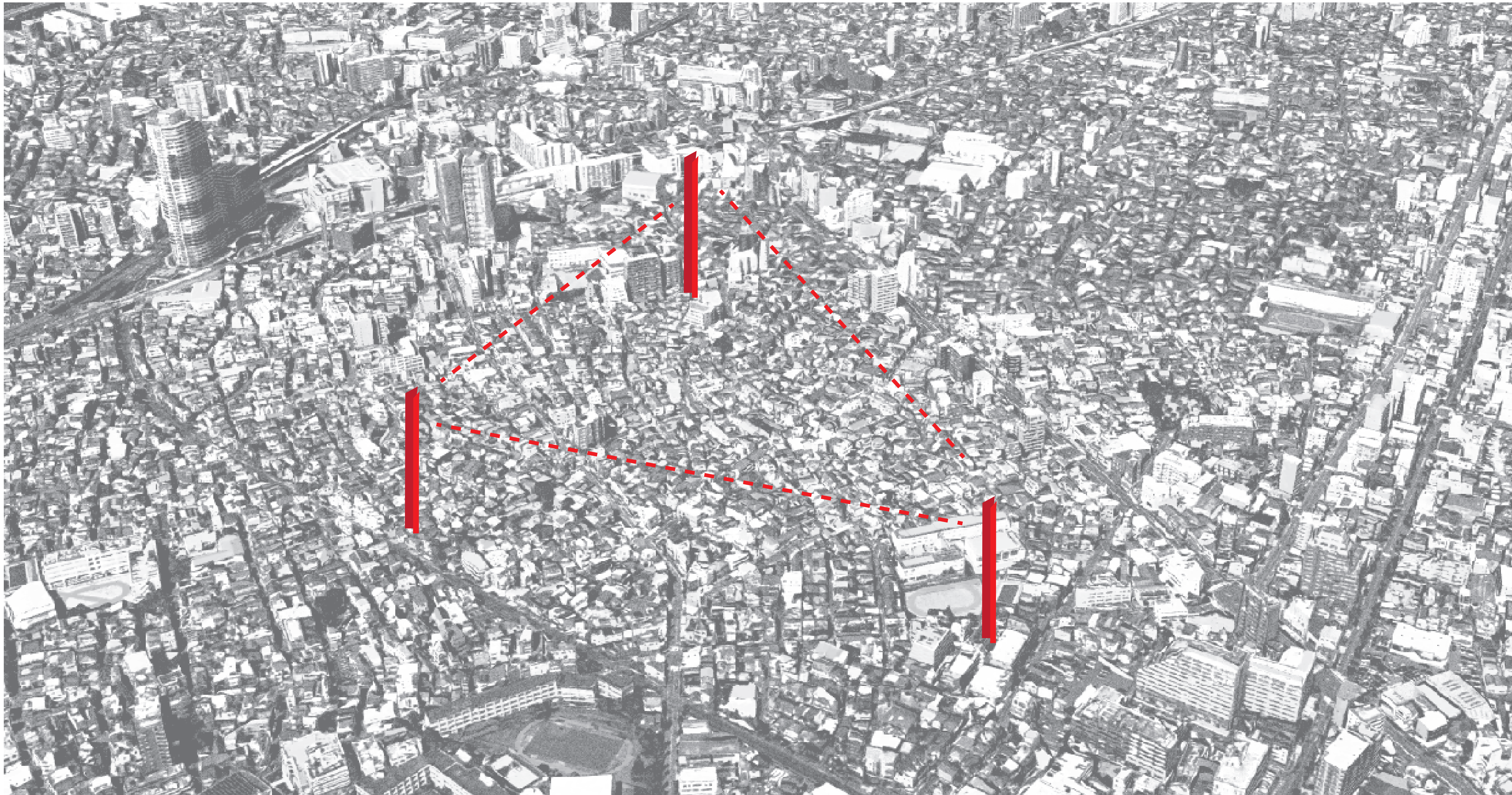
Scorecard

幸福

資源

強靭性

THE BEACON
KYOJIMA SMART CITY CENTER



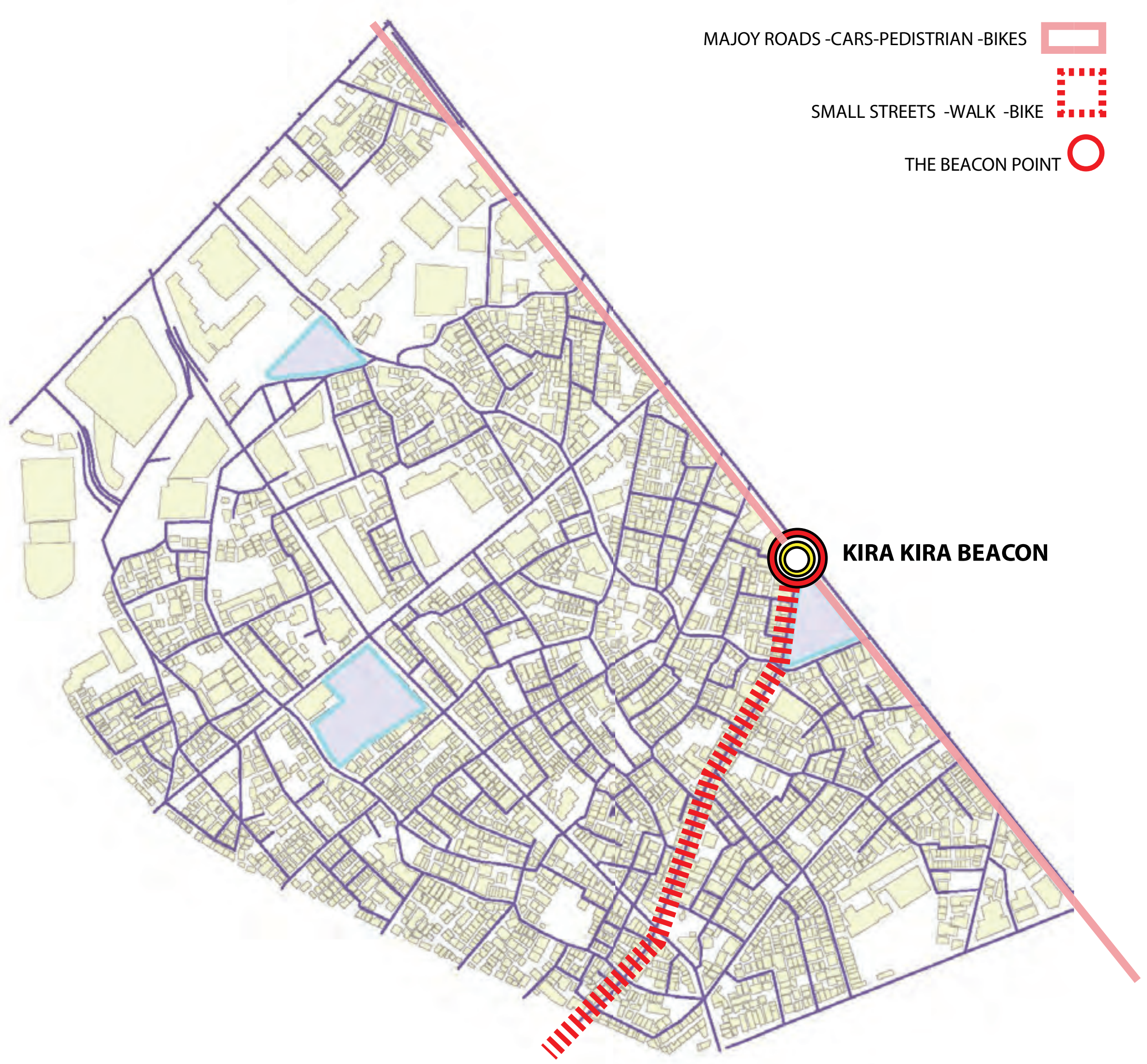
THE CONNECTION OF THINGS IN KYOJIMA

CONNECTING ALL THE NEW WITH THE OLD THROUGH A SMART NETWORK

INSPIRATION

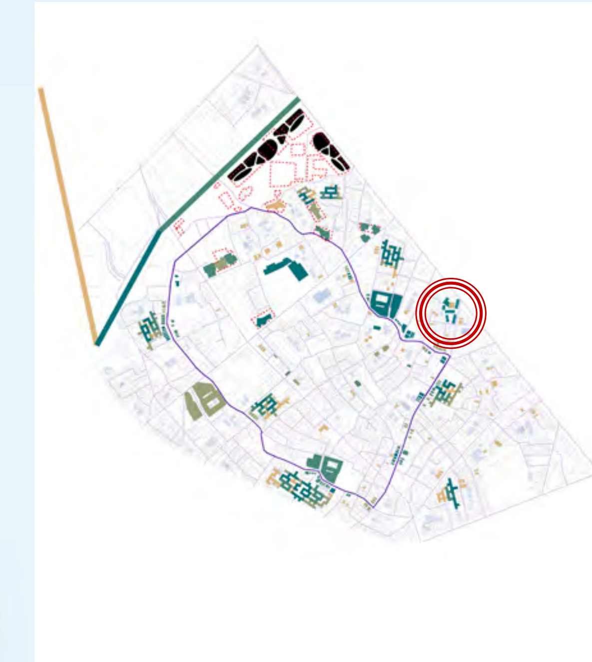
-TRADITION
-CITY CENTER
-CULTURE

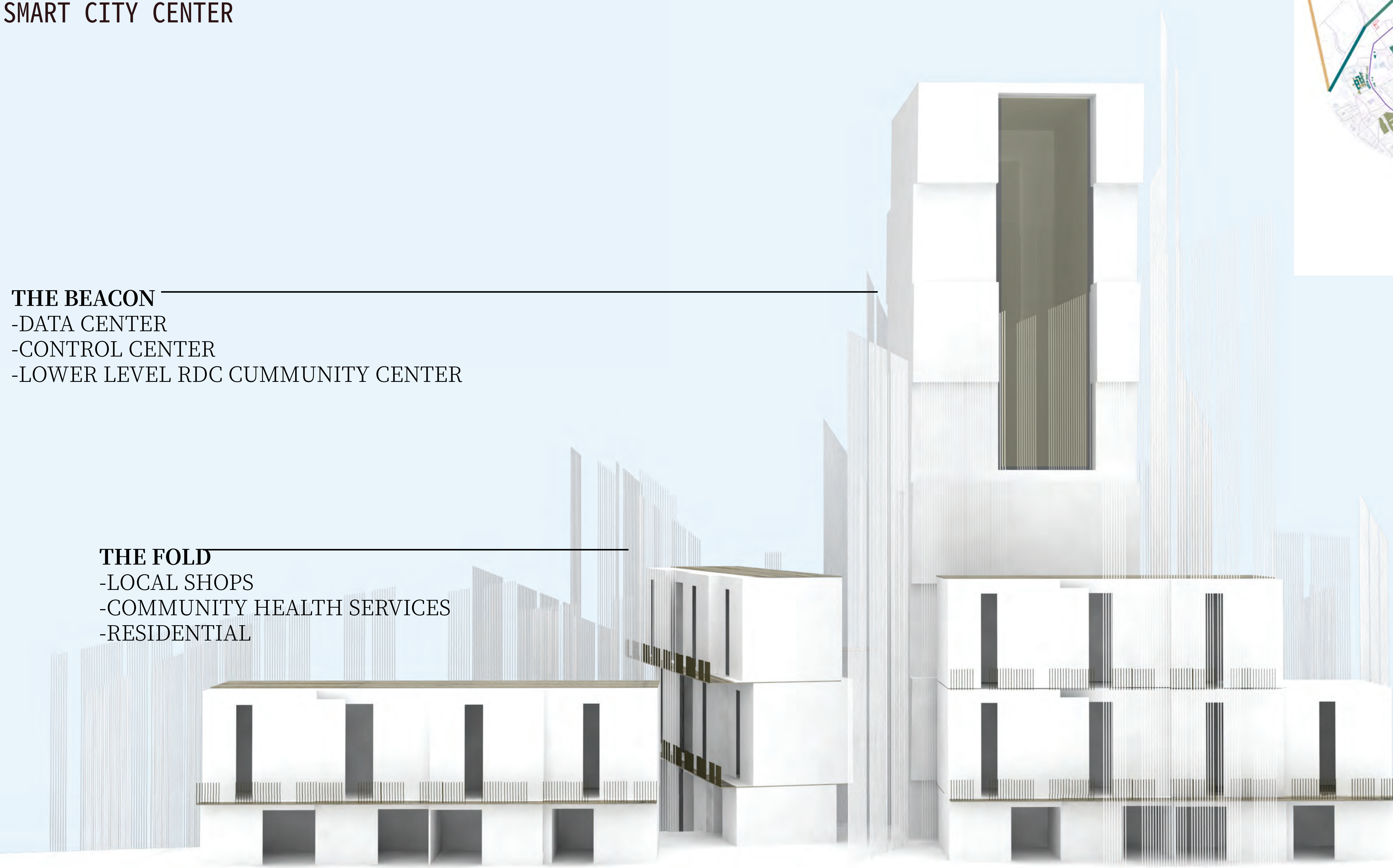
KYOJIMA IS MORE LIVABLE AND LIVELY THAN THE AREAS LAID OUT ON A GRID BECAUSE OF ITS HAPHAZARD STRUCTURE...IT HAS CREATED THE ATMOSPHERE OF COMMUNITY AND 'DRAWS LIVABILITY TO THE AREA.'
-JOURNAL OF ASIAN ARCHITECTURE AND BUILDING ENGINEERING



THE BEACON

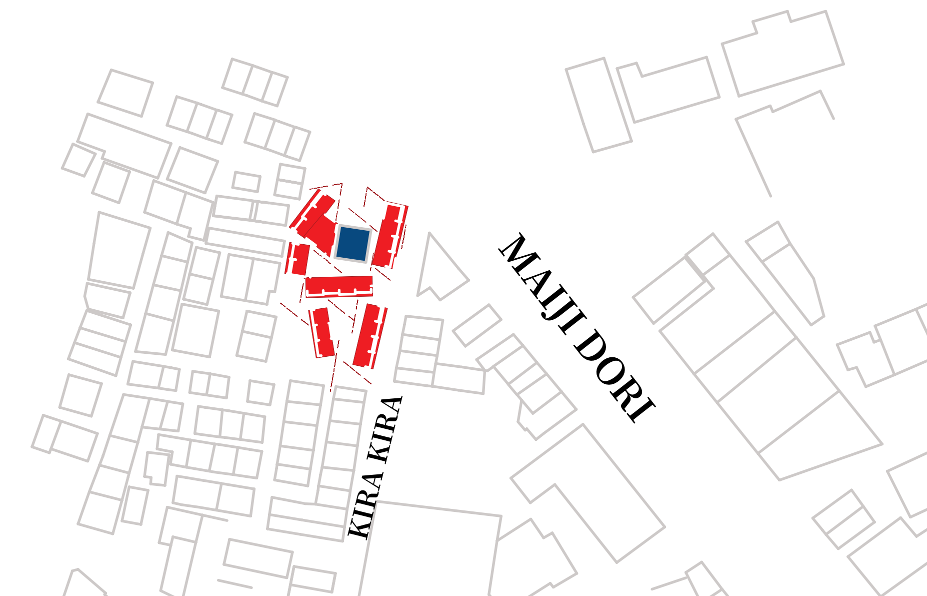
KYOJIMA SMART CITY CENTER

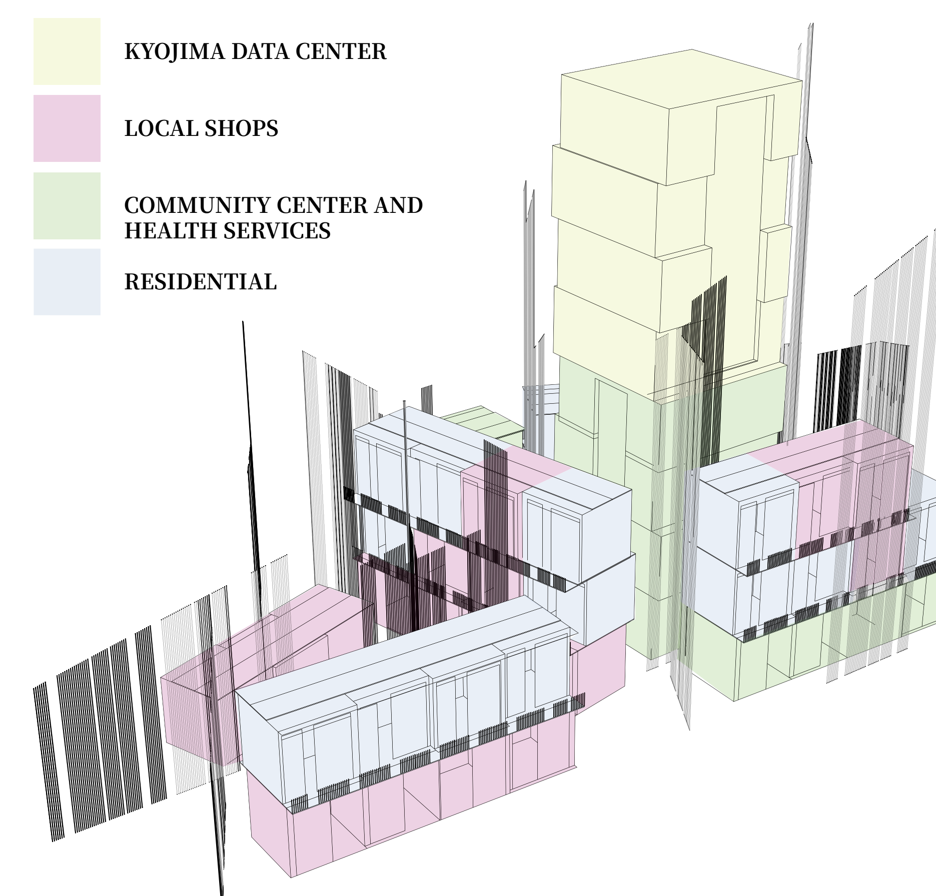




THE BEACON

KYOJIMA SMART CITY CENTER

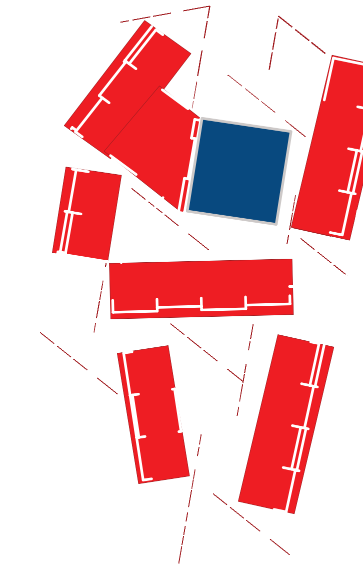




KYOJIMA has pockets of underutilized land and decaying urban areas. These pockets of underused land weaken the city and provide an opportunity to answer to the city's challanges. Within one of these pockets is The Beacon, which could become the first CENTER of Kyojima.

THE BEACON

KYOJIMA SMART CITY CENTER

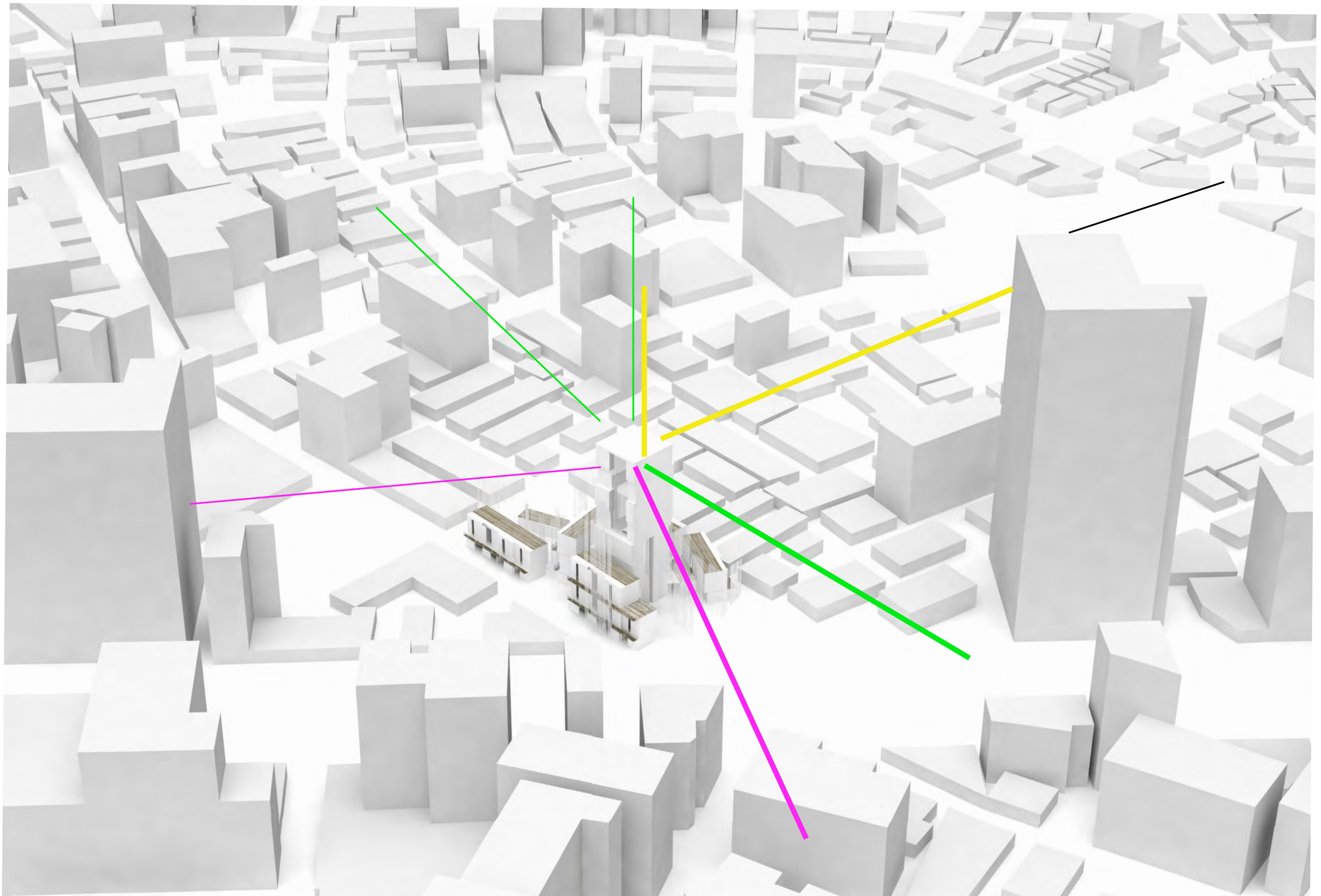


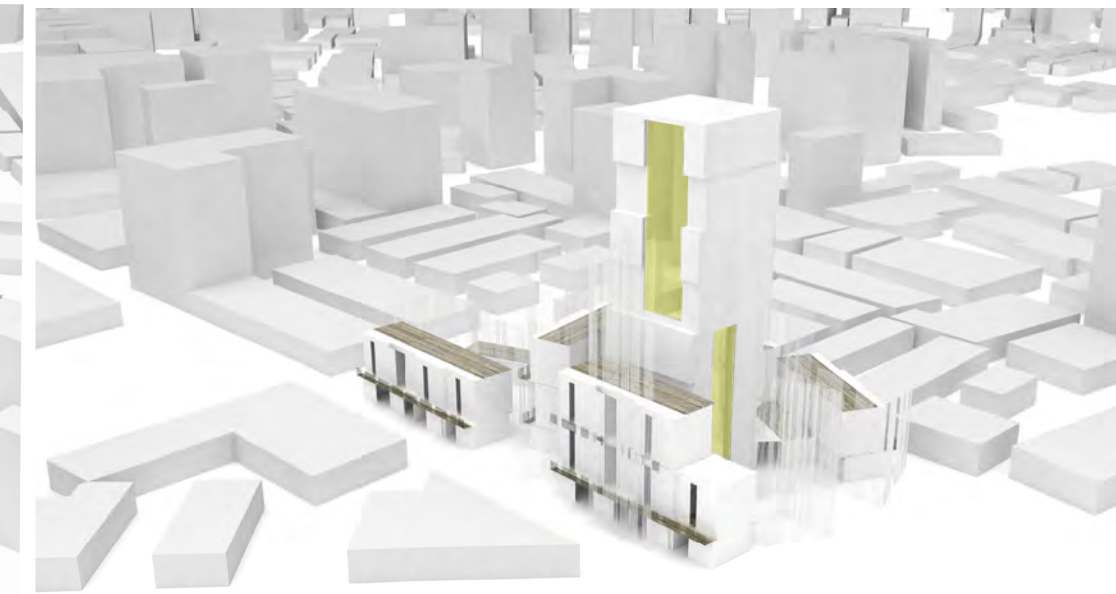
The image, livability, and productivity of Kyojima can be tied together within THE FOLD of THE BEACON .

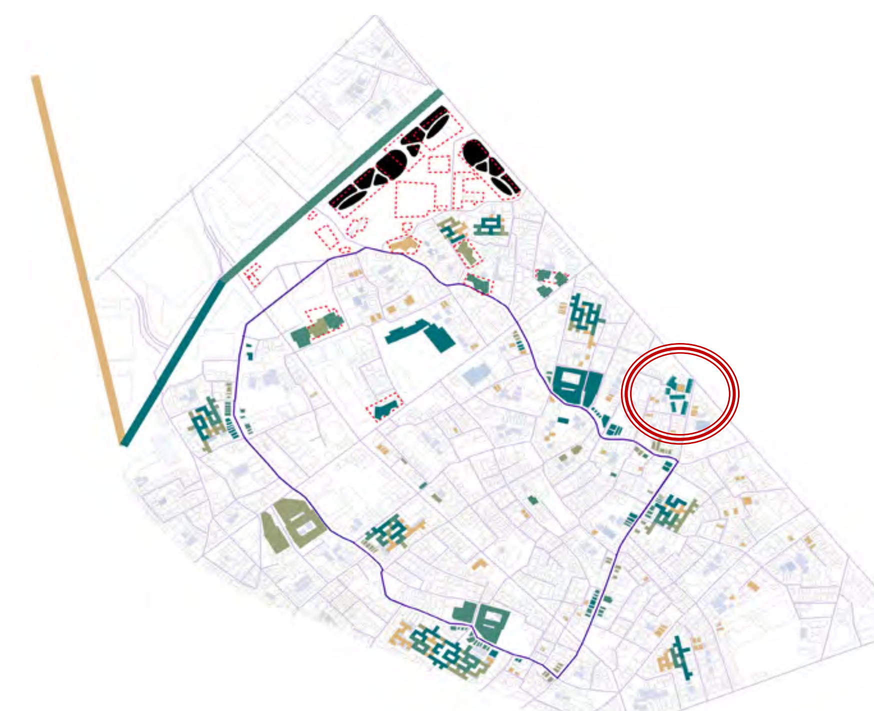
THE BEACON

KYOJIMA SMART CITY CENTER

CONNECTING KYOJIMA WITHOUT IMPACTING THE EXCITING INFRASTRUCTURE







COMMUNITY CONTROL CENTER
-ALERTS
-INFORMATION DISTRIBUTION
-PEDESTRIAN GUIDANCE
-RESIDENT NEWS OUTPUT

COMMUNITY ENERGY AND RECOURCE DISTRIBUTION
-SOLAR PANELS
-DRONE SERVICES

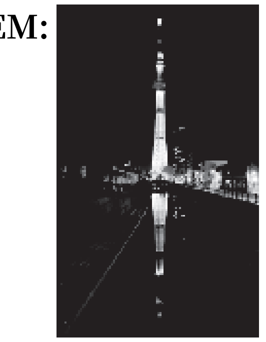
DISASTERS
-DRONE DELIVERY AID
-DRONE USHERING PEOPLE AWAY FROM DISASTER
-SOUNDS AND CUES FOR TOURISTS

DISASTER RESISTANT
WHEN ALL OTHER FALLS, THE BEACON WILL CONTINUE TO STAND TALL TO LOCATE KYOJIMA.

THE BEACON system

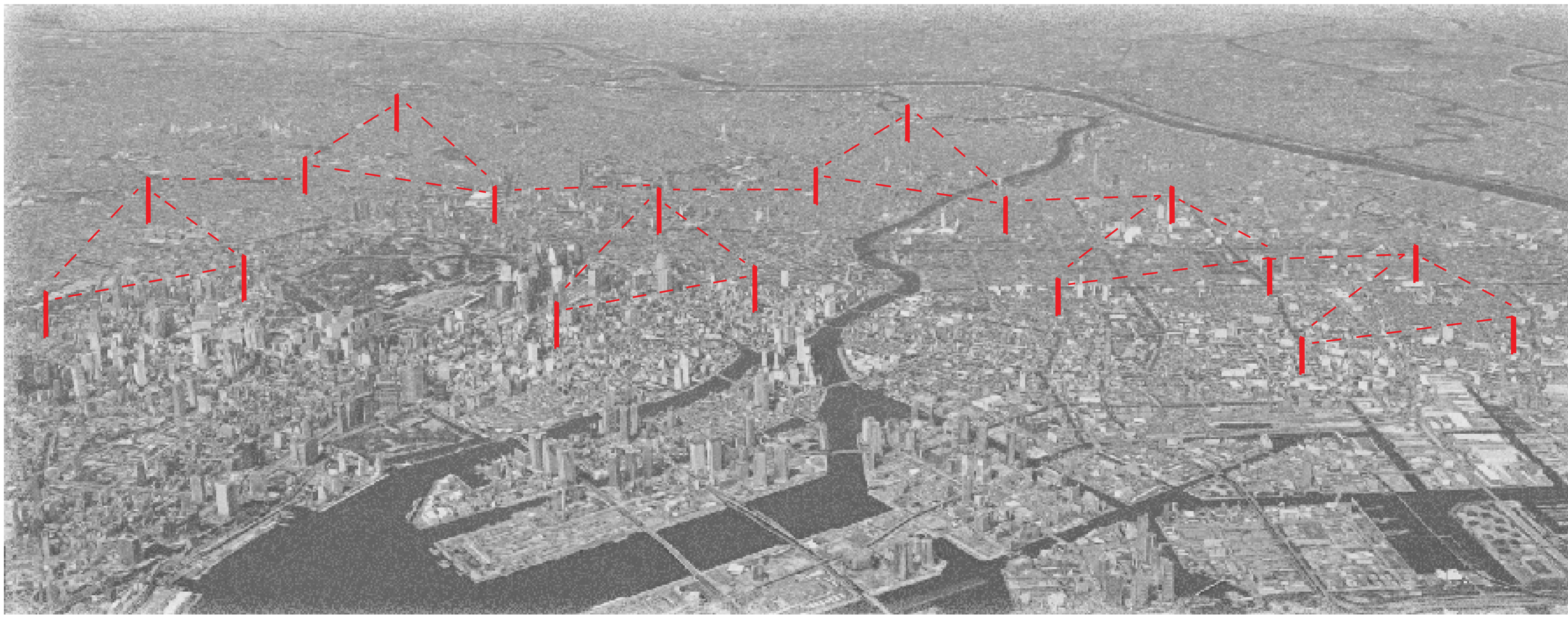
23 WARD SMART CITY CENTER

THE THREE TIERED SYSTEM:


Skytree


THE BEACONS -Sub Systems

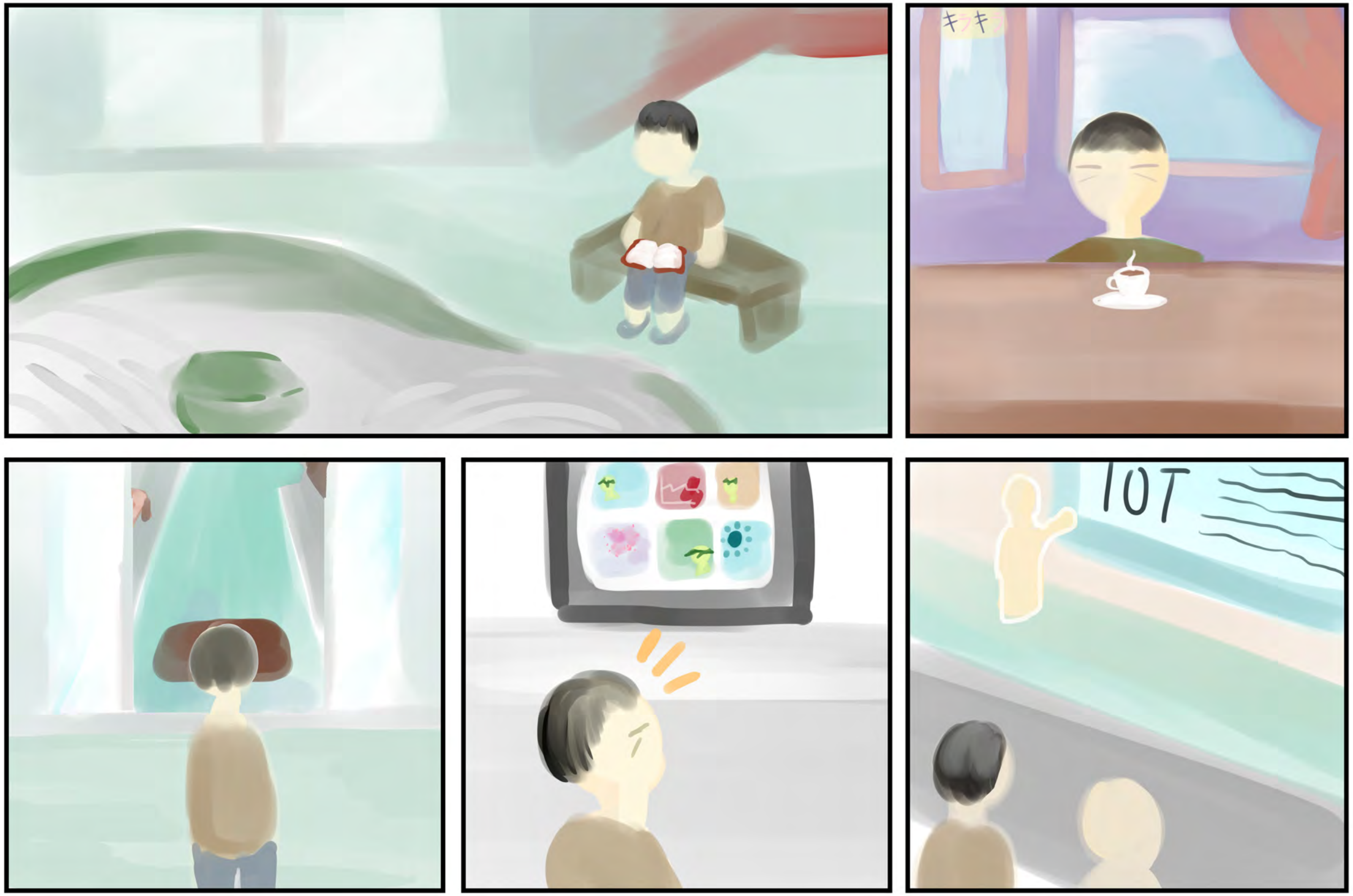

DIGITAL LANTERNS



The Frontier for The Beacon system

DISTRIBUTION OF THE BEACON SYSTEM THROUGHOUT THE 23 WARDS TO GIVE EACH WARD ITS OWN SMART CITY CENTER.

Storyboard



Eco-Cell

Abaan ALI

The Eco-Cell

Main Typology: Eco-Cell

The Eco-Cell typology is an urban regeneration guideline intended at proposing built environment catalysts for the creation of Net-Zero, Smart-City, and "green" urban component in the North Kyojima district through specific architectural interventions. The aim of the Eco-Cell typology is to stimulate the productive growth and future sustainable opportunity for the existing elderly population and incoming younger generation living in the city of Kyojima, specifically North Kyojima which is highly receptive to newer urban development and generates a substantial amount of the city's traffic due to its locational adjacency of the Keisei Oshiage Line and intersecting highways. With the introduction of the 2020 Olympic Games in Tokyo, the resiliency of Kyojima is bound by the sustainable interventions of the area that will promote job creation and potential infrastructural growth for the existing elderly citizens and newly emerging younger age group. That is where Eco-Cell will provide the area a compilation of strategies of creating communities that create a cohesive urban fabric that will complement the existing site. The guidelines provided create strategic interventions to promote more greenspace to improve user-experience and ecological concerns, depopulate older residential quarters with newer neighborhood communities to protect from environmental hazards, and accommodate Smart-City techniques to accommodate future technological growth. Underneath the umbrella of the Eco-Cell typology hierarchy there are subcategories of building typology that are categorized by a taxonomy of scales based on existing building form conditions called Meta-Typologies. The Meta-Typology scales are referenced as: XS, a singular building component; S, an aggregate of two or more buildings; M, a full block-scale community; and L, the Eco-Cell. These Meta-Typology will ensure integration and assimilation within the current urban framework that exists in Kyojima, and will only complement the cultural aesthetic of the site. The meta-typology proposals created include:

Meta-Typology #1: "Stitch House"

The Tokyo "Stitch-House" is a neighborhood residential district creating a knotted connection between building, interior environment, and exterior environment while redefining the vernacular representation of the existing residential typology that exists in Kyojima.

Meta-Typology #2: "Sky Bridge"

The Tokyo "Eco-Line" is an elevated urban park connecting two adjacent buildings. Created as an identifying landmark and a potential attraction, the connection between building above the street interface and along train line corridor will allow for an increase in population access into the area and resurgence in economic growth for the area.

Meta-Typology #3: "Vertical Garden"

The Tokyo "Ecopartment" is a modular "green" apartment housing design that aims at reducing CO_2 emission and increase in the amount of greenspace existing within a small building footprint. Each resident has access to a private greenspace and viewshed towards the city

Meta-Typology #4: "Sky Bridge" Typology

The Tokyo "Eco-Line" is an elevated urban park connecting two adjacent buildings. Created as an identifying landmark and a potential attraction, the connection between building above the street interface and along train line corridor will allow for an increase in population access into the area and resurgence in economic growth for the area.

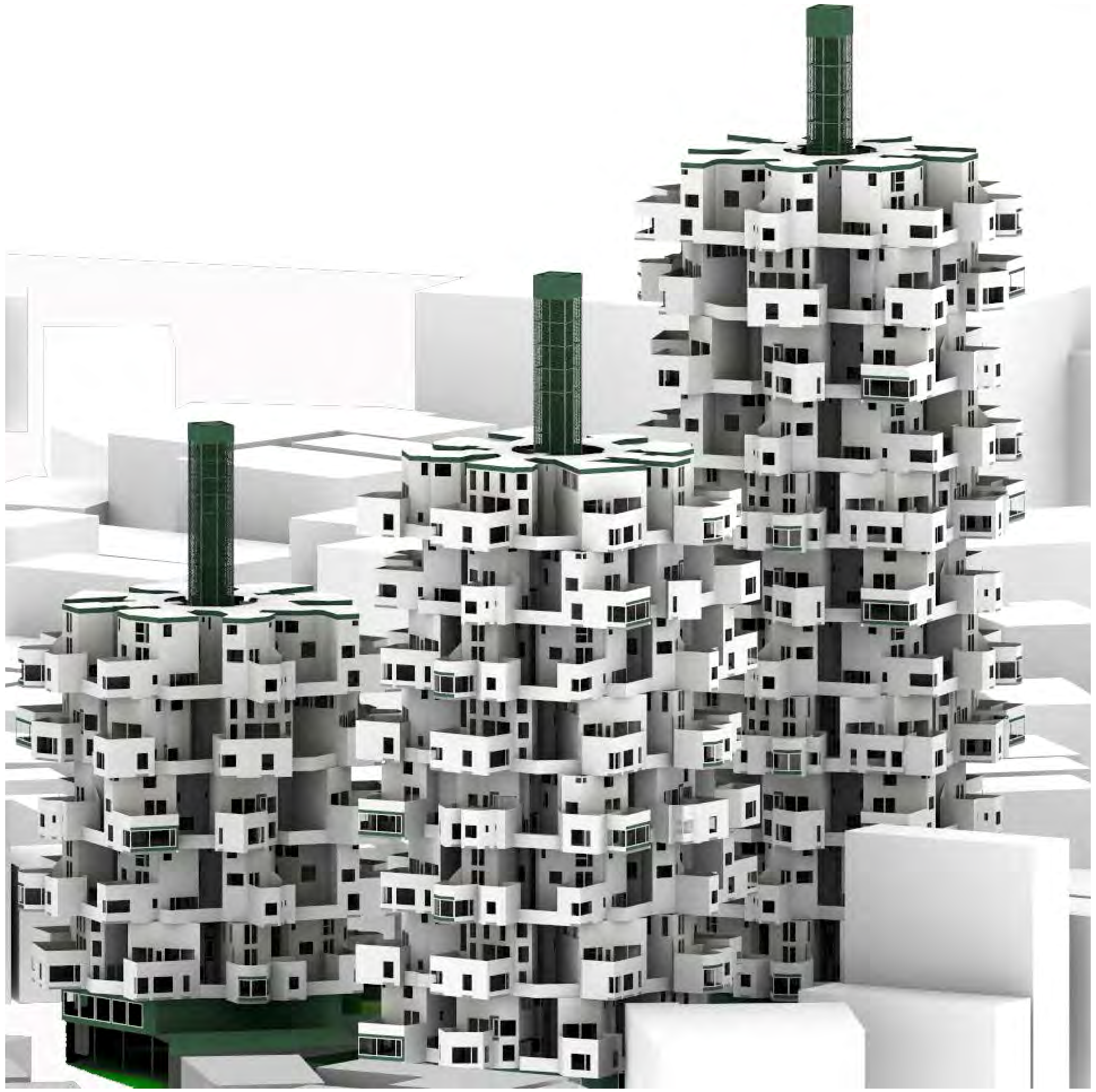
Meta-Typology #5: "Shipping Container"

The Tokyo "Stack House" is a shipping container modular housing community that brings inspiration and connection to the abundance of materials located in Tokyo Bay. Stack House complements site-specific situations due to the flexibility and expansion abilities of the design concept which can be used as single detached housing or aggregated community building forms.

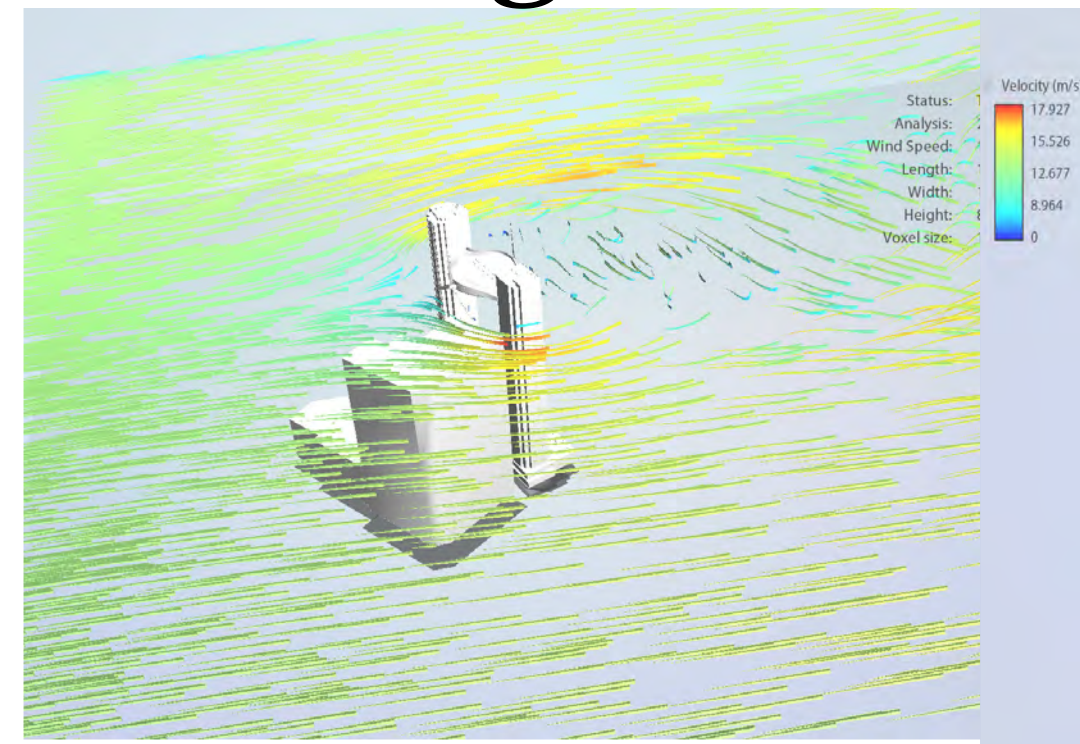
Meta-Typology #6: "Green District"

The Tokyo "Eco-District" is a net-zero feasible multifunctional district concept that creates a network of live, work, play, within an existing block. The main attributes of this community is that it is an all-encompassing neighborhood structure that represents the organic structure of the vernacular shopping district but incorporates a housing component above.

The formation of these meta-typologies creates the formation of an Eco-Cell community that can be self-sufficient and self-functioning without relying on external resources. The collage of building typologies complements the whole of the community and become a symbiotic functioning system. The main concern through the creation of the Eco-Cell was to not detract from the existing character of Kyojima. Even with the introduction of these new building typologies, the original character of the city are untouched and protected through the progression of future possibilities.



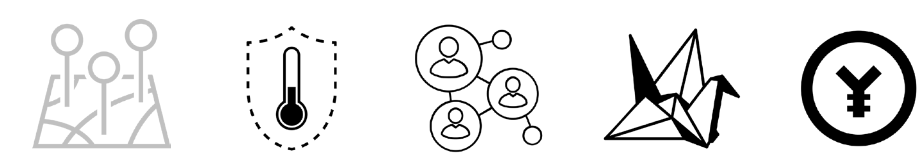
Modeling



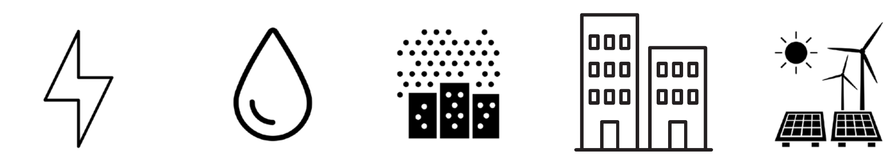
Wind Potential

Scorecard

幸福



資源



強靭性

Eco-Cell
環境を考える

Eco-Cell [環境を考える]

TYPOLOGY HIERARCHY

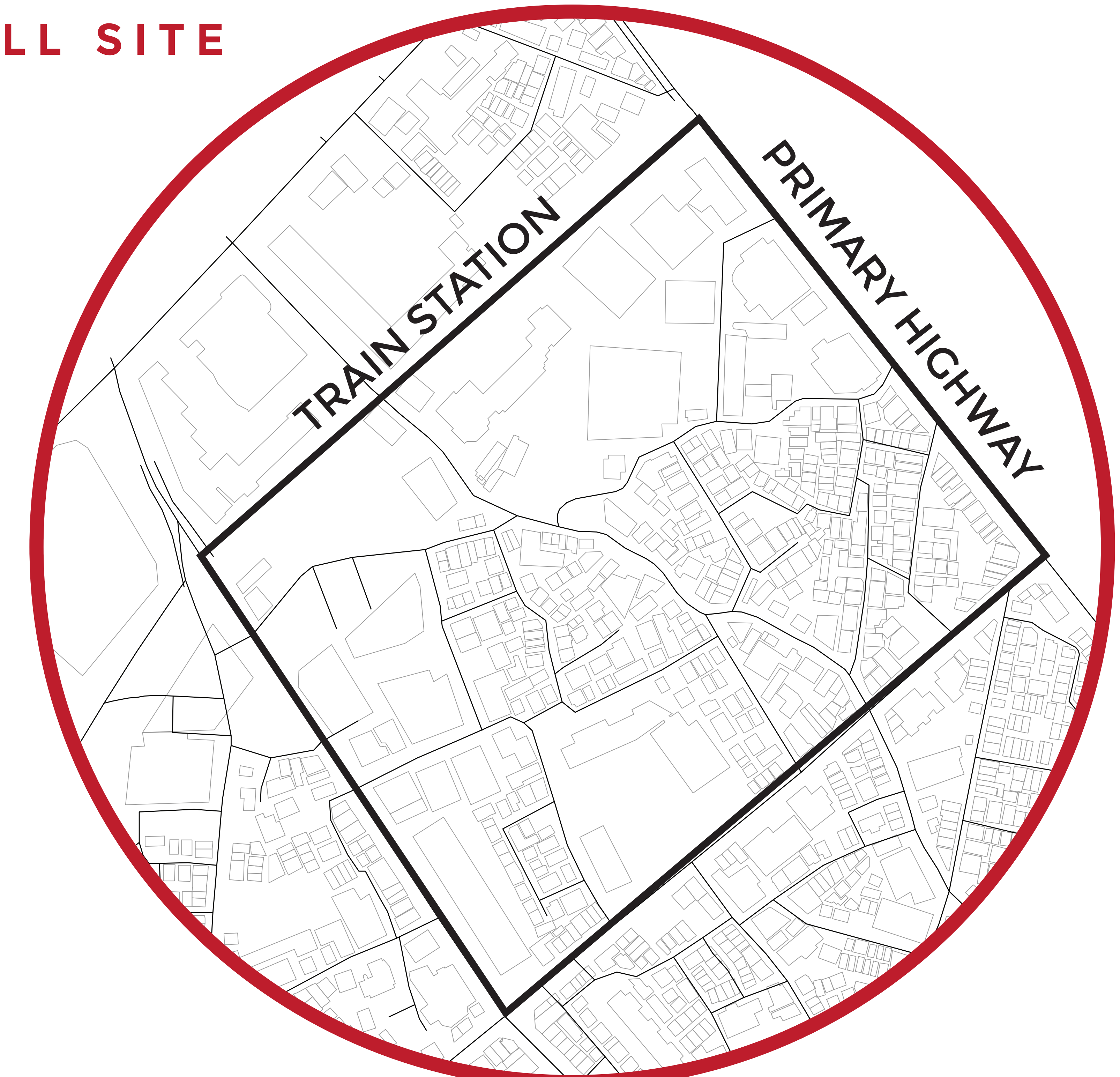
META TYPOLOGY	META TYPOLOGY	META TYPOLOGY	MAIN TYPOLOGY
[XS]	[S]	[M]	[L]
BUILDING	AGGREGATE	BLOCK	COMMUNITY

Eco-Cell [環境を考える]

KYOJIMA CONTEXT

Eco-Cell [環境を考える]

ECO-CELL SITE



Eco-Cell [環境を考える]：STITCH HOUSE

STITCH HOUSE TYPOLOGY

1 エコロジースカイブリッジ green neighborhood

META TYPOLOGY

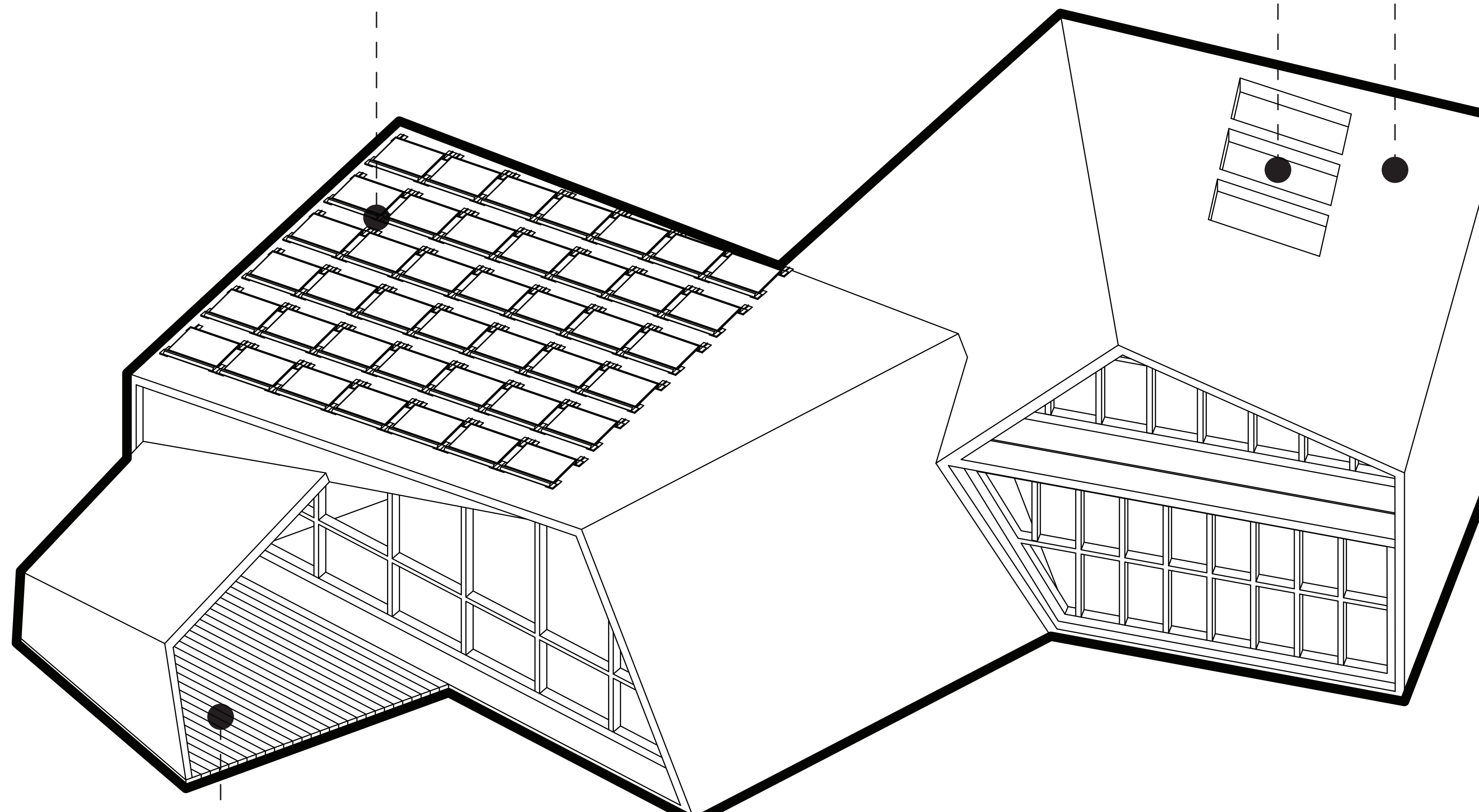
[M]

FUNCTION: TOKYO "STITCH HOUSE"

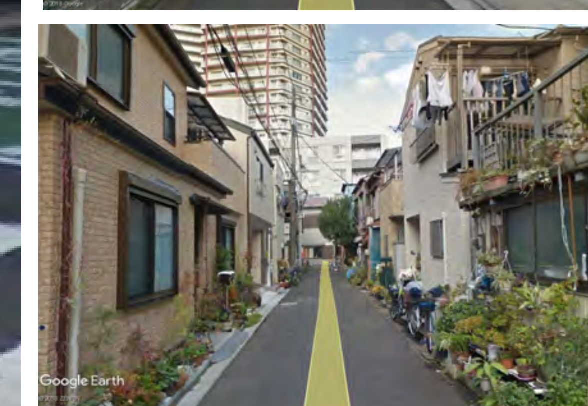
Residential district creating a knotted connection between building, interior environment, and exterior environment. Creating a vernacular representation of the existing residential typology that exists in Kyojima

USES

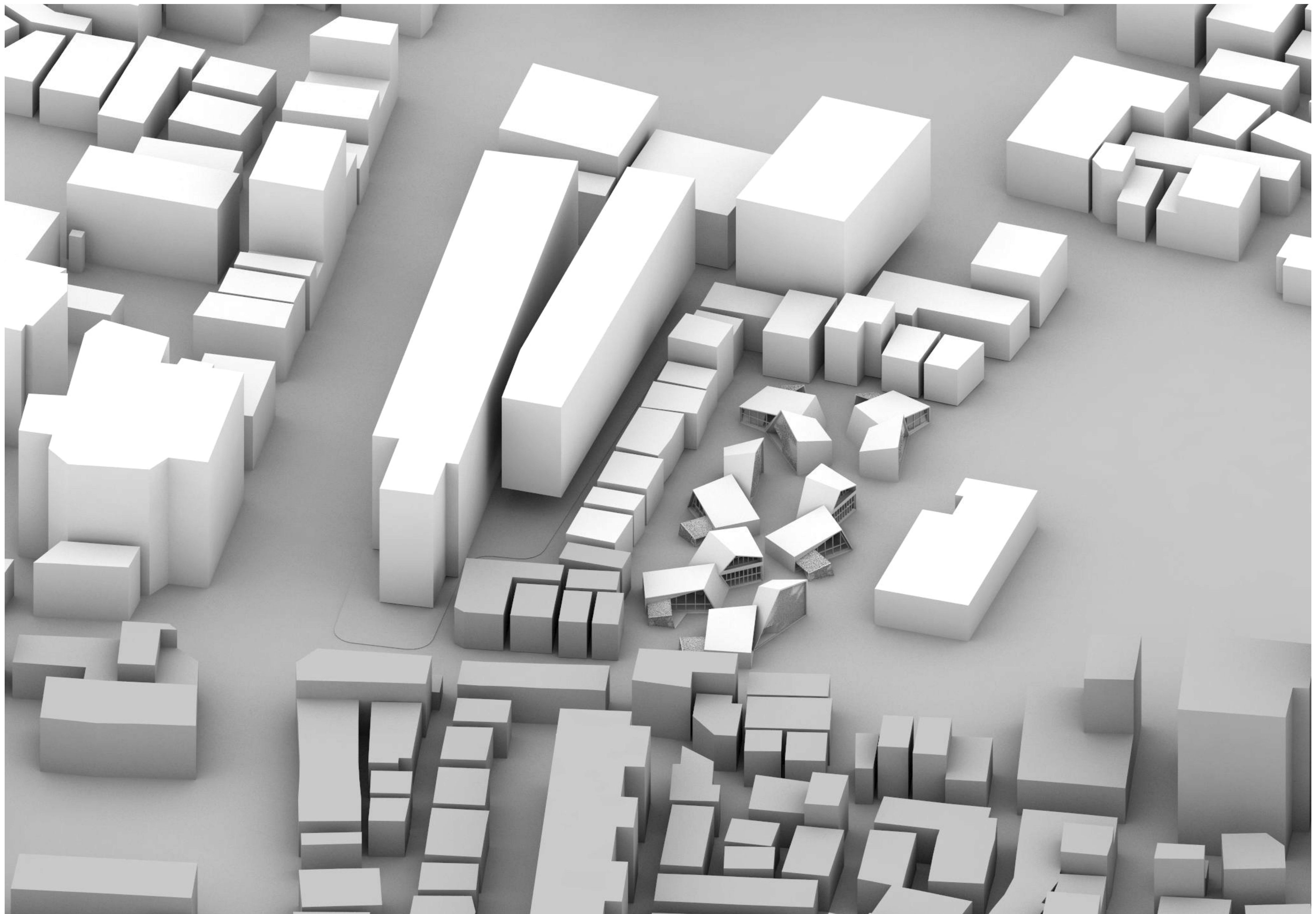
Residential



Eco-Cell [環境を考える]：STITCH HOUSE



Eco-Cell [環境を考える] : STITCH HOUSE



STITCH HOUSE TYPOLOGY WITHIN SITE CONTEXT

Typology Description

A new future housing unit application that stitches the landscape fabric to the existing fabric of the site to the housing unit creating a integrative block structure

Typology Goals

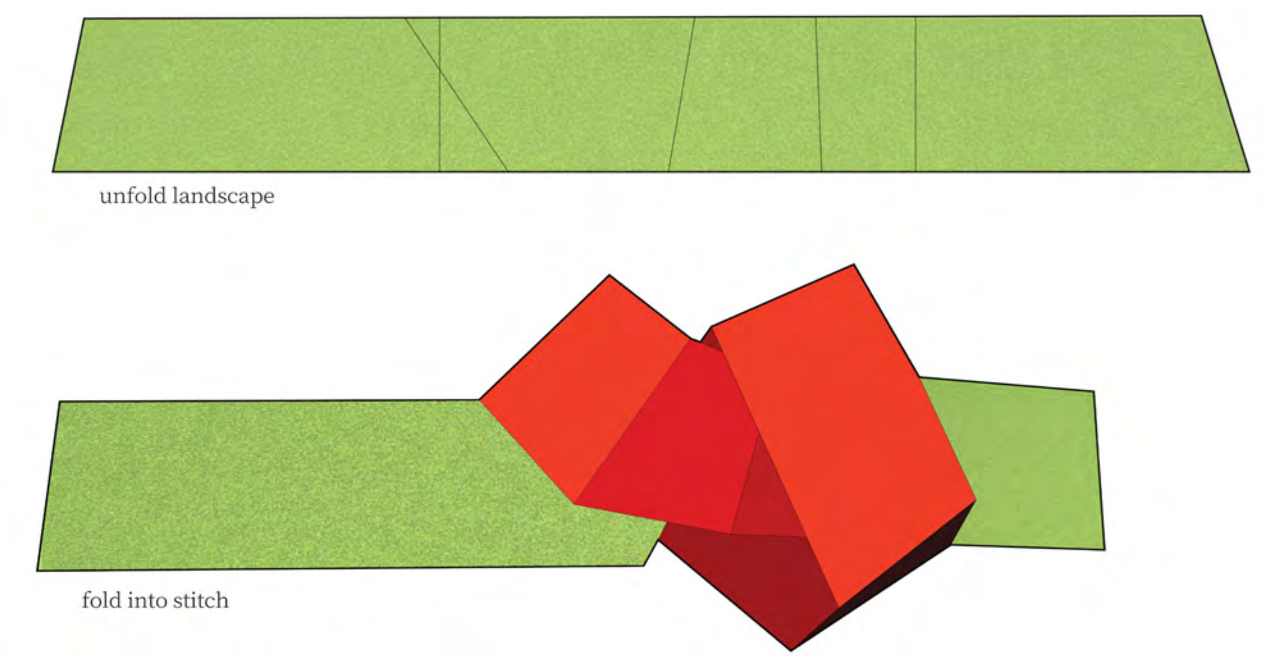
[Community Development] [Sustainable Design] [Folded Landscape] [Neighborhood District] [Informal Greenspace] [Vernacular Architecture]

Performance

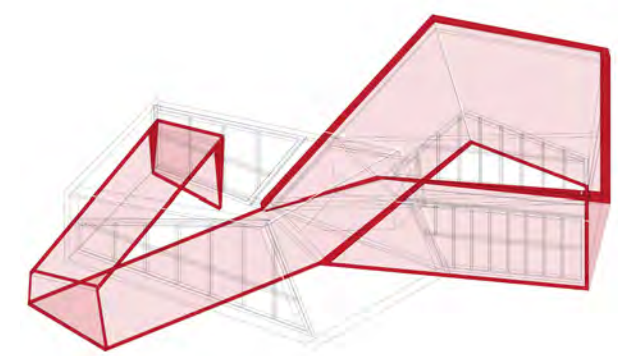
The building is an example of a community housing proposal that provides three combined units and integrates solar panels to allow for a more energy efficient alternative to continue a process to become less dependent on gridded energy sources

Eco-Cell [環境を考える] : STITCH HOUSE

Process Diagram:



Unfolded Landscape & Folded Into Stitch



Folded Fabric into Housing Unit

Issue

How to preserve the cultural and vernacular architectural identity of residential housing while creating a more modern and sustainable housing unit for new residences coming to the area.

Strategy

Provide a integrative“fabric”that allows the housing unit to maintain a direct connection to the landscape and gives the residences an identity to reclaim

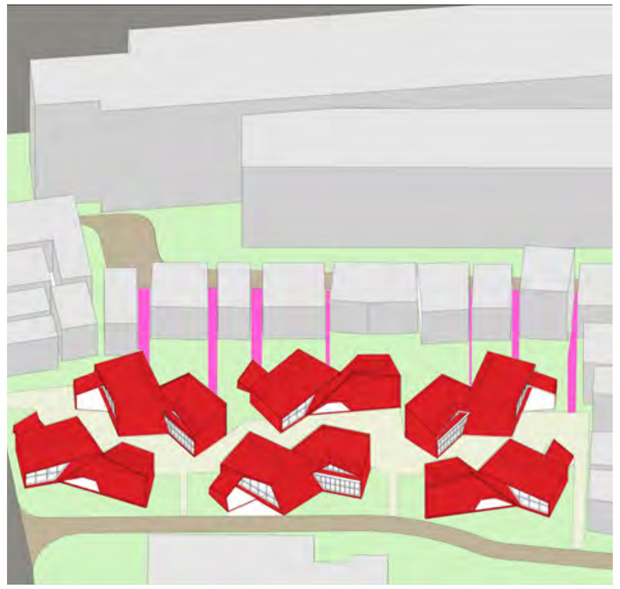
Future Goal

The idea is to create a neighborhood unit that is not entirely foreign to the people of Kyojima and allows for a connective cell structure going forward

Street Integration:

Primary Main Road

Secondary Interior Connective Pathway



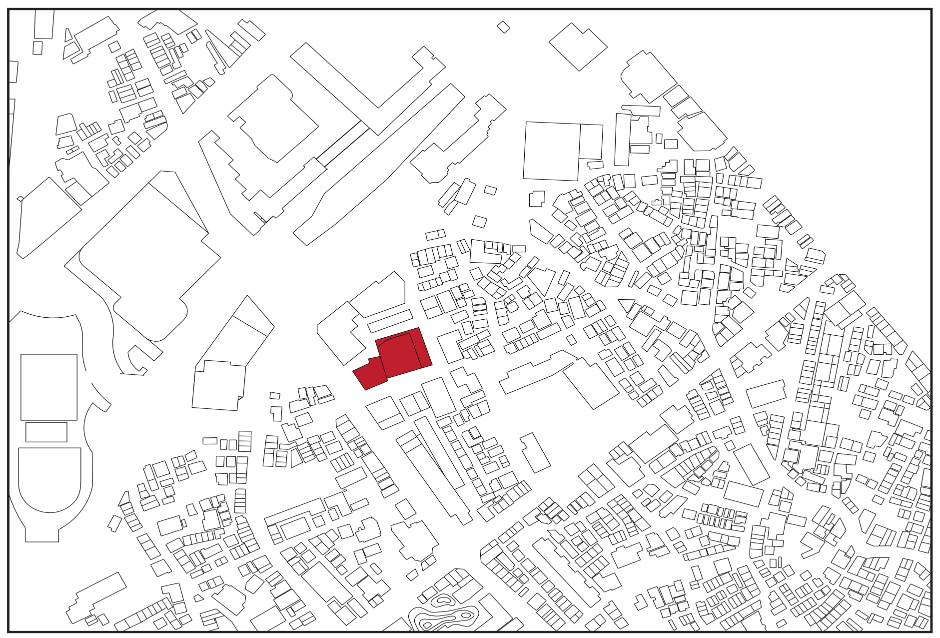
Tertiary Informal Alleyways

Eco-Cell [環境を考える] : STITCH HOUSE

Rendering of Secondary Pathway

Eco-Cell [環境を考える] : TOKYO SKY BRIDGE

SKY BRIDGE TYPOLOGY



2 エコロジースカイブリッジ ecological sky bridge

META TYPOLOGY

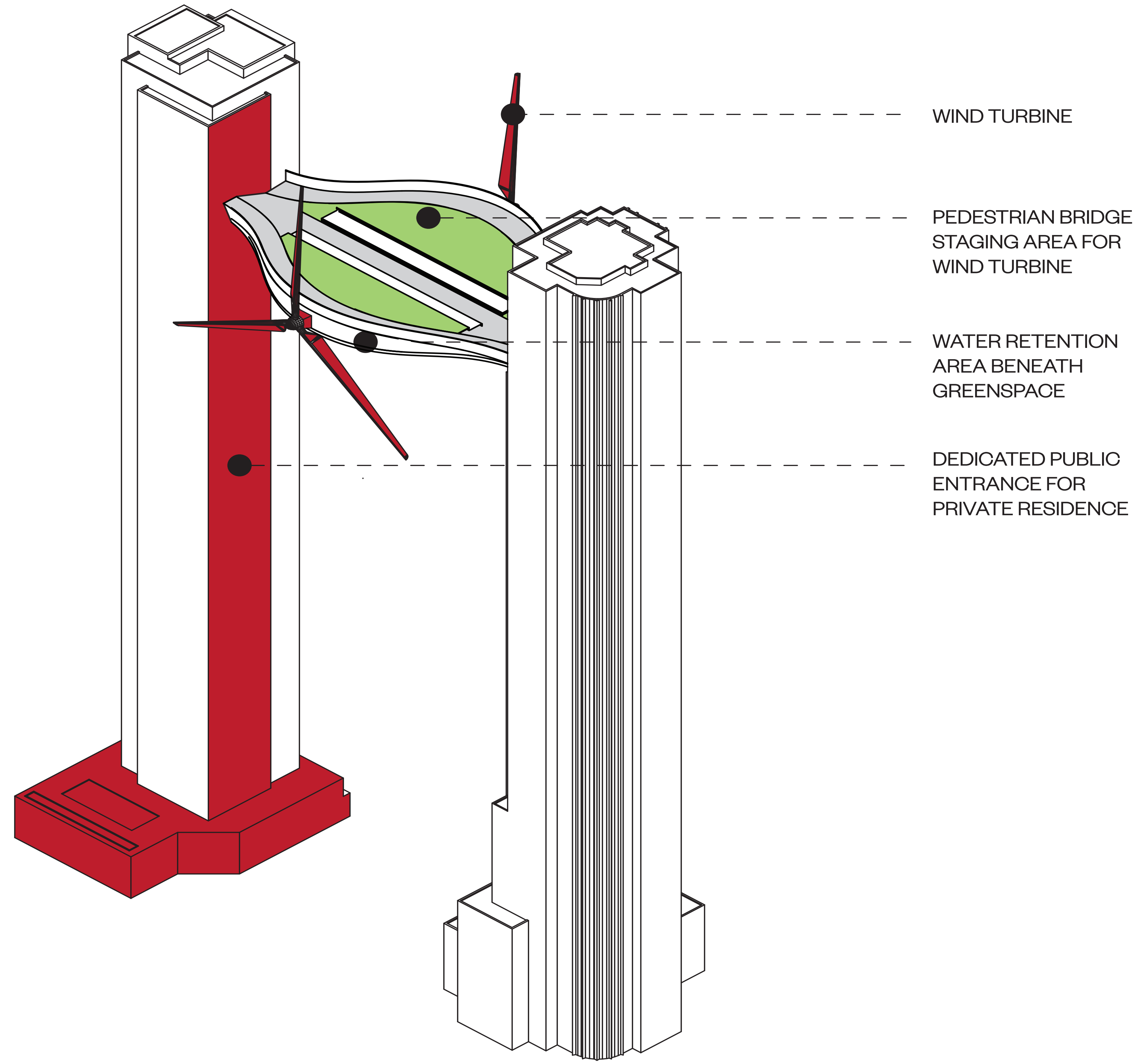
[S]

FUNCTION: TOKYO “ECOLINE”

green horizontal connection between building above the street interface and along train line corridor

USE:

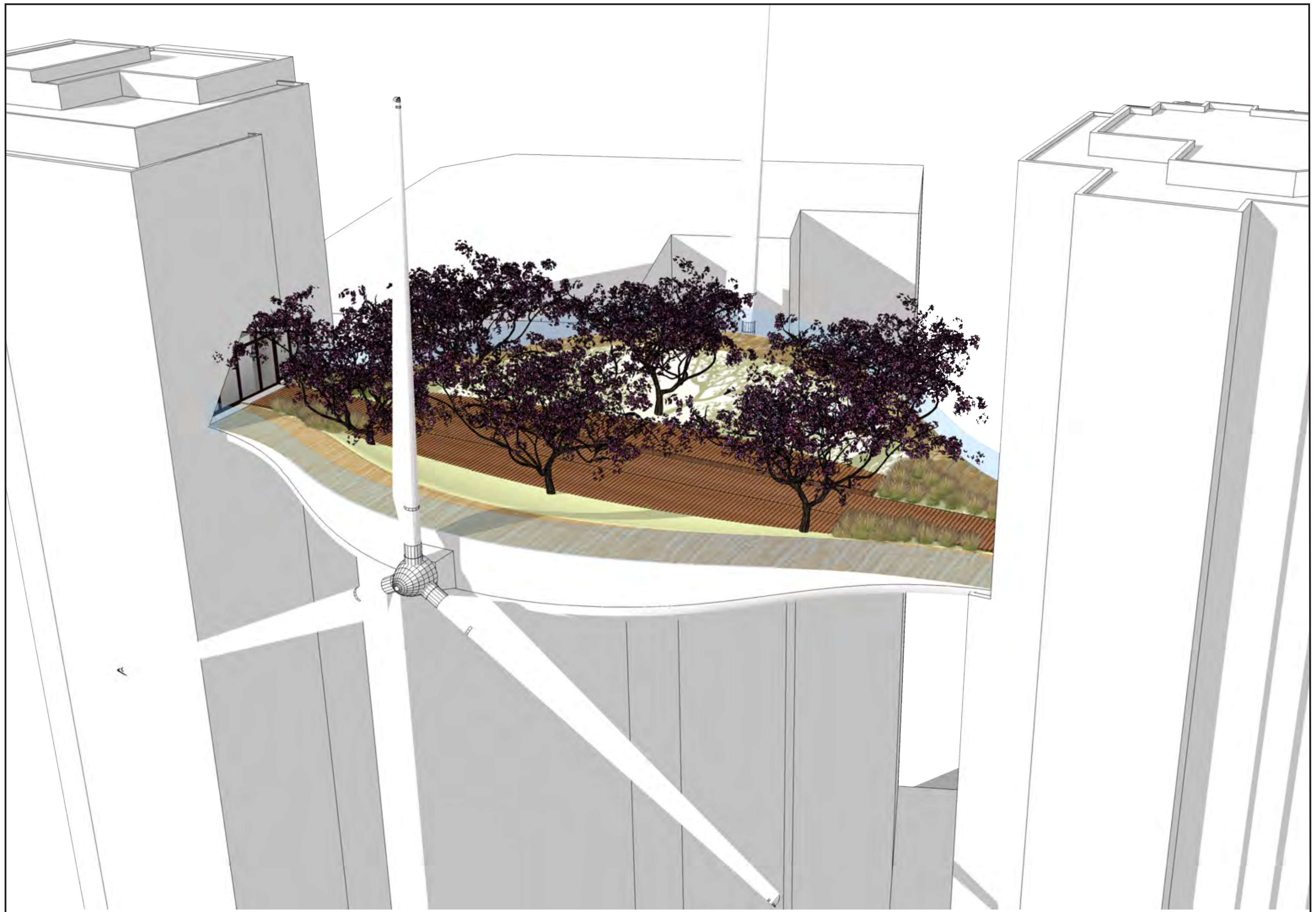
public greenway + retail + office + residential



Eco-Cell [環境を考える]

Eco-Cell [環境を考える] : TOKYO SKY BRIDGE

Eco-Cell [環境を考える] : TOKYO SKY BRIDGE



TOKYO SKY BRIDGE TYPOLOGY

Typology Description

A new urban park that creates a connective and adaptive fabric to potentially existing or new building construction. The urban park applies wind energy solutions to mitigate energy expenditures

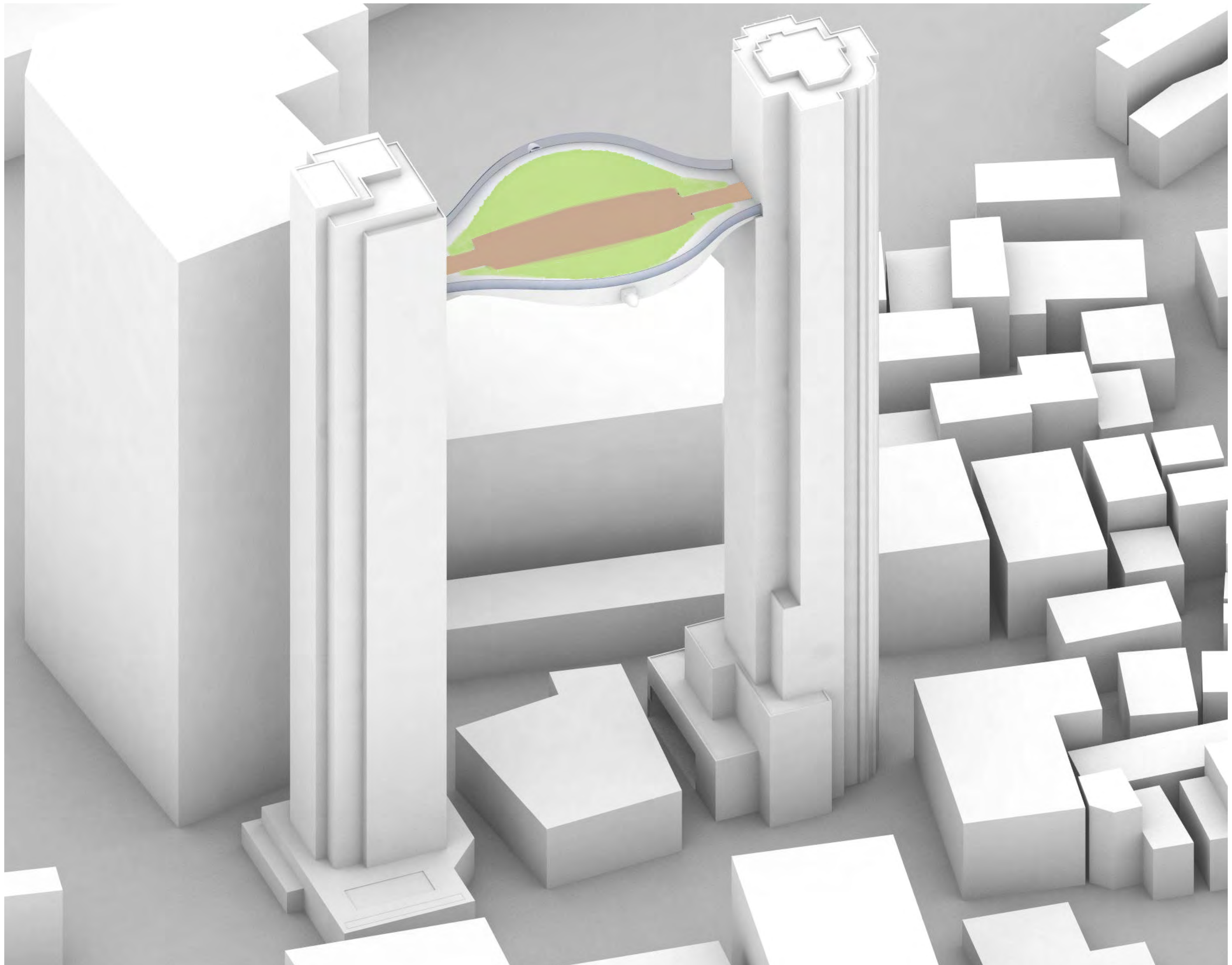
Typology Goals

[Pedestrian] [Bridge the Gap] [Adapative] [Wind Energy] [Urban Space] [Greenspace] [Integrative] [Iconic]

Performance

Wind Energy
Greenspace

Eco-Cell [環境を考える] : TOKYO SKY BRIDGE



Issue

How to create unique urban spaces that integrate technology that promotes self-reliance and can sustain a community for not only public gathering but public consumption

Strategy

Attach a wind turbine to the front of the bridge to harness the wind energy strategically placed Nprth-South

Future Goal

The goal is to provide enough wind energy to become completely self-sustaining by harnessing wind from these individual urban wind parks and also feeding off the wind farms along the Edo River and Tokyo Bay.

Eco-Cell [環境を考える] : TOKYO SKY BRIDGE

Rendering of Urban Wind Park on Tokyo Sky Bridge

Eco-Cell [環境を考える] VERTICAL FOREST

VERTICAL FOREST TYPOLOGY

3 エコロジービューハウス
ecological view house

META TYPOLOGY

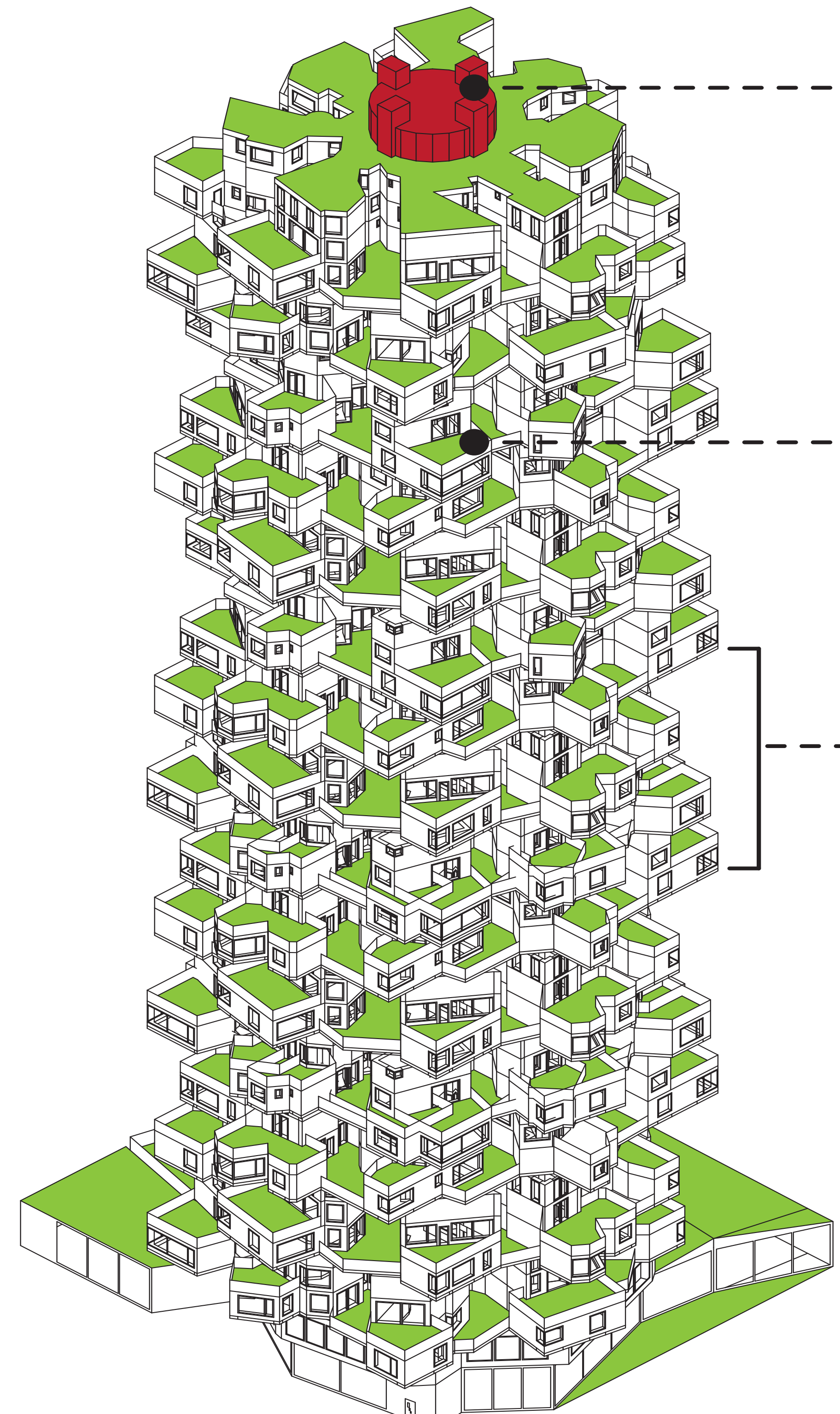
[XS]

FUNCTION: TOKYO "ECOPARTMENT"

green apartment housing that will reduce CO2 emissions and carbon footprint allowing more greenscape for a city relegated in concrete

USE:

greenscape + viewshed + residential



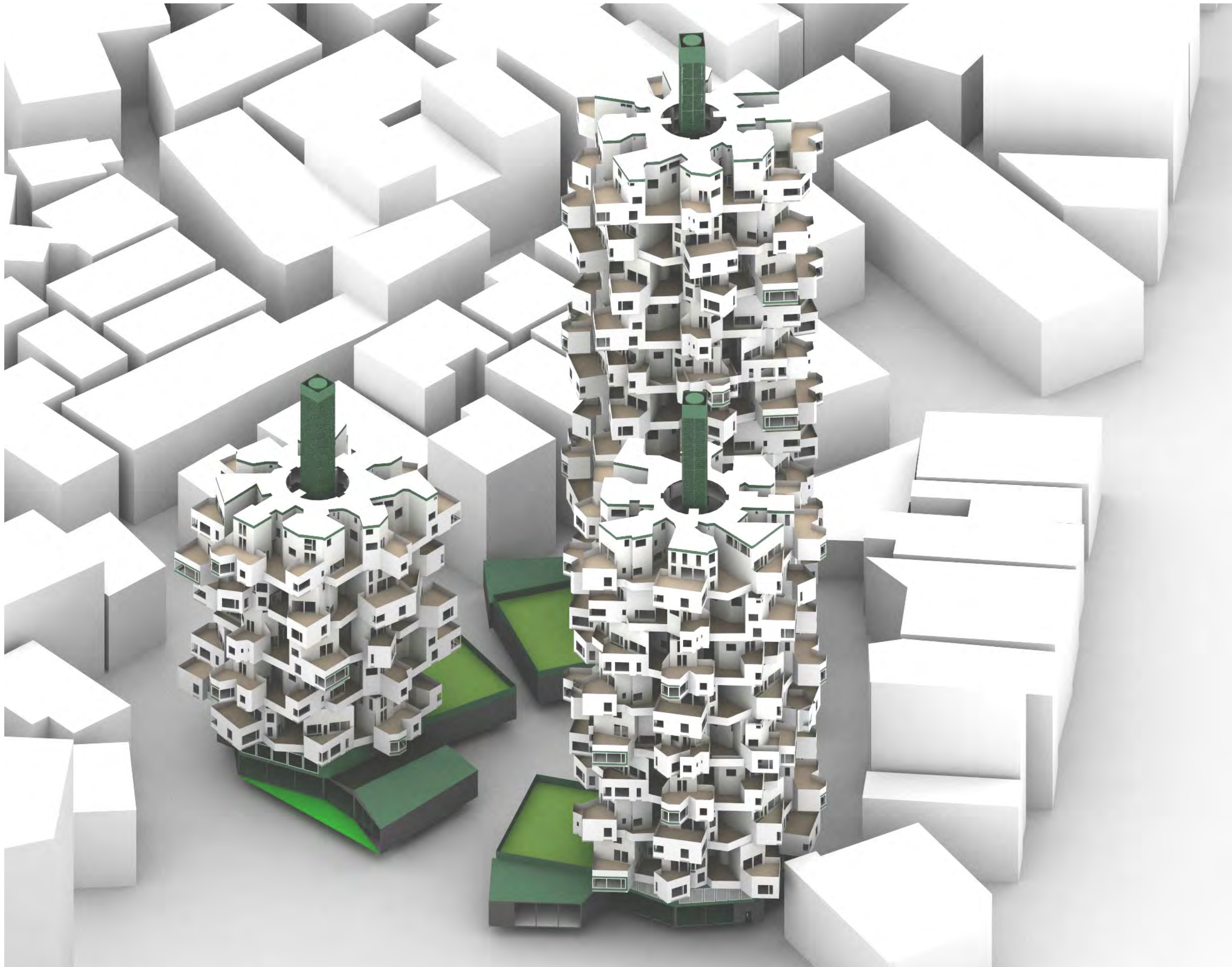
WIND TOWER TO ALLOW FOR CROSS-VENTILATION

DEDICATED PRIVATE GREENSPACE

3 FLOOR PROTO. ROTATED AND TO ALLOW FOR GREEN MAXIMIZATION

Eco-Cell [環境を考える] VERTICAL FOREST

Eco-Cell [環境を考える] VERTICAL FOREST



Typology Description

A new typology of modular apartments that reclaims a vertical distribution of greenspace. The apartment is constructed in modules of three floors and each floor is rotated 90 degrees to accomodate a private greenspace and viewshed for each resident. At the peak of the building is wind tower that provides passive cooling for the abundance of opening on the building

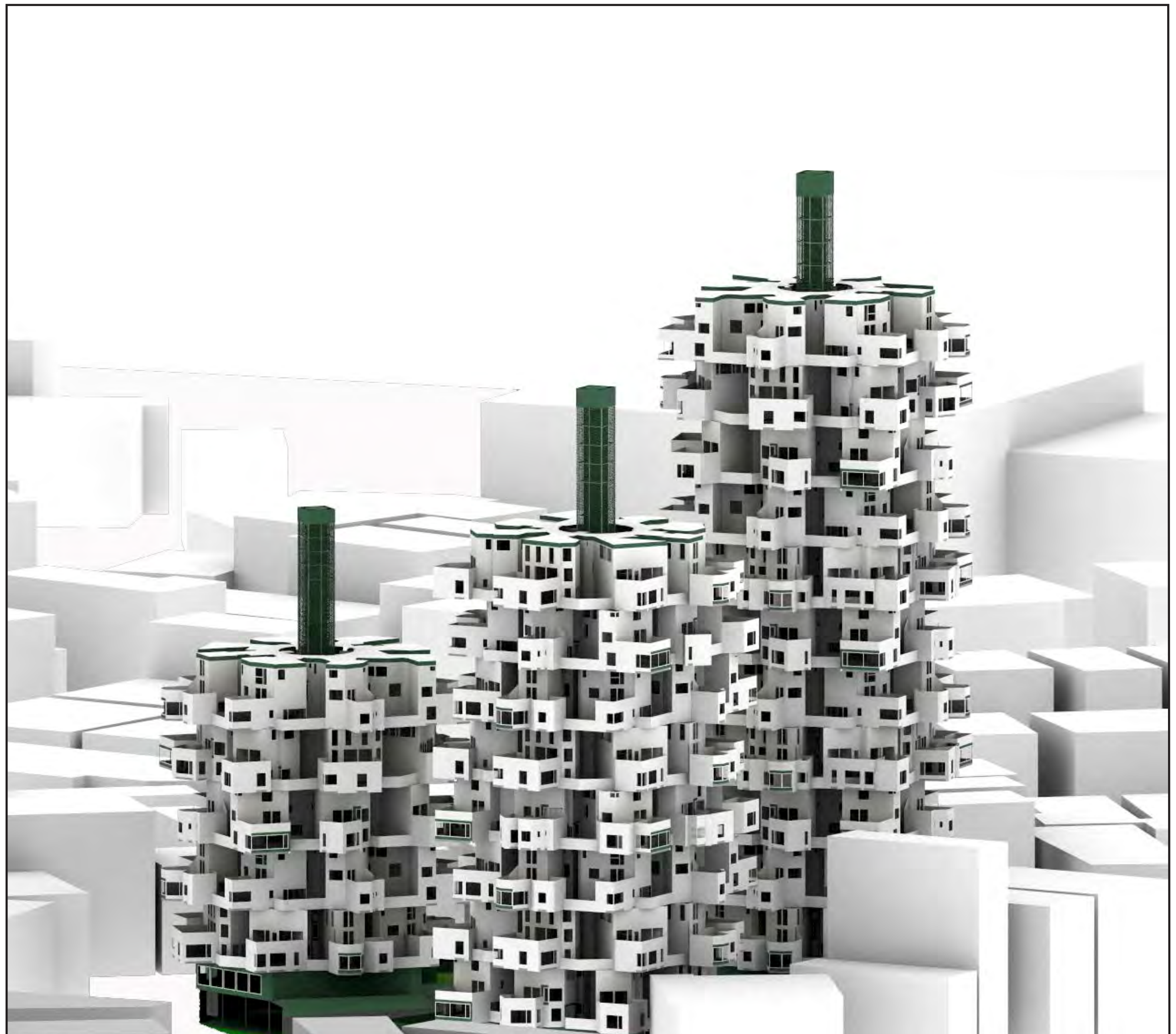
Typology Goals

[View Shed] [Greenspace] [Wind Tower] [Passive Energy [Vertical Greenspace]

Performance

Wind Energy
Greenspace

Eco-Cell [環境を考える] VERTICAL FOREST



Rendering of Varied Module Apartment

Single Apartment Prototype

Issue

How to create an abundance of greenspace in a highly densified city such as Kyojima where land is not as readliy available to create a natural horizontal greenspace area or public park. How would you also create vertical density to an area that needs additional population growth for emerging jobs and industries.

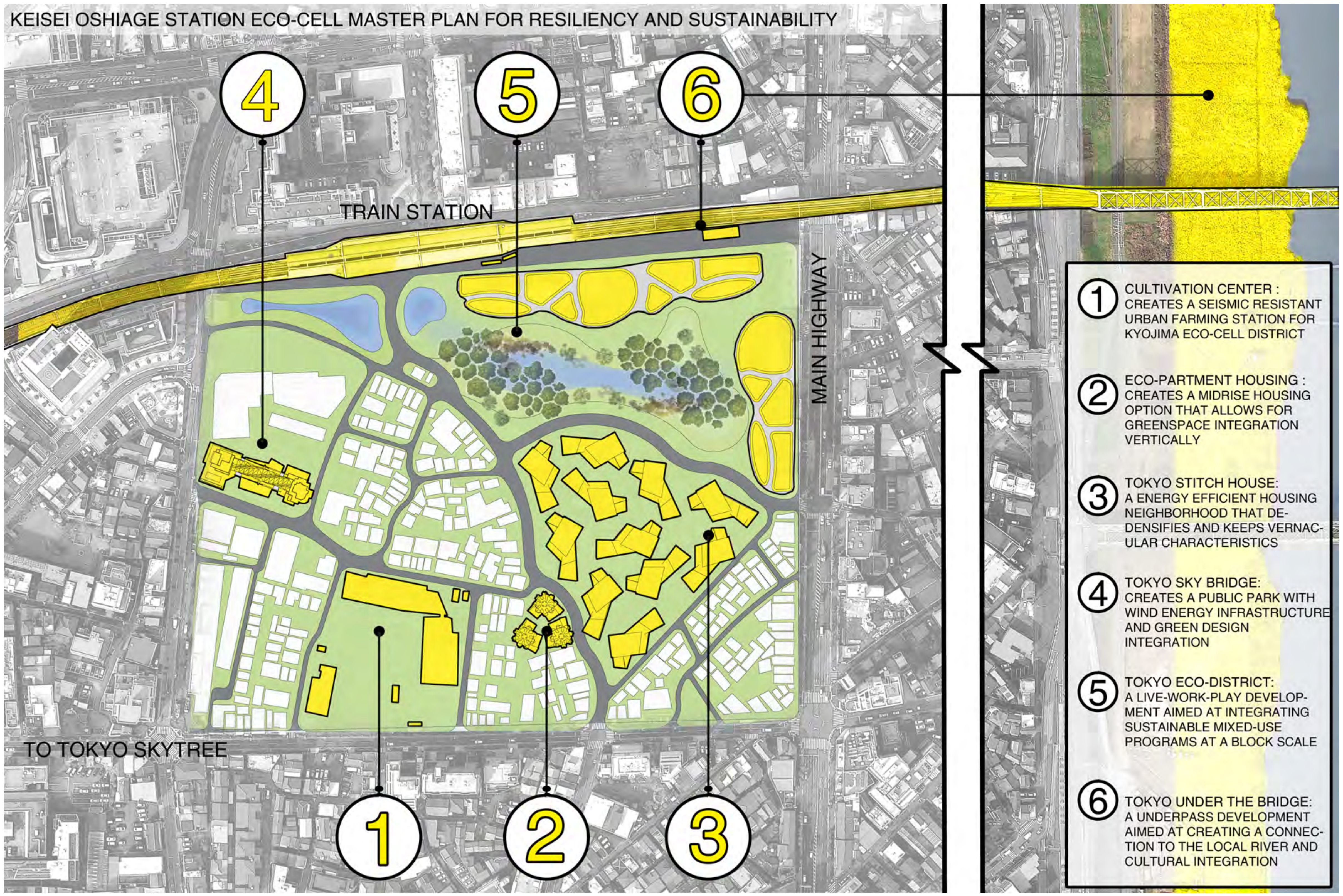
Strategy

Create a modular design for the apartment complex that maxmizes the amount of greenspace making it appealing to residents and also efficiently creating spaces.

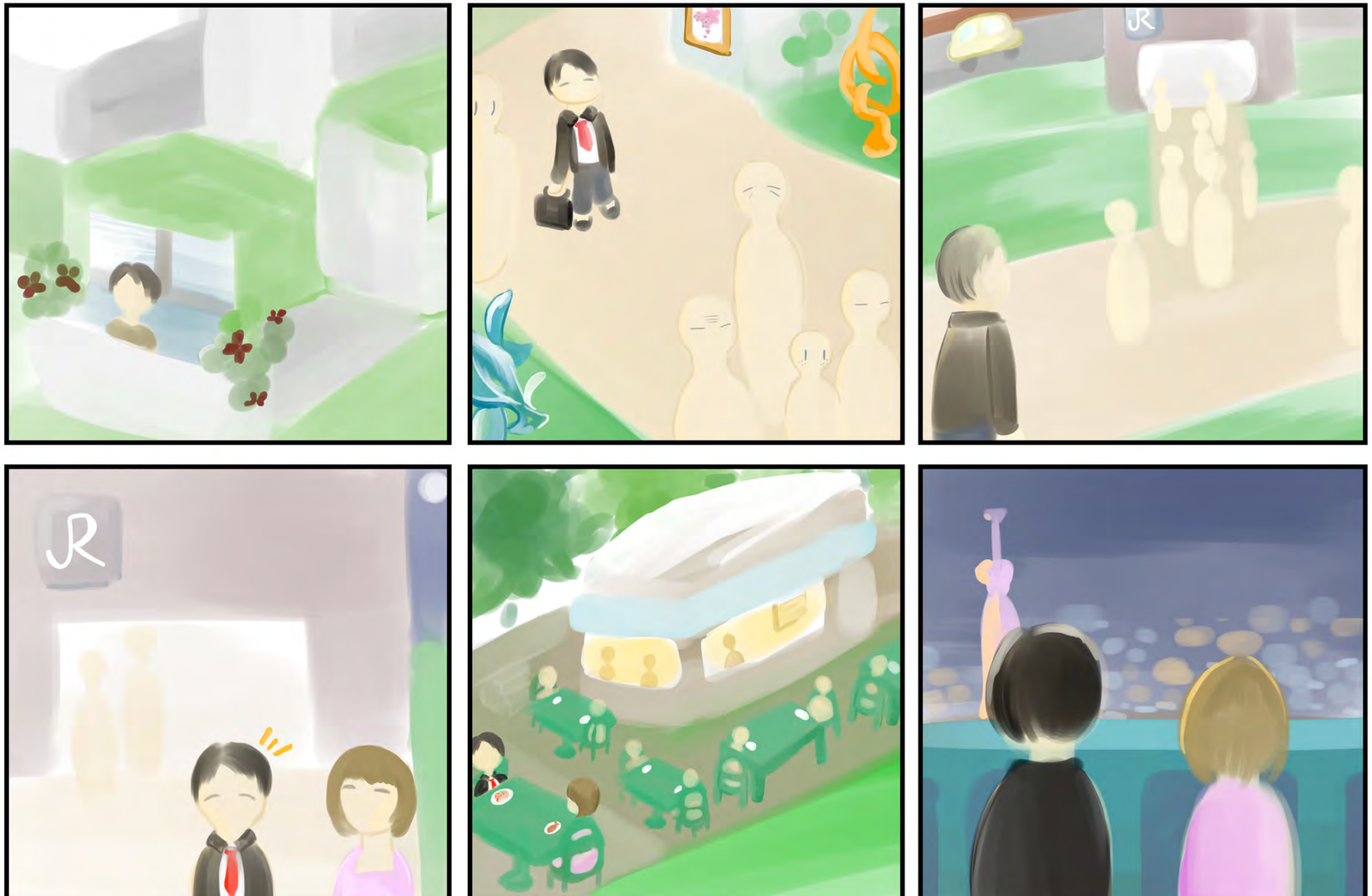
Future Goal

The goal for this typology is to increase a vertical density not only with population but with the greenspace, allowing a place for residents to live and experience Kyojima in a exciting way

Eco-Cell [環境を考える] SITE PLAN PROPOSAL



Storyboard



Cultivation Center

Ricardo GARCIA BAEZ

The Cultivation Center

What does it means to cultivate in the context of Kyojima? Cultivation centers are at the forefront of the Urban regeneration in the Sumida district. Dealing with the immediate future, this typology addresses contemporary issues of age, population and sustainability. To regenerate is to readapt and reuse, in that sense, the concept seeks to reimagine public buildings as a source for shelter in case of risk, and more important, as a place for multigenerational social interaction.

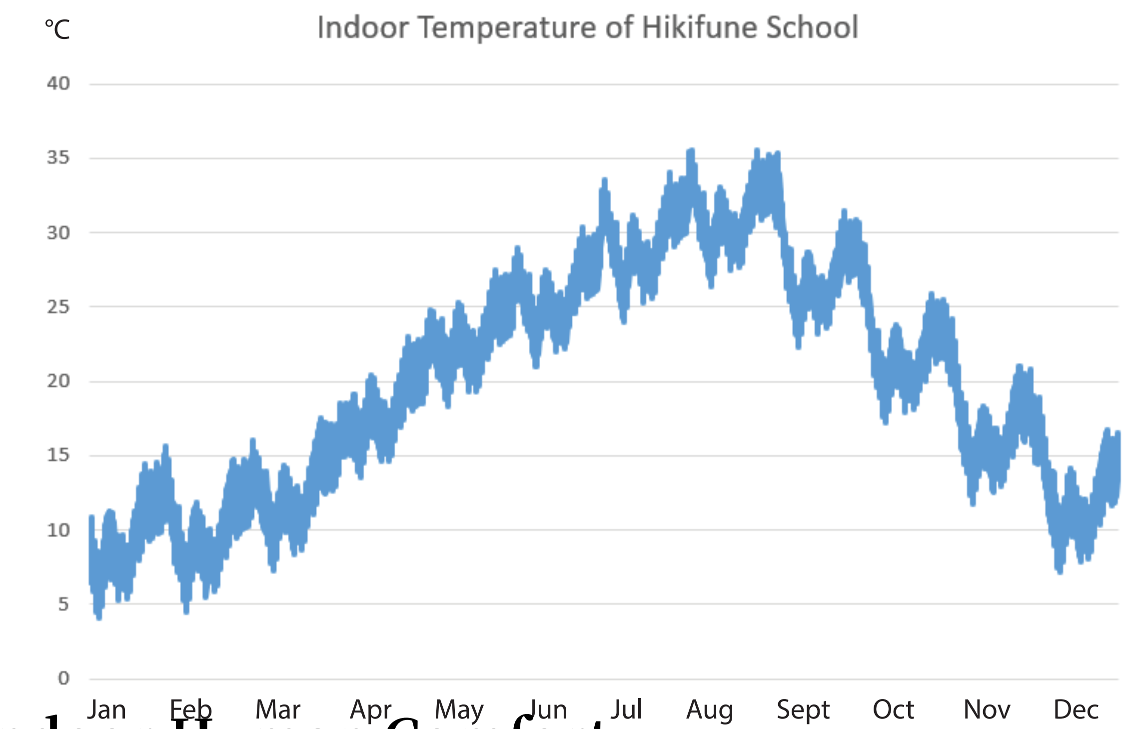
Public infrastructure needs to be reconcile with specific needs in Kyojima. The typology tries to make use of existing public buildings such as school to have a dual purpose: to match technology with learning, and in the case of a disaster, be able to be structurally sound in order to serve as a disaster shelter. As public schools become community centers, its public spaces and facades then can be improving with public funding to provide vertical and community gardens where elderly people can have a sense of purpose and be able to start changing Kyojima identity to a community that produce their own food.

Public schools can be reimagining and improved by using underutilized classrooms and readapted them into research facilities, this will ameliorate the conditions of some of the schools while younger generations learn about the lost art of farming. The facades of the public school then can be improved by inserting seismic dampers and devices to allocate plants in a vertical manner. This could be the start of a regeneration not only at an urban level but as a socio-economic generator that could bring younger generations into Sumida.

Finally, the large vision of the cultivation center is to engage the existent community and create a cultural district that could be branded as a food-oriented district, by making use of the existent products harvested in the public spaces by the Kyojima residents. These products then will be available for sell to local restaurants in order to have seasonal events that portrayed traditional signature dishes from Kyojima, thus creating a touristic attraction and a more sustainable community.

Cultivation Center
食を作る

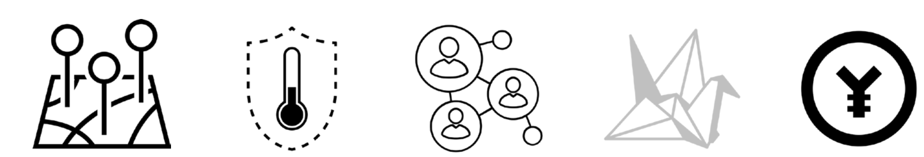
Modeling



Indoor Human Comfort

Scorecard

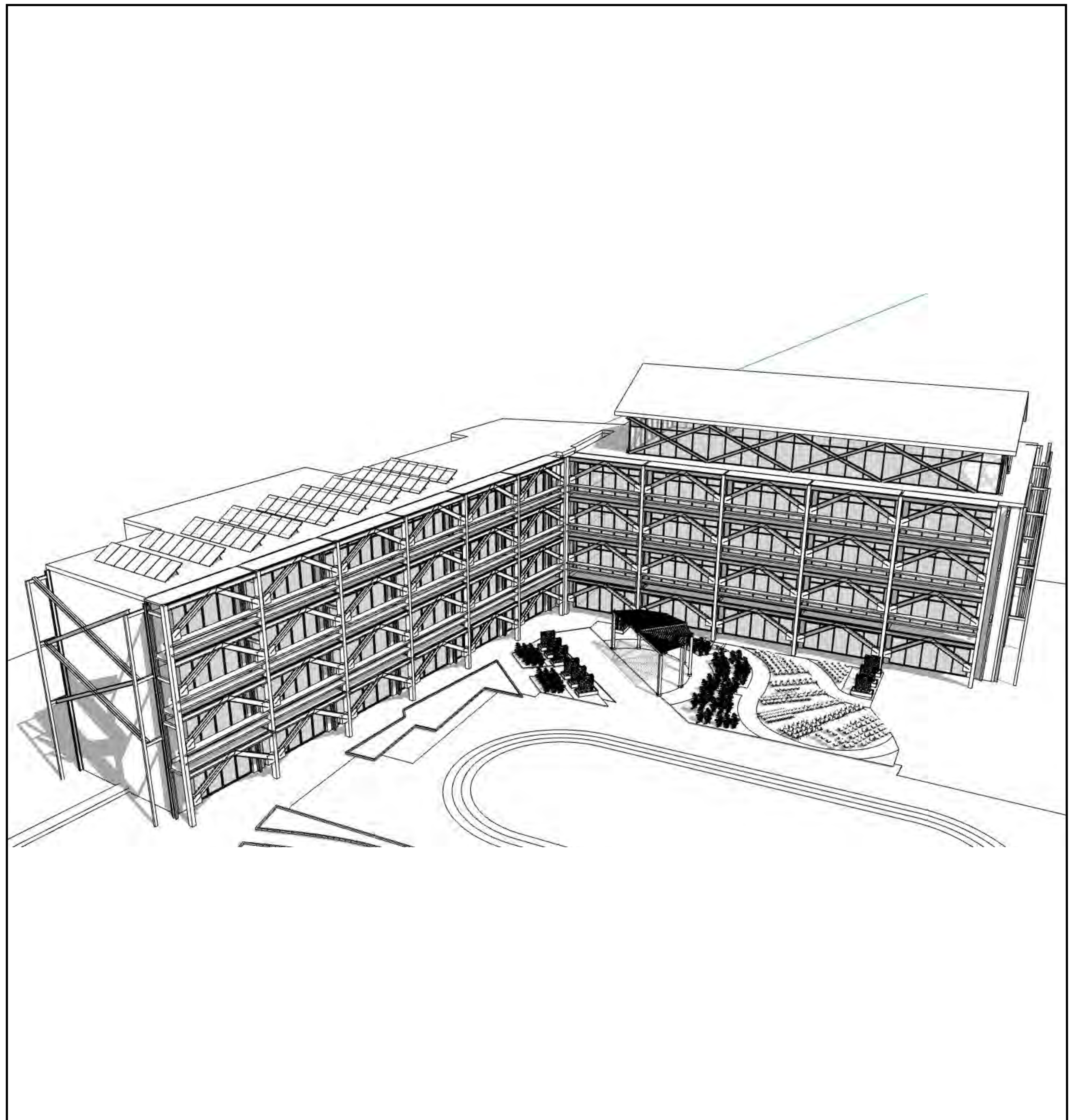
幸福



資源

強靭性

Cultivation Center 食を作る



Description

Typology Description

Cultivation centers are community urban farms around the district of Kyojima. This farms are inserted in the contextual fabric by creating, retrofitting, and adapting, underused public buildings like schools and vacant warehouses in order to create an agrifood neighborhood. This farms then give a multi-generational solution to some issues current and future residents of Kyojima have.

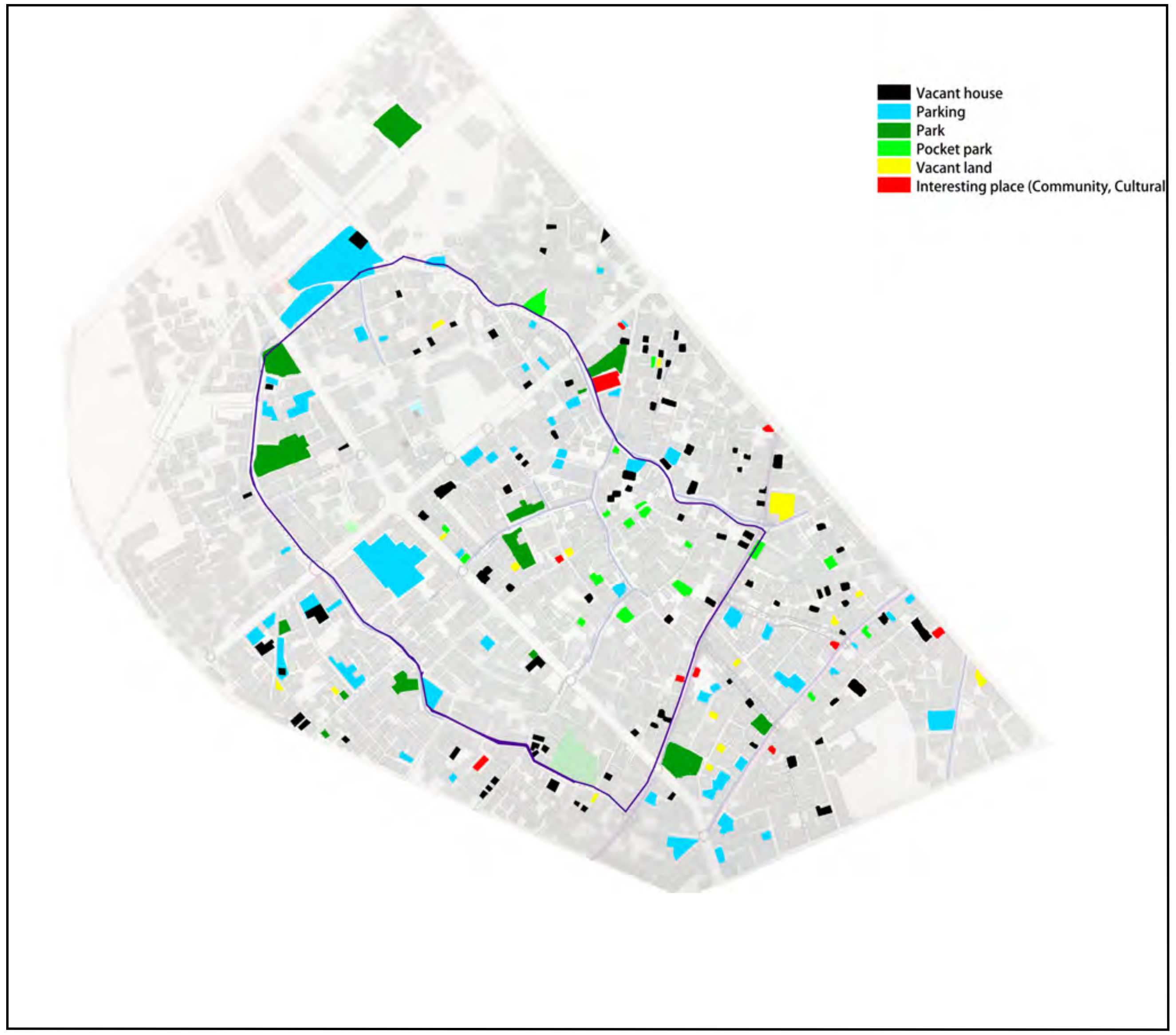
Typology Goals

+ To create a culture around Kyojima based on food profuse by the community
+ Give a sense of purpose, and inclusiveness to senior residents of Kyojima
+ Create seismic retrofit buildings in case of emergency
+ Combine Technology and tradition on a learning environment

Issues

+ Lack of interest for population of Japan in moving to Kyojima
+ Elder residents and young families
+ Vacant buildings
+ Structurally fragile buildings

Cultivation Center 食を作る

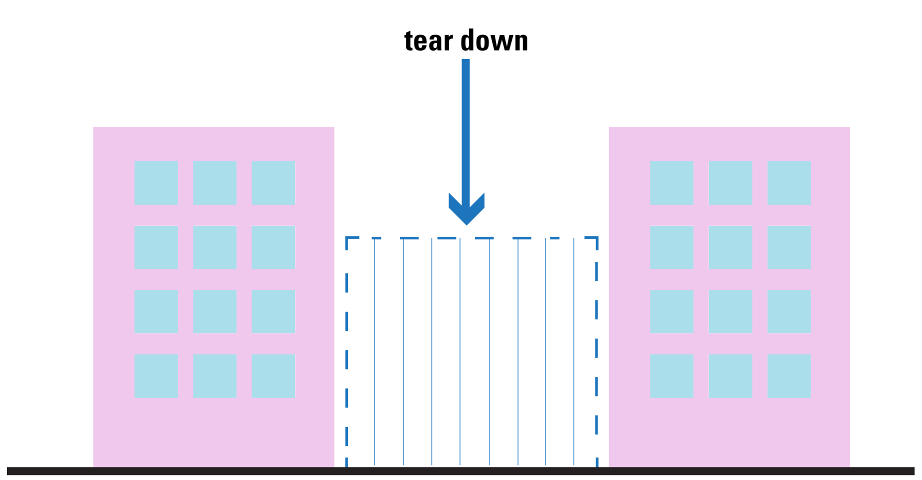


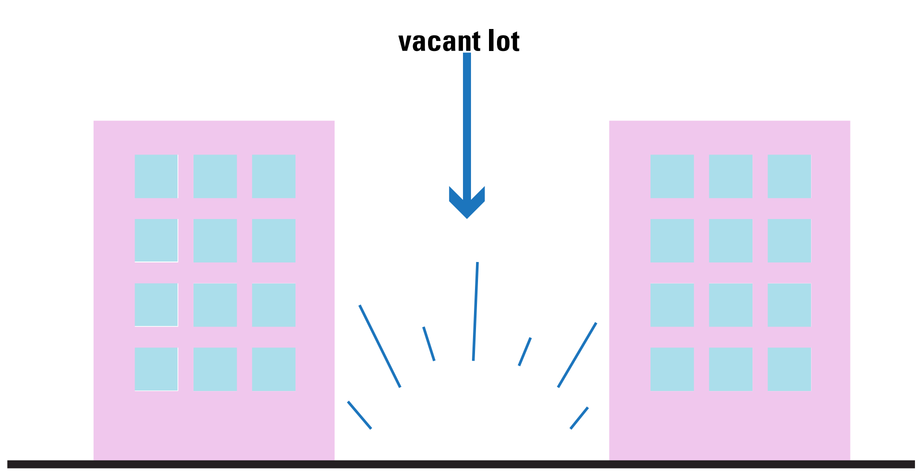
Site strategies

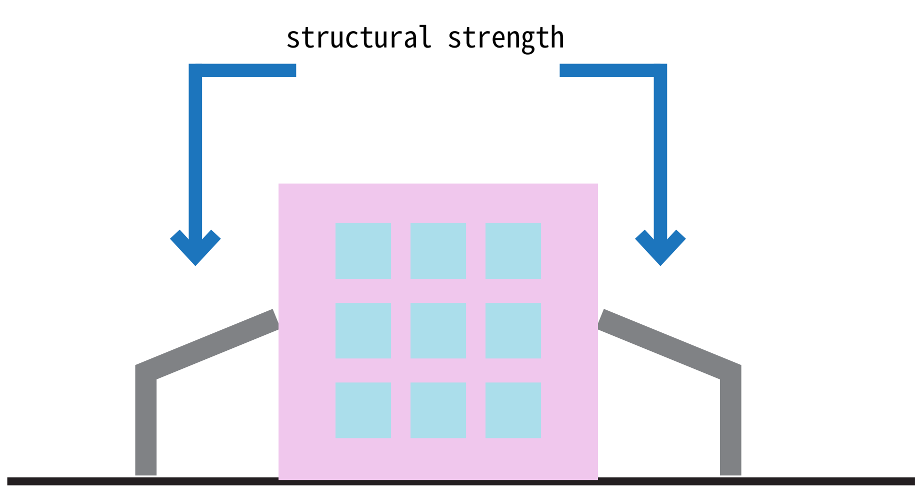
Cultivation centers are community urban farms around the district of Kyojima. This farms are inserted in the contextual fabric by creating, retrofitting, and adapting, underused public buildings like schools and vacant warehouses in order to create an agrifood neighborhood. This farms then give a multi-generational solution to some issues current and future residents of Kyojima have.

Site Implementation

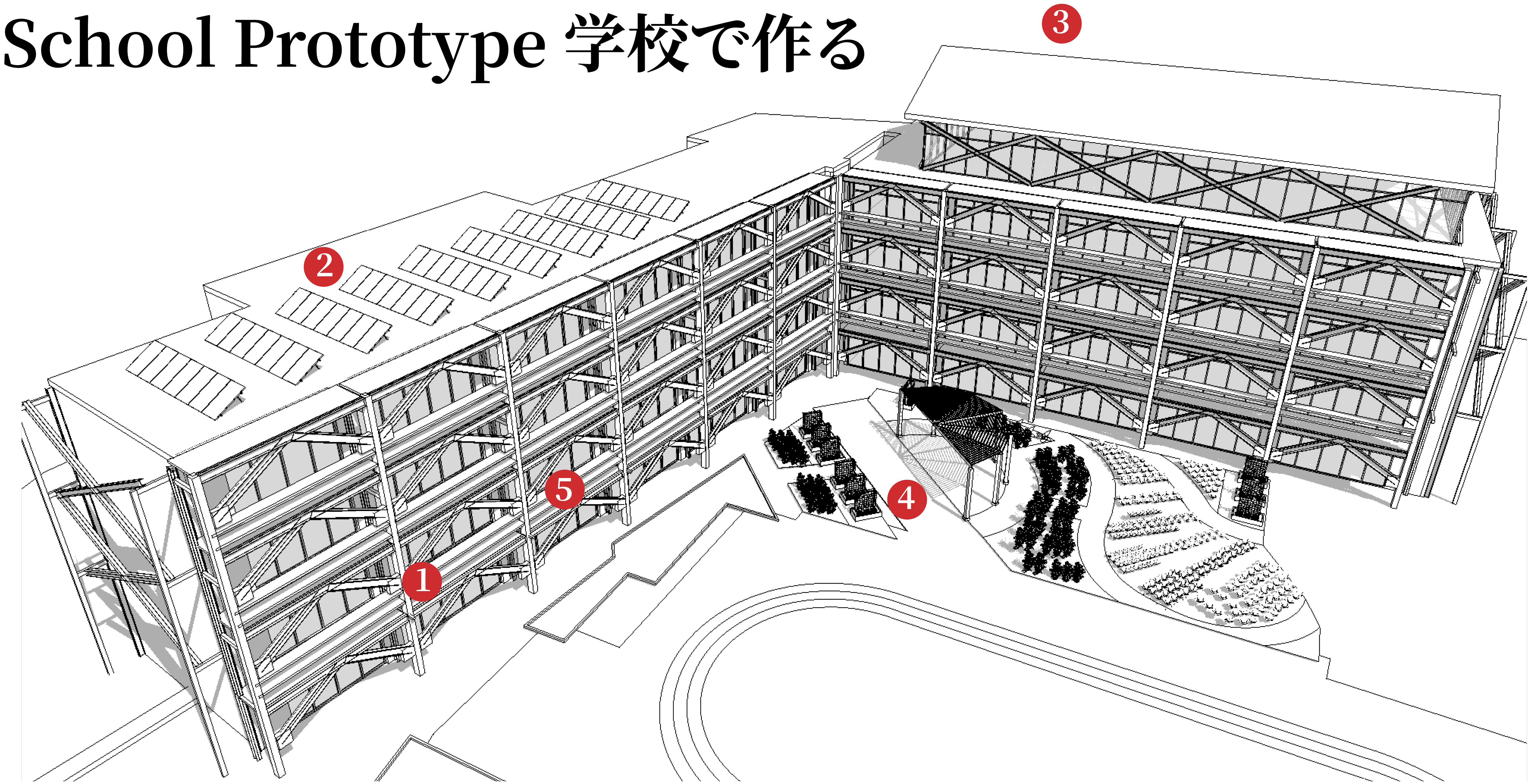
- Schools
- Warehouses
- Vacant spaces

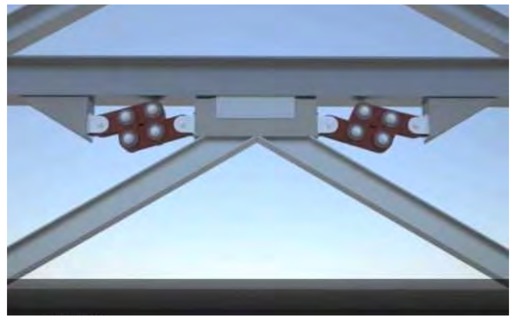






School Prototype 学校で作る





1 Seismic Braces

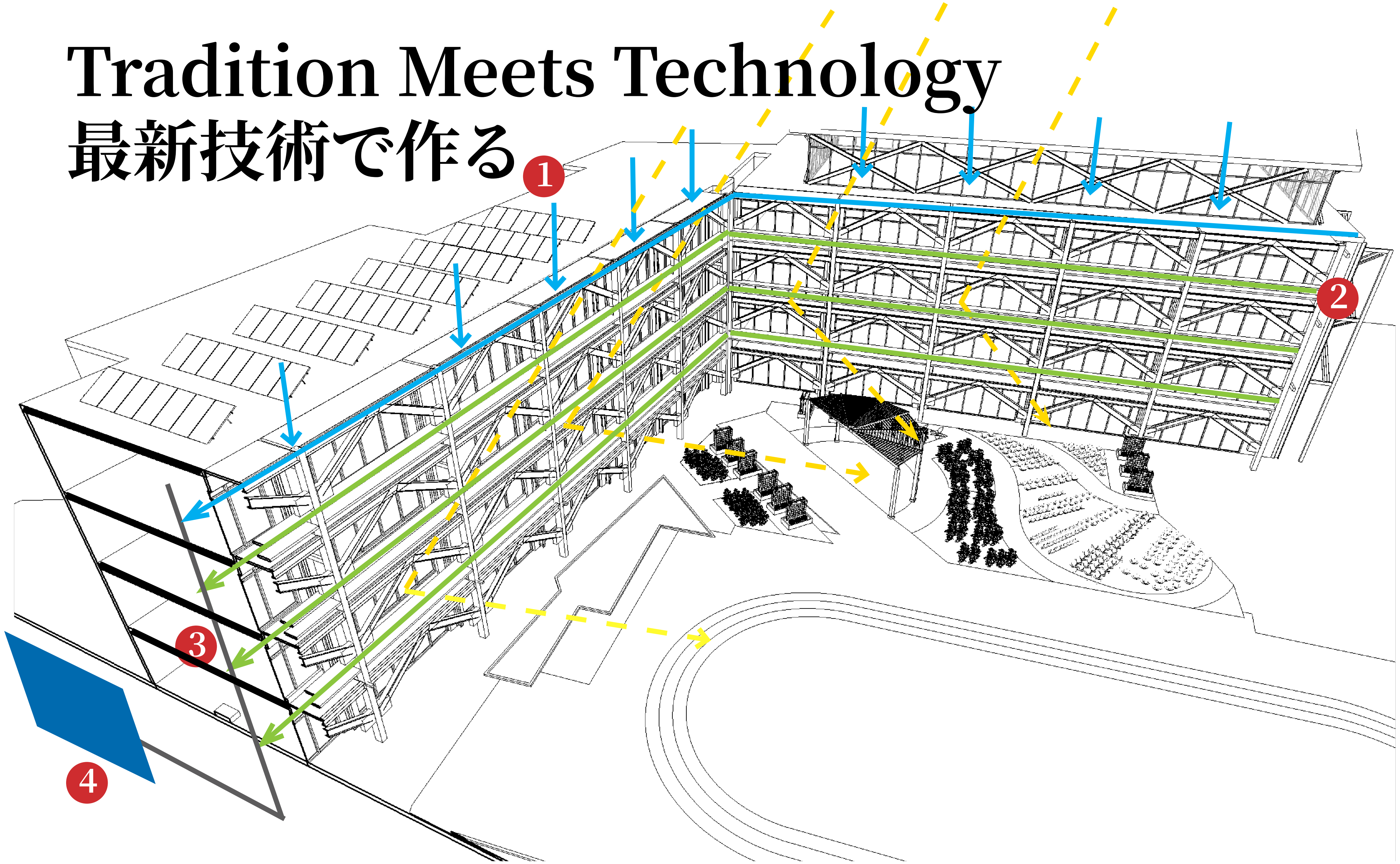
2 Solar Panels

3 Roof Garden

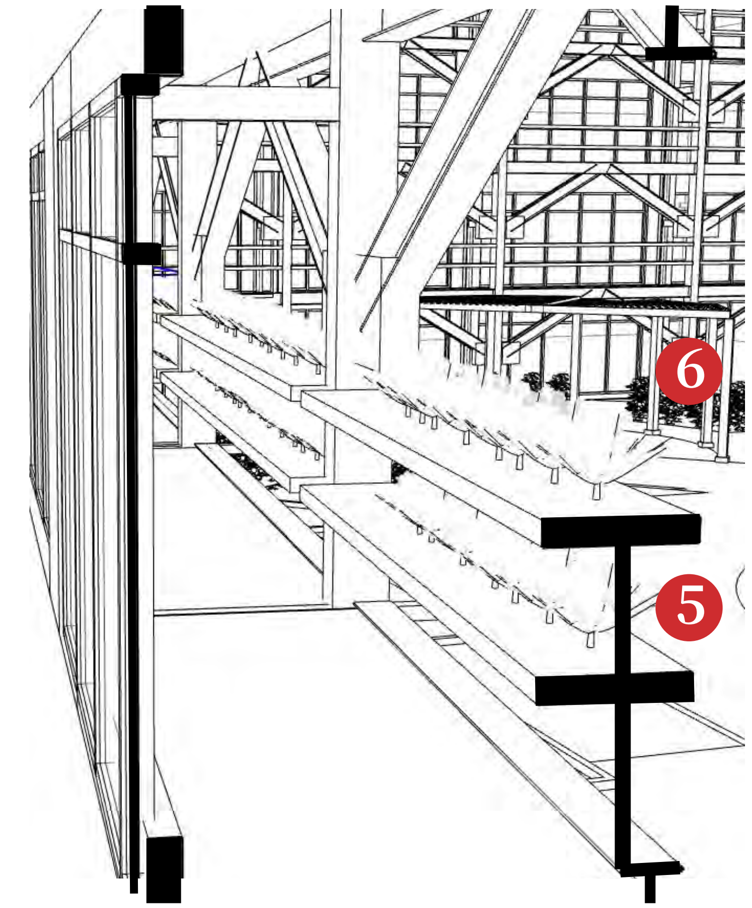
4 Community Garden

5 Vertical Garden

Tradition Meets Technology
最新技術で作る



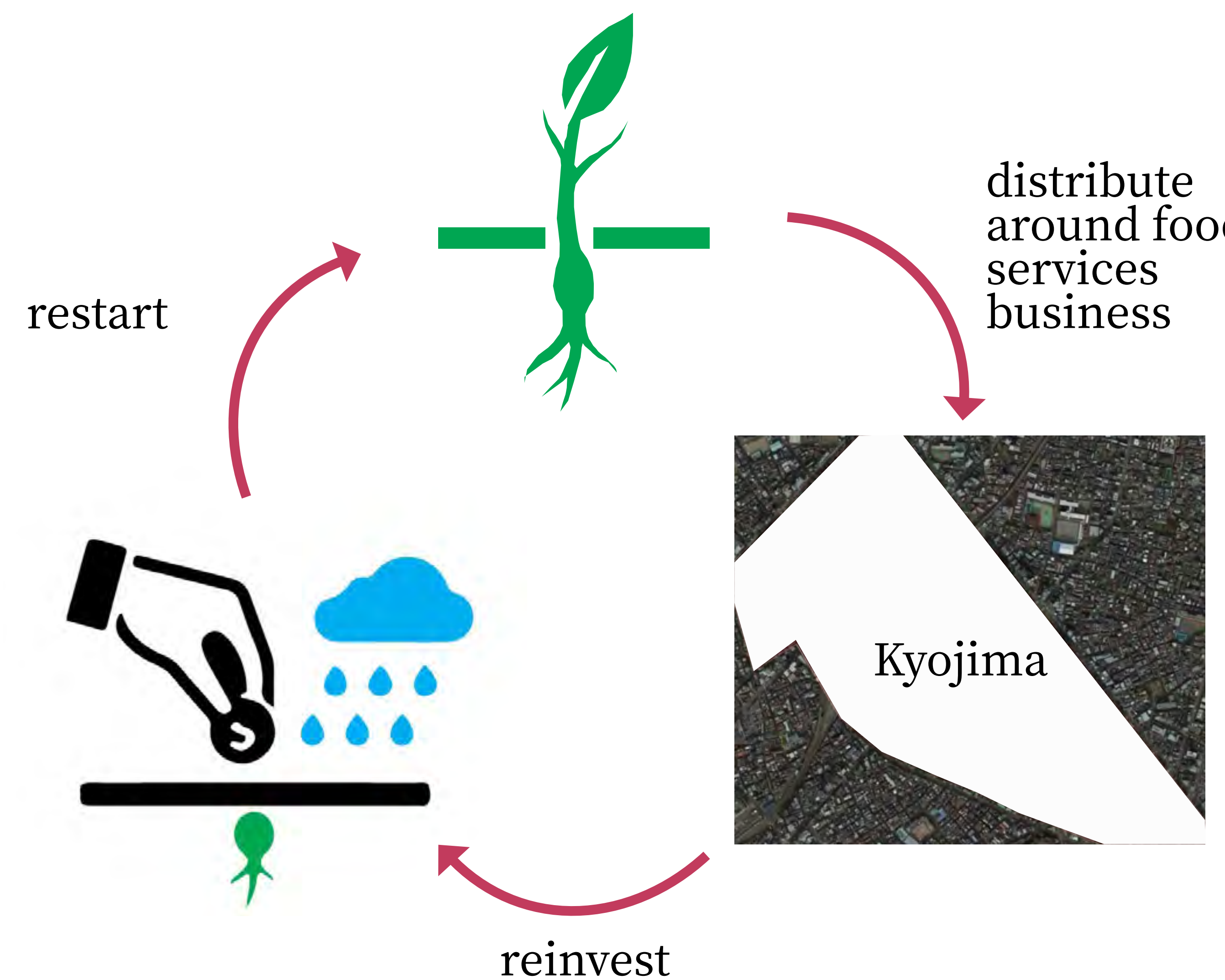
1 Rain water catchment
2 Pipe with nutrients enriched water
3 Used water
4 Used water treatment reservoir
5 Pipe with nutrient enriched water
6 Aquaponics base



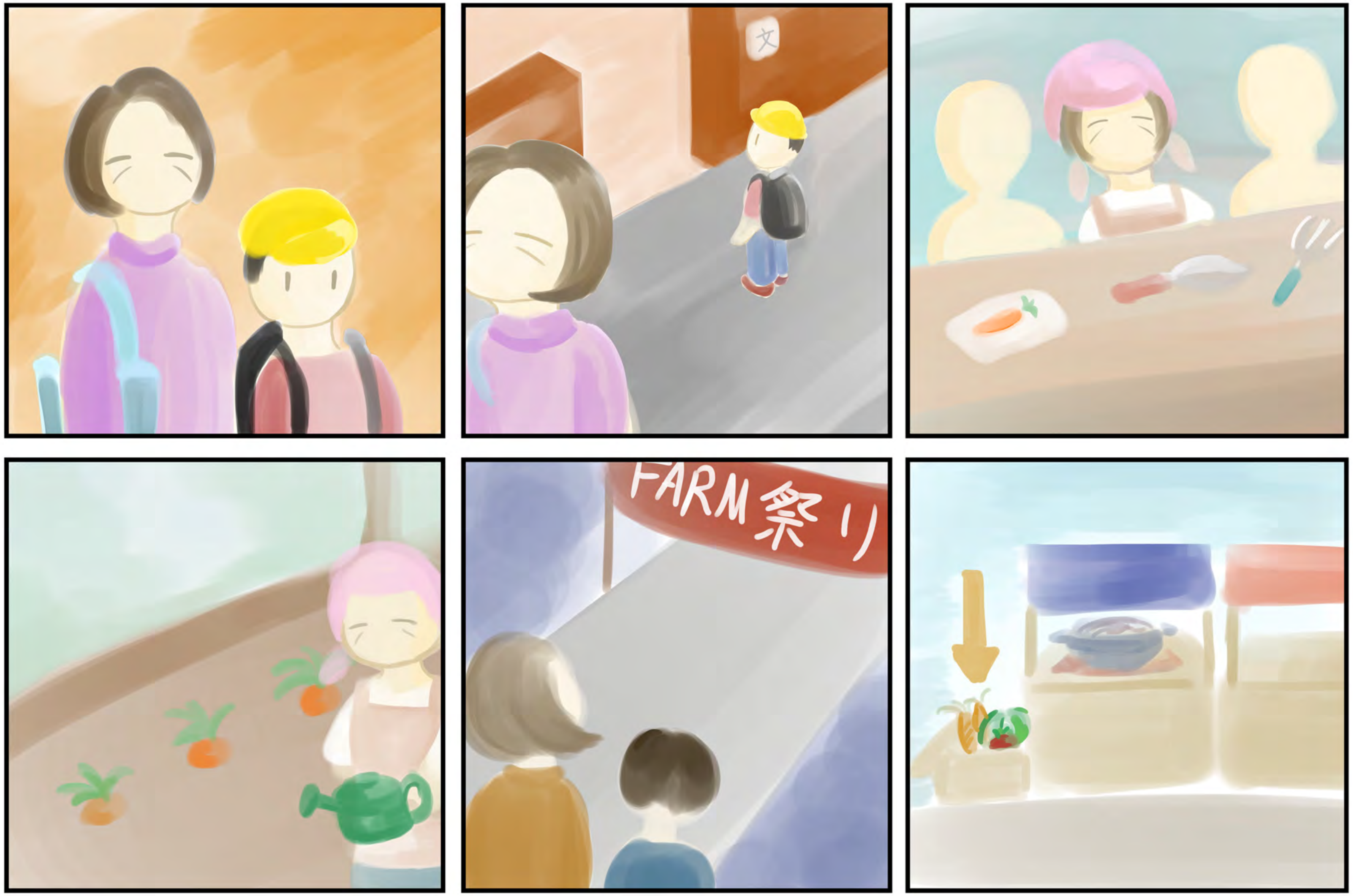
Community farming innovation on a learning environment

Conclusion

By a sensible and strategical insertion of cultivation centers around kyojima where wooden family homes, vacant buildings and unused storage could be transform into a seismic resistant buildings. Multi-generational community base can thrive on farming techniques and new farming technologies to connect tradition with innovation and serve the commercial food service sector and promote a new Kyojima based on a food festival using only ingredients produced by the community



Storyboard



Prefab Generator

Alyssa MCKAY

The Pre-fab Generator

Kyojima has the opportunity to become a thriving neighborhood by preserving the cultural past while at the same time creating a more efficient design process that will promote disaster resilience and sustainable features. Combining the concept of Sumida Modern, a blend of the old and new, and Prefabricated design as an efficient construction method, we can allow Kyojima to keep its Cultural Integrity while displaying a design method that is economically and structurally promising for the neighborhood.

The “Sumida Modern” movement has a mission to take traditional crafts, including food products, and make them useful for today’s consumers. They describe the concept as “Nostalgic, yet New.” In order to create the Prefab Generator, Japan has a policy that allows for buildings that currently house craft workshops to be rebuilt as long as they protect the crafts, customs, and traditions. Walking around Kajima, there are already young artists moving in and the Prefab Generator would be an ideal solution for them.

With Prefab design, we can help retrofit Kyojima promptly and without much interference on their daily lifestyle. Prefab has the ability to adapt with conditions and changes over time, be built under a safe and local manufacturing business, have a short construction process, and be efficient for emergency and severe conditions. The current conventional construction process can be lengthy and, with the aging demographics, be difficult to start without the proper number of workers. Prefab design allows the fabrication be made off-site where it can be transported via trucks straight to the site with little interference on neighborhood for most modular design can be completed within 2 months. Prefab design has the ability to blend and merge with different facades depending on the conditions of different neighborhoods which leads into the slow start of retrofitting and allowing owners to slowly adjust to the revitalization of Kyojima.

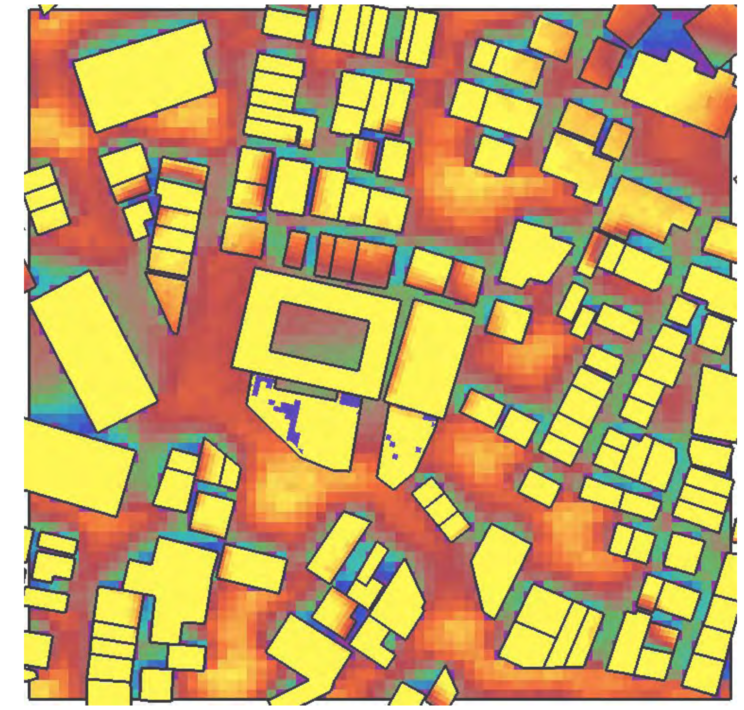
By uniting Sumida Modern and Prefab design, retrofitting facades of buildings can allow the people of Kyojima to stay comfortable with the old features from the Edo period but allowing a smarter design process that can help ventilate air and decrease energy costs. On streets that are currently being widened, the opportunity for current homeowners to keep the integrity of Old Kyojima may allow a quicker widening process. Currently, the government supports the retrofit of existing houses for they acknowledge the lack of need for new build. They are offering more incentives and hope to double the amount of sales of second use by 2020.

Using vacant lots in Kyojima, particularly starting around Kirakira Street allows small public gardens alongside private houses. Thus creating a delicate balance between public and private.

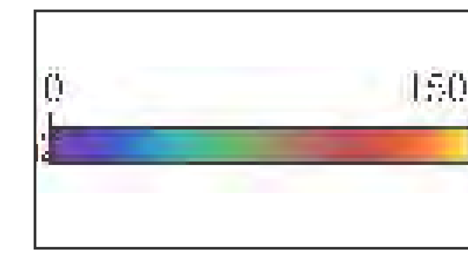
The typology ‘Prefab Generator’ will then create a Cultural Arts Center that can have different prefab layouts based on 5-10’ modules that will allow different artists to live within the Center as well as work, display, promote, and sell their work. This center will bridge the generation gap between the young and old by demonstrating cultural workshops as well as allowing the younger generation to have their own co-working space to help develop their skills. This will help stimulate Sumida Modern and bring economic growth within Sumida. The Cultural Centers will be placed among the Connector Route to ensure circulation throughout the ward. The Cultural Center would create a stronger connection with the road by pulling people off the streets and help promote secondary streets that are not traveled as much. The ground and second floor would become a public space including coworking space, workshops, café, shops, and a Generator Space in the center that allows public shows. The top floors are private and intended to offer Affordable Housing to those who choose to work within the Center. The building has a central open core that allows cool air to circulate within and hot air to rise out of the center. The different housing modules have the opportunity to adapt to who is living within them for separate units can be combined to create a larger space. Aside from these virtues, prefab spaces can now boast levels of energy efficiency that conventional structures are hard-pressed to match. More coordination and precision during the building process means insulation can be integrated into components and sub-structures rather than added on site. Other energy features such as solar panels and a permeable ground also add efficiency and can be better integrated into the overall design. Some of the houses featured actually produce more electricity than the occupants use and return it to the grid, thus earning the owner a small monthly income.

By uniting Sumida Modern and Prefab Design, the opportunity to unite the old and new becomes apparent. Respecting the culture and integrity of how Kyojima has grown keeps the Old Tokyo feel, but with Prefab design it allows the buildings to be more net positive and disaster resilient. The residents can know that their history will be preserved and passed on, but have a Ward that will attract new residents with their upgraded construction process that promotes consistent quality, less risk, and economical benefits.

Modeling

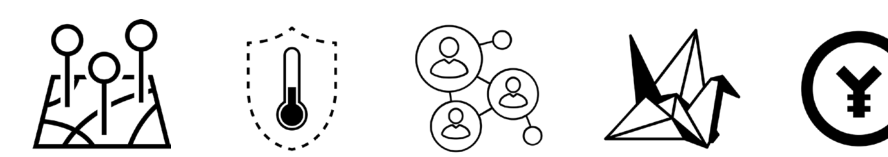


Solar Radiation
radiation/year/m2



Scorecard

幸福



資源

強靭性

Prefab Generator
プレファブで創る

Prefab Generator

Perspective Views - SW & SE

Typology Description

The goal of 'Prefab Generator' is to create a community that will help reconstruct the social fabric from the bottom up. As a parts to whole design style, Kyojima will start small in changes by beginning to retrofit the facades of areas that previously boosted large crowds, such as Kira Kira street, using prefab modules to help enliven the atmosphere through architecture. Using 5'x10' modular panels, it will decrease cost and construction time, and help to promote Net Positive designs. Prefab modules have the ability to keep the cultural look of the past but in a safer design build. Eventually, a Cultural Center will be developed to help further stimulate the concept 'Sumida Modern.' This center will bridge the generation gap by hosting demonstrations unique to Kyojima, as well as bringing in new artists' styles.

Typology Goals

[Energy Efficeincy] [Community Development] [Human Comfort] [Social Harmony] [Sustainable Design] [Economic Prosperity] [Cultural Fortitude]

Modeling Performed

Building Energy Use
Ventilation
Solar Energy

Cultural Arts

Sumida Modern

Intangible Cultural Property *mukei bunkazai* 無形文化財

Cultural Property: Drama, music, applied art, and other intangible cultural products that are of a significant historical or artistic value to Japan

Folk Property: Manners and customs, related to food, clothing, and housing, to occupations, to religious faiths, and to annual festivals... which are indispensable to the understanding of changes in the mode of life of Japan

Japanese Policy

Law for the Protection of Cultural Properties (1950)

Provides national designation of ICP and funding for disaster preparedness measures

Global Policy

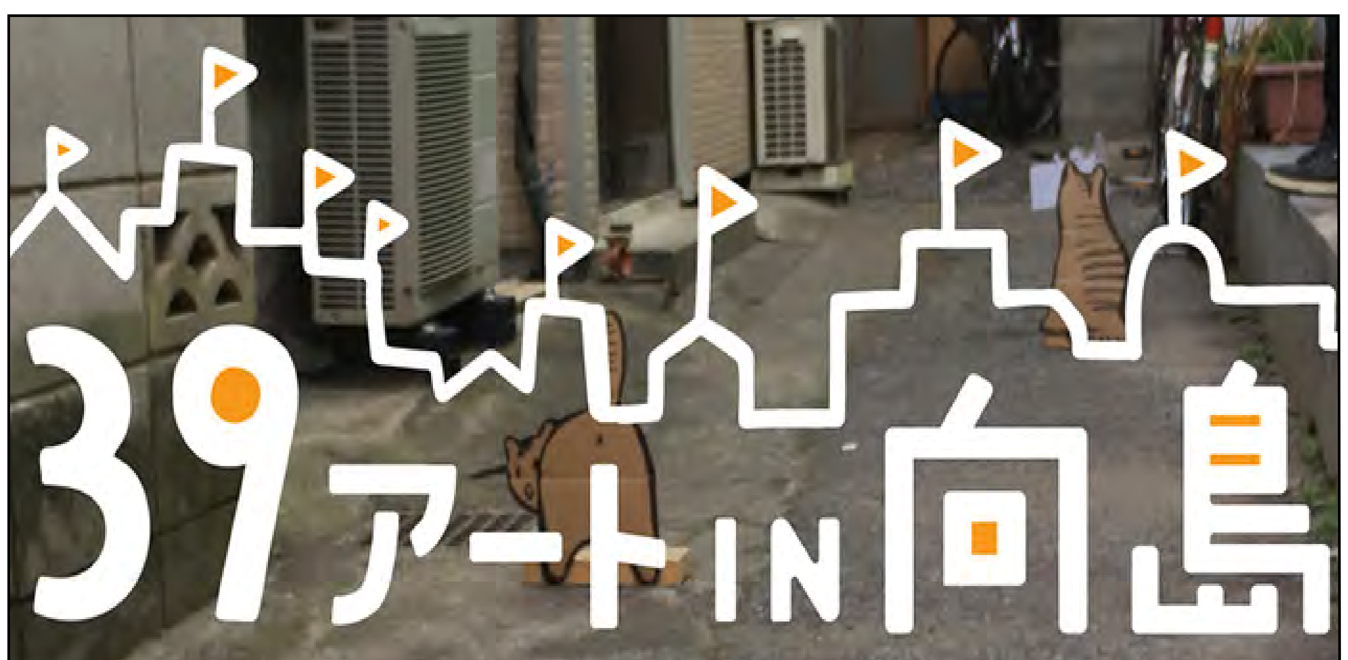
Japanese Funds-in-Trust (1969)

Voluntary investment of $260 million

UNESCO- Convention for the Safeguarding of the Intangible Cultural Heritage (2003)

Allows protection of crafts, customs, and traditions while allowing redevelopment and improved disaster preparedness
Sumida Modern opportunities: textiles, ceramics, glass, metalworking, etc

Supporting Policy

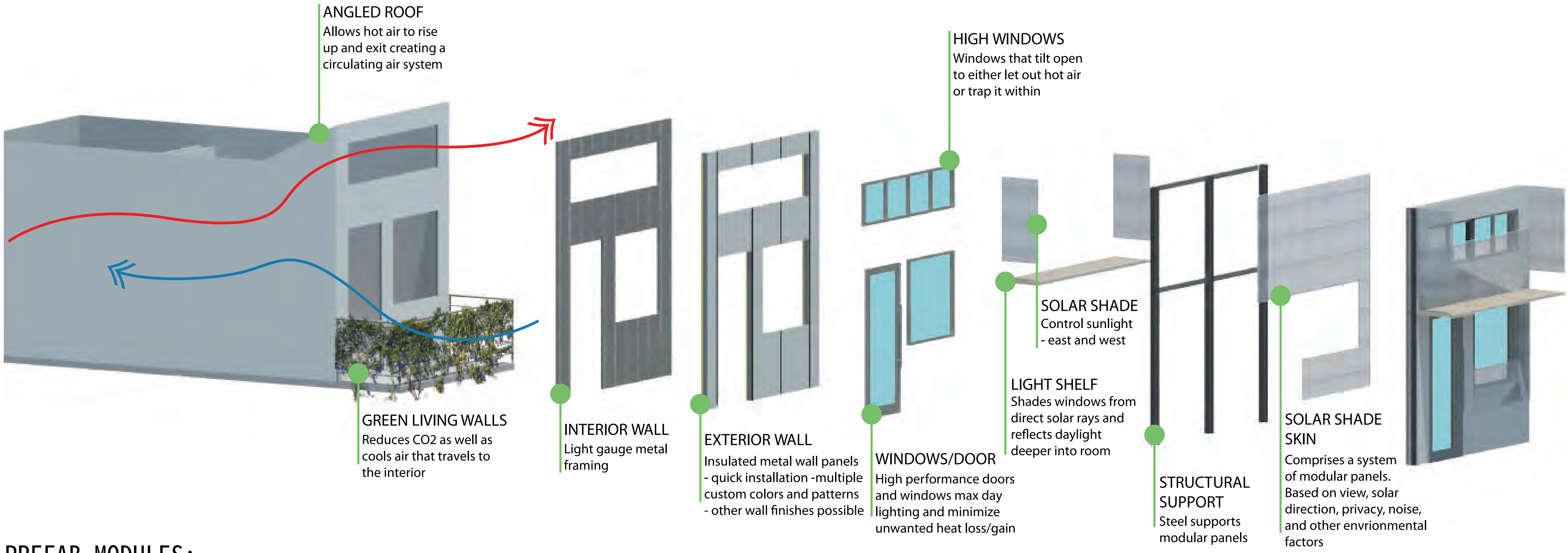


Current Cultural Arts Projects - 39 Art in Mukojima

Opportunity to revitalize Kyojima

PreFab Facade

1. ABILITY TO ADAPT WITH CONDITIONS AND CHANGE OVER TIME
2. SIMPLE SHAPE AND SYSTEM CAN BE EASILY ORGANIZED
3. PARTS PRODUCED UNDER SAFE LOCAL MANUFACTURING BUSINESS
4. THE CONSTRUCTION SCHEDULE CAN BE SHORT AND ECONOMICAL
5. IT IS EFFICIENT FOR EMERGENCY AND SEVERE CONDITIONS



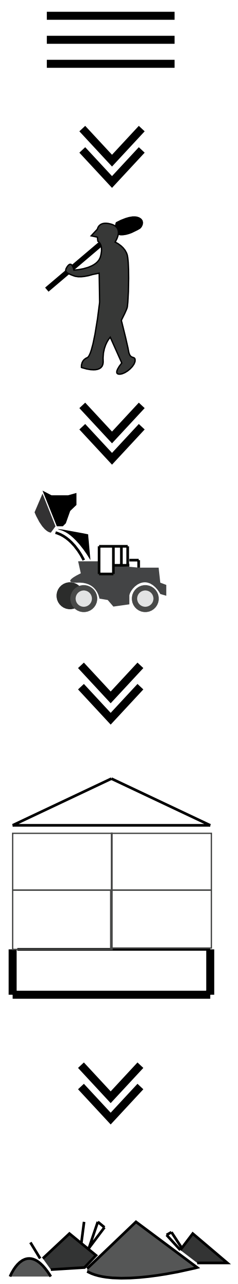
PREFAB MODULES:

1 EXTERIOR FABRIC
2 GARDEN PLANTER
3 VERTICAL GREEN WALL
4 PERFORATED IMP
5 TIMBER HYBRID
6 LIGHT SHELF
7 FIBER GLASS METAL
8 HORIZONTAL LOUVERS
9 CORRUGATED PERFORATED METAL

Prefab Process

Existing:

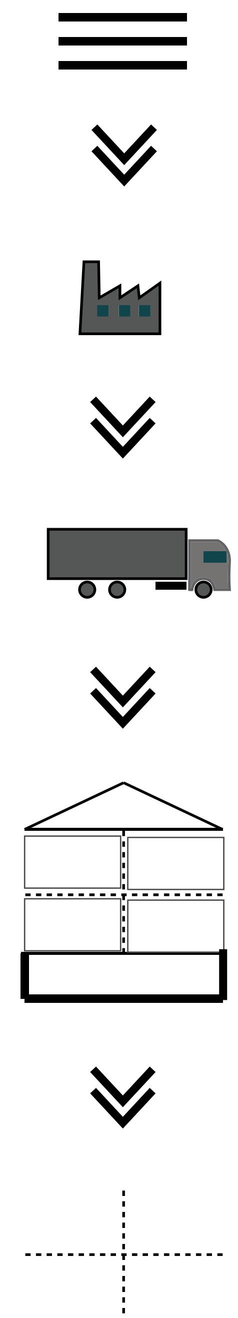
1. MATERIALS
2. TRANSPORT OF WORKERS TO SITE
3. ON-SITE CONSTRUCTION
4. FORM MODULE BUILDING
5. SCRAPS AND WASTE LEFTOVER



ON-SITE CONSTRUCTION (CONVENTIONAL)

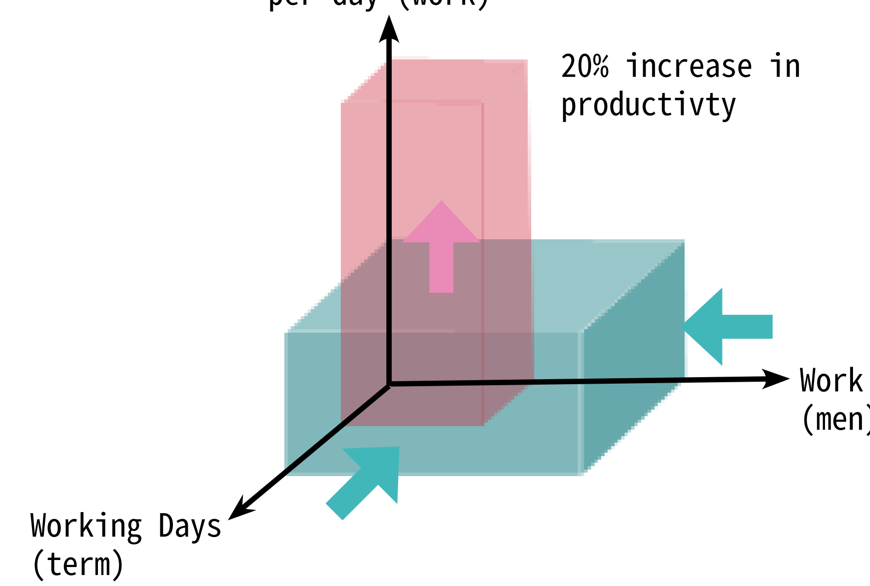
Proposed:

1. MATERIALS
2. FABRICATION IN FACTORY
3. TRANSPORT OF MODULES
4. TEMP. WALLS FOR STRUCTURAL INTEGRITY
5. LEFTOVER MATERIALS



MODULAR CONSTRUCTION (PREFAB)

iConstruction:



i-Construction will make it possible to implement the same amount of work using fewer people over fewer working days.

Reduction in number of working days (increase in time off)

New Modular designs cost, on average, 10-35% less than Conventional construction

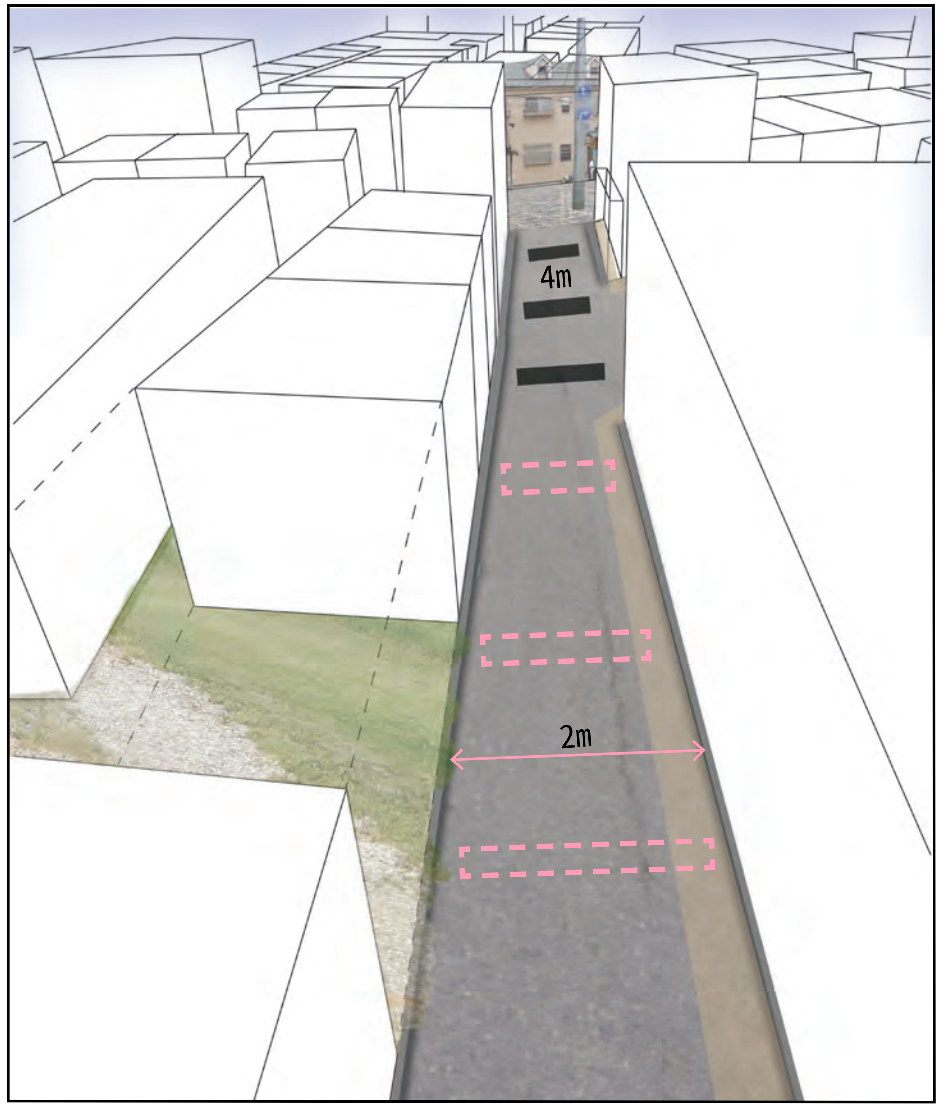
New Modular construction time takes 4 weeks - 3 months compared to a Conventional construction time of 3+ months

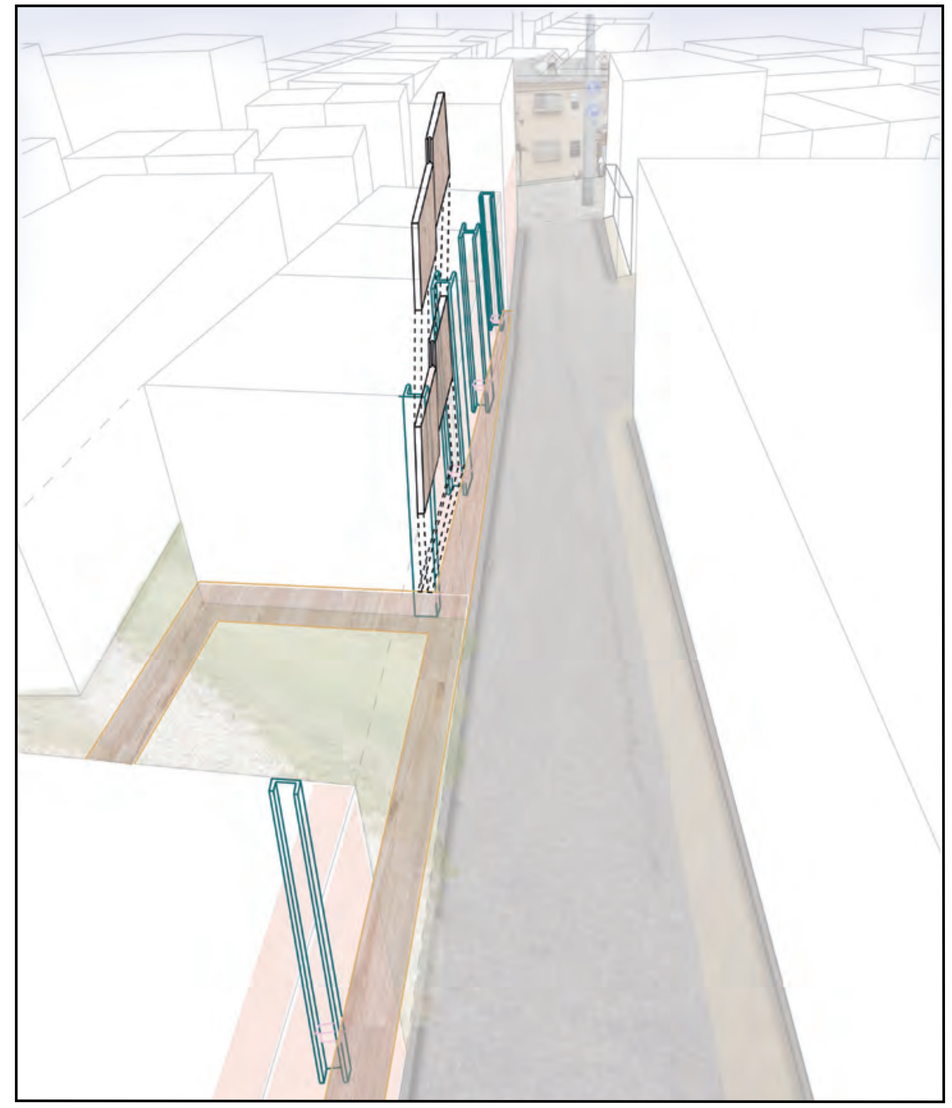
Prefab Transport

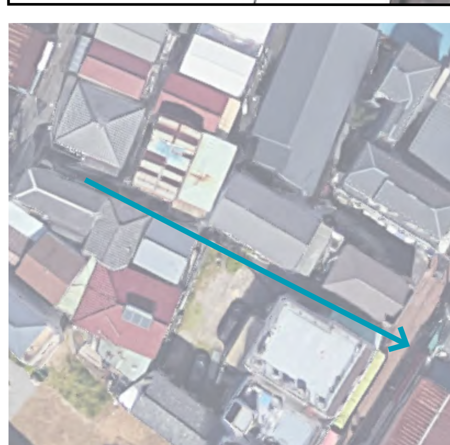
Facade Renovation - Kyojima

http://www.mlit.go.jp/en/statistics/white-paper-mlit-index.html

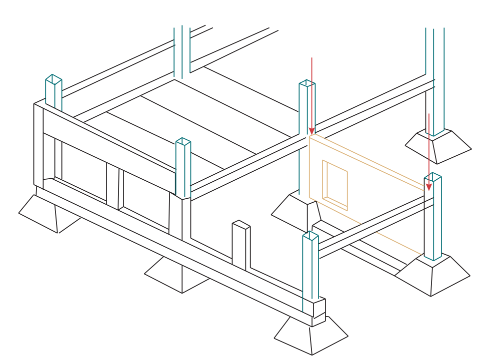
Revitalizing Kyojima

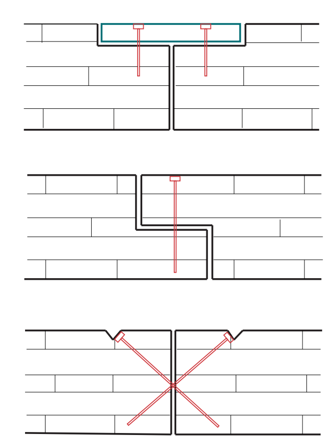




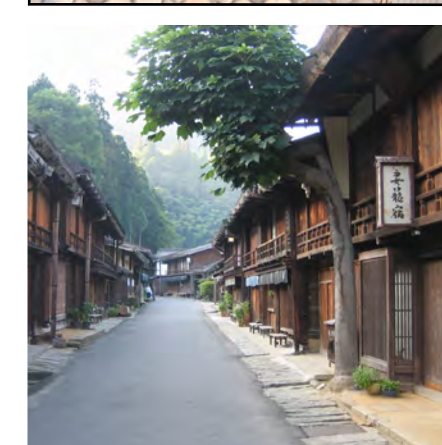


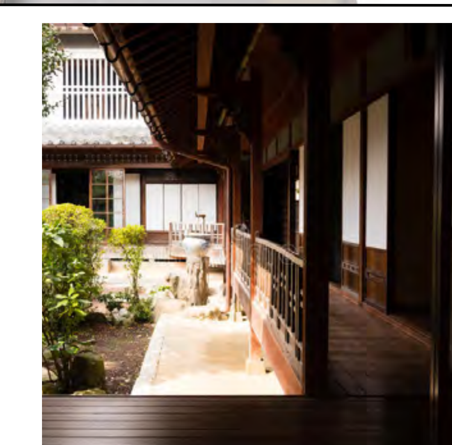
Current Conditions





Remove and Reconstruct





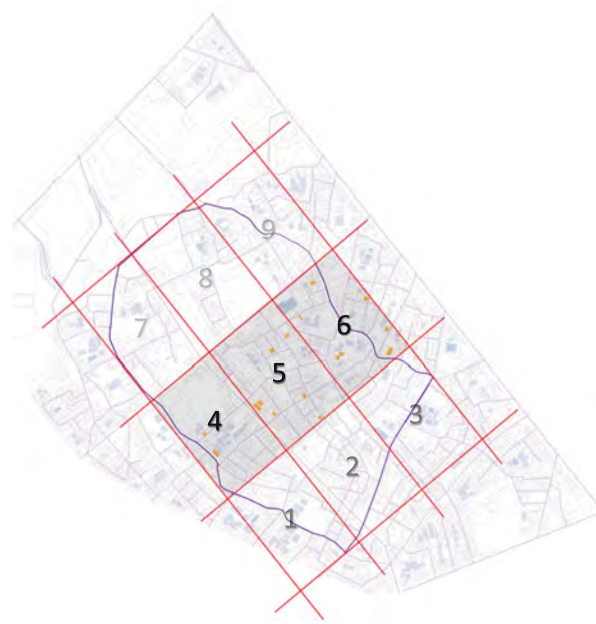
Revitalization of Edo Period - Public Spaces

Revitalizing Kyojima

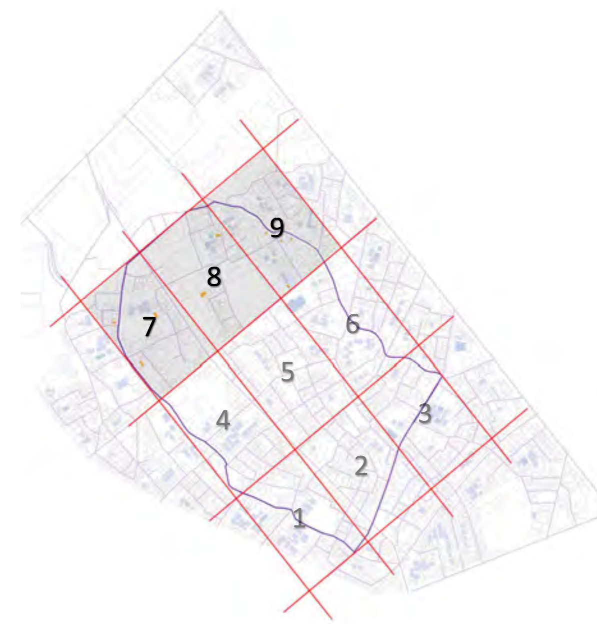

Revitalized Back Street

Design-Build Narrative

Stage 1 - Vacant Housing



Stage 1 - Vacant Housing



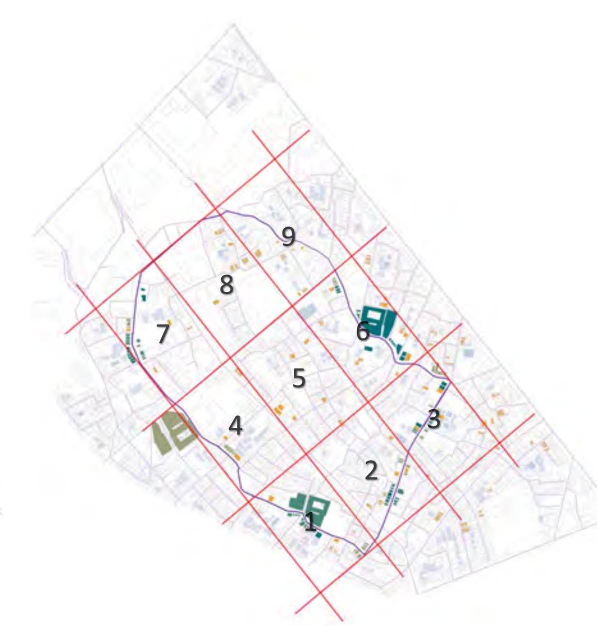
Stage 1 - Vacant Housing

Stage 2/3 - Aging Buildings
& Cultural Ctr.

Stage 2/3 - Aging Buildings
& Cultural Ctr.

Stage 2/3 - Aging Buildings
& Cultural Ctr.

Stage 4 - Expand Retrofits



Stage 4 - Expand Retrofits

Process:

1. Vacant Housing

a. Section 1-2-3
6-12 Months
b. Section 4-5-6
6-12 Months
c. Section 7-8-9
6-12 Months

Total Time: 3 years

2. Retrofit Aging Homes

a. Start retrofitting owners homes who desire to have rebuilt facades
b. Buildings that have Cultural Arts Shops will be supported by the Intangible Cultural Property Policy.
Total Time - 3 Years

3. Begin Build of Cultural Centers

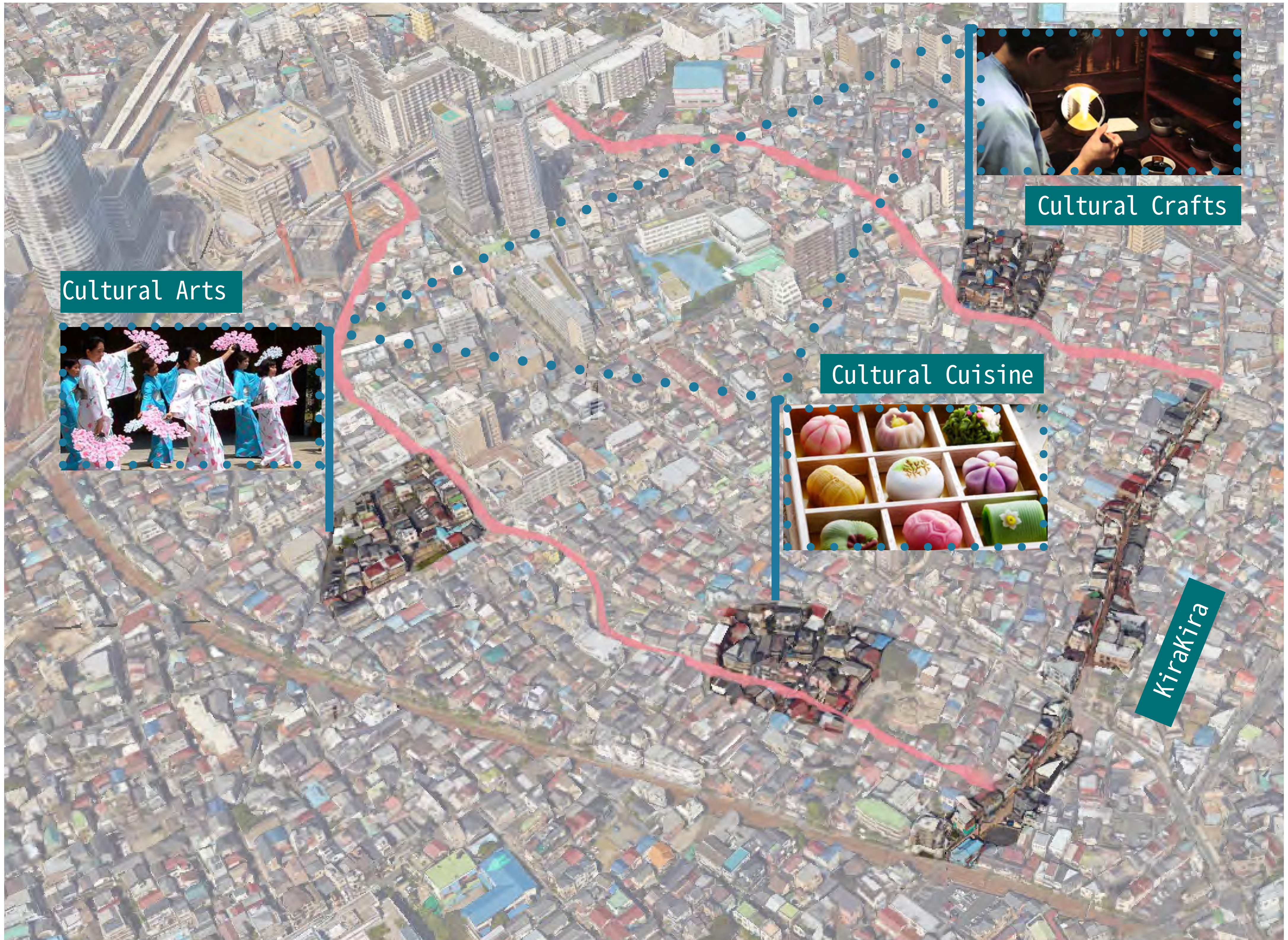
a. Section 1-2-3
1-2 years
b. Section 4-5-6
1-2 Years
c. Section 7-8-9
1-2 Years

Total Time: 6 years
(Will not be done immediately after the other)

4. Expand Retrofits outside

5. Repeated BIM Program for future locations

Prefab Generator



Issue:

How to perserve the integrity and cultural personality of the Sumida Ward while designing a more resilient, less impactful reconstruction design process on the tight infrastructure of Sumida.

Process:

Through the use of Prefab design and the idea of “Sumida Modern”...

1. Energy Savings
2. Quick Construction
3. Less Impact on Site
4. Preserve the Cultural Integrity
5. Net Zero Design

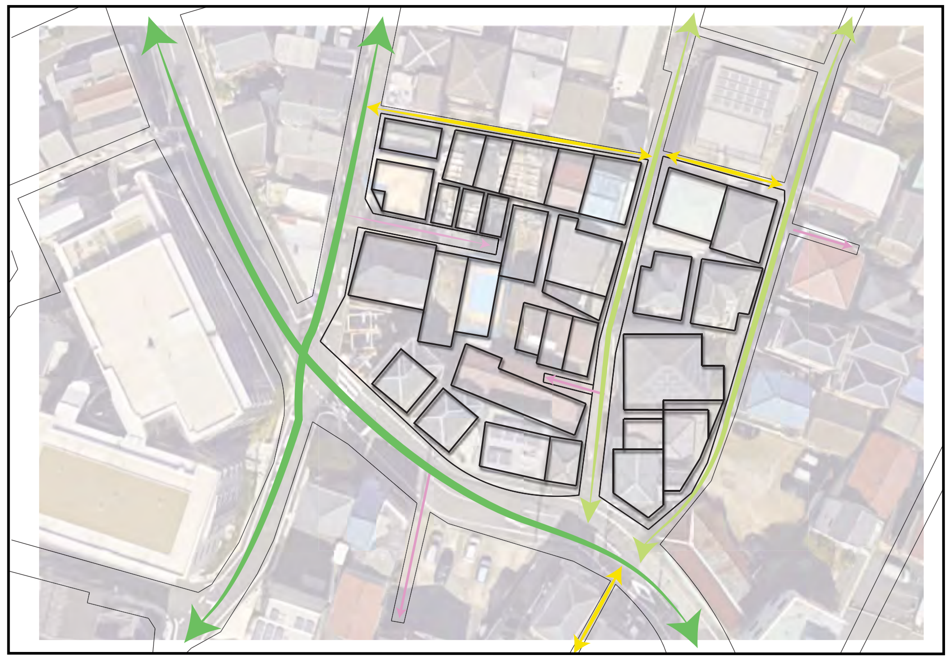
The Future:

Kyojima has the opportunity to become a thriving ward by preserving the cultural past but at the same time creating a more efficient design process that will promote safe and sustainable features.

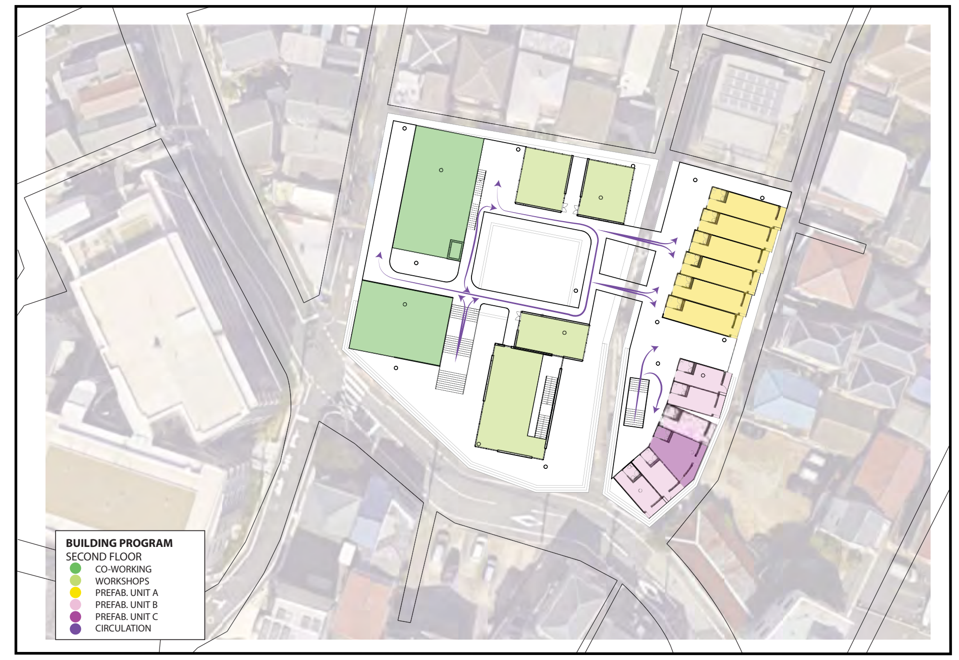
Prefabricated Modules can help by designing and constructing different facades off-site and transporting them into Kyojima.

Combining the social concept of Sumida Modern and Prefabricated design allows this concept to address social, economic and sustainable design features.

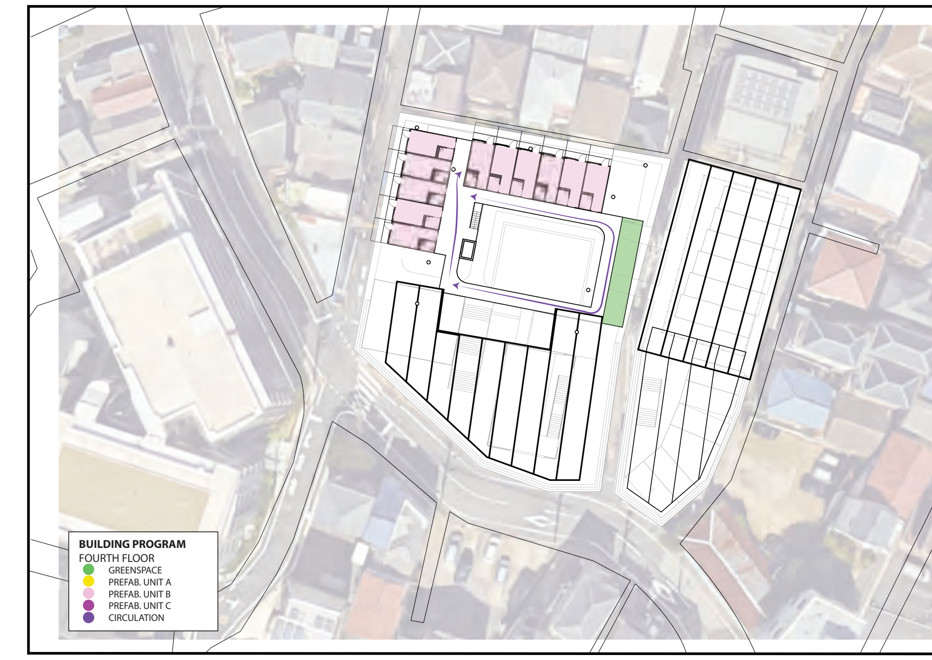
Prefab Generator



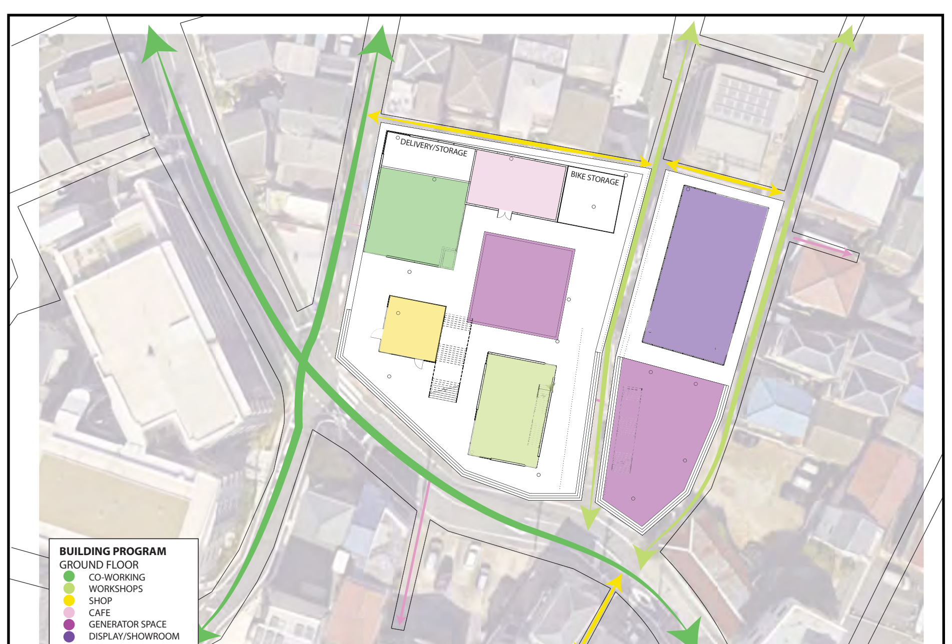
Current Mobility



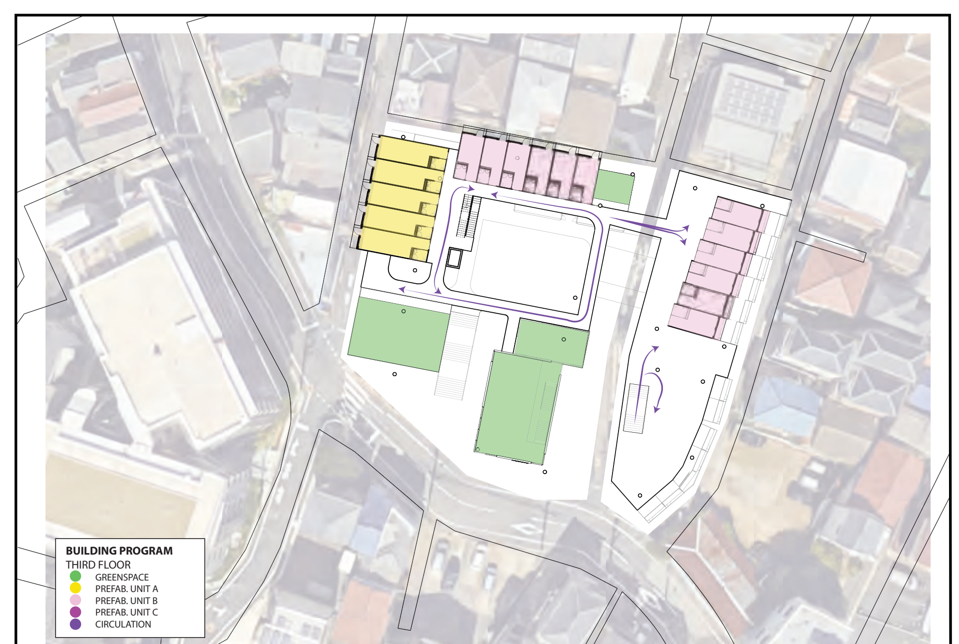
Second Floor Plan



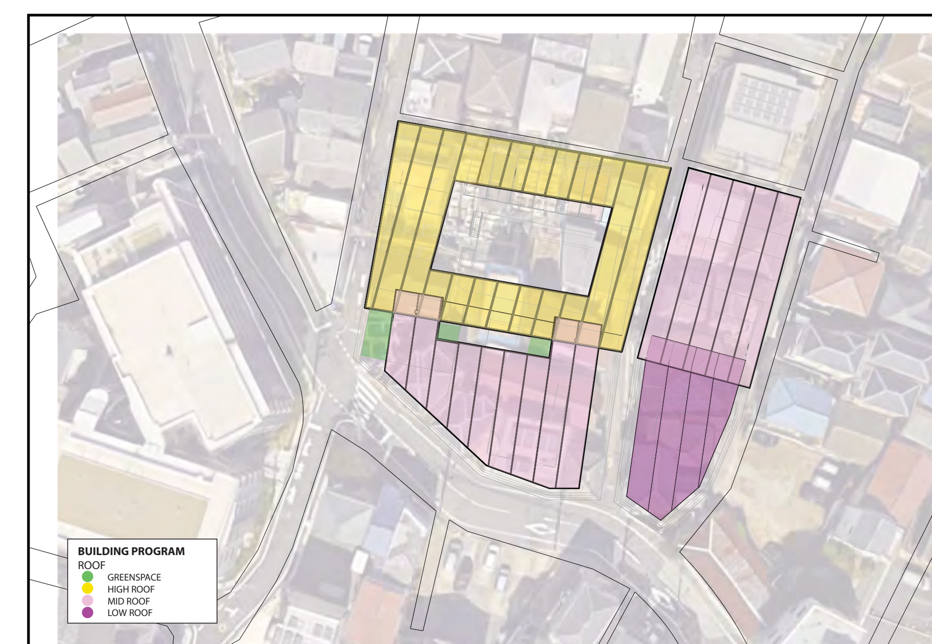
Fourth Floor Plan



New Mobility & Ground Floor Program

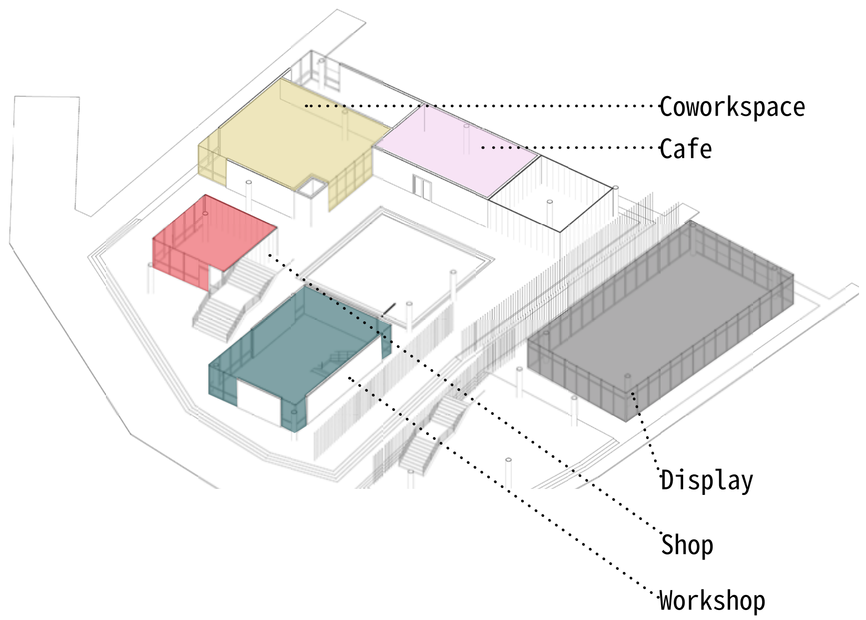


Third Floor Plan

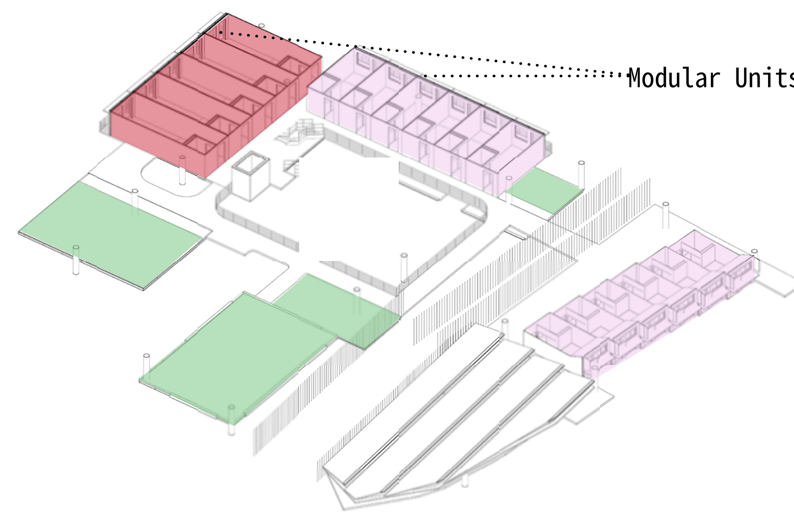


Roof Plan

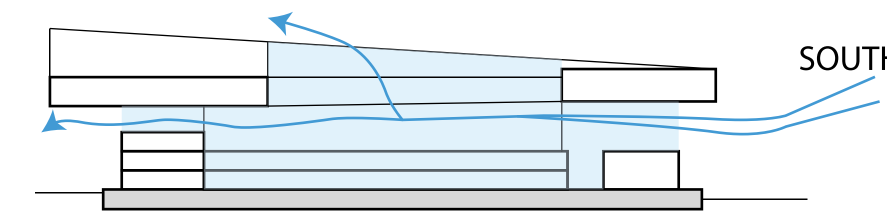
Prefab Generator



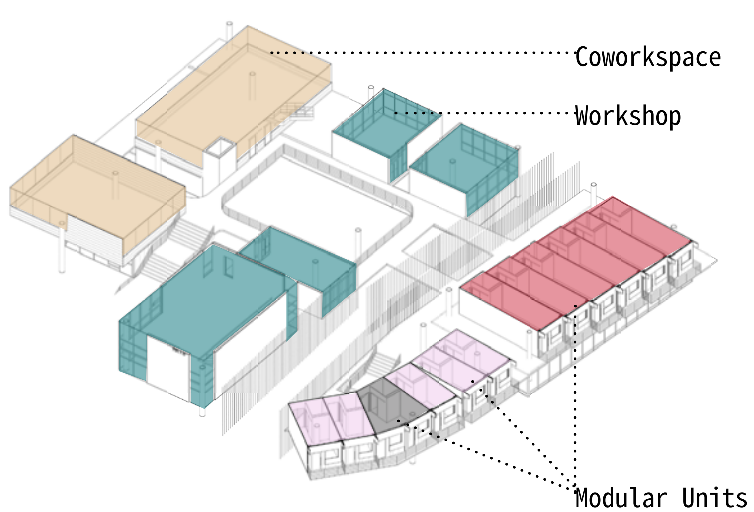
Ground Floor - Public



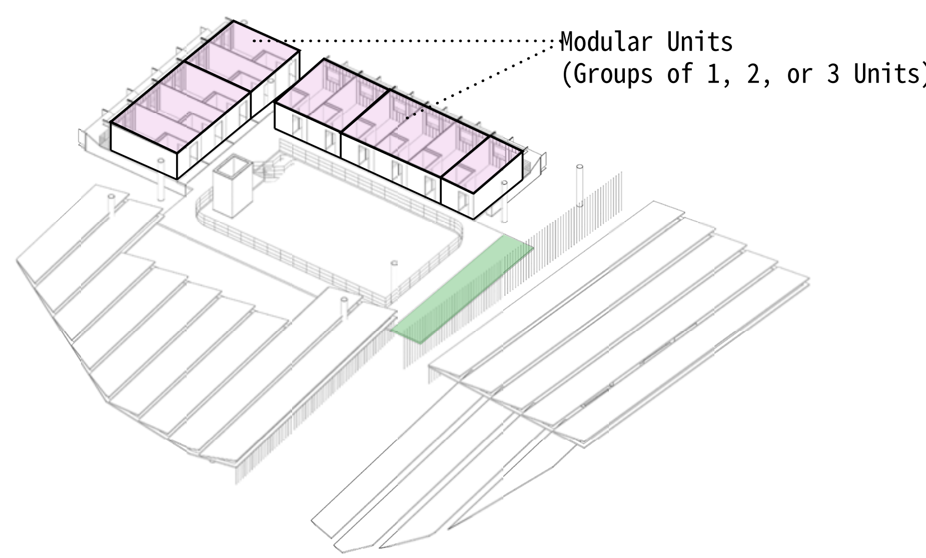
Third Floor - Private



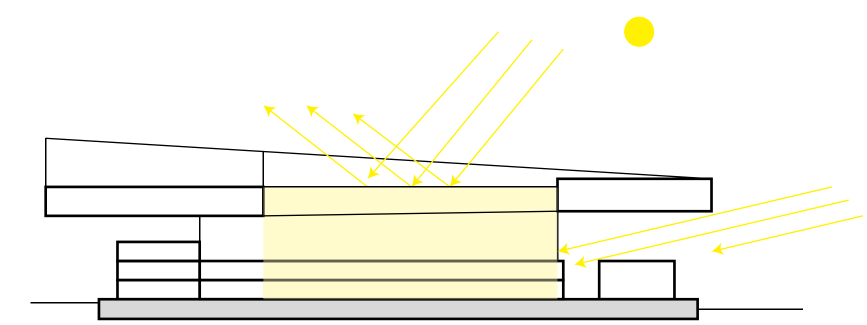
Natural Ventilation



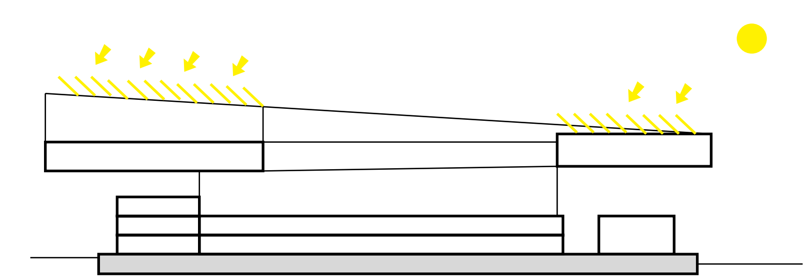
Second Floor - Semi-Public



Fourth Floor Plan - Private



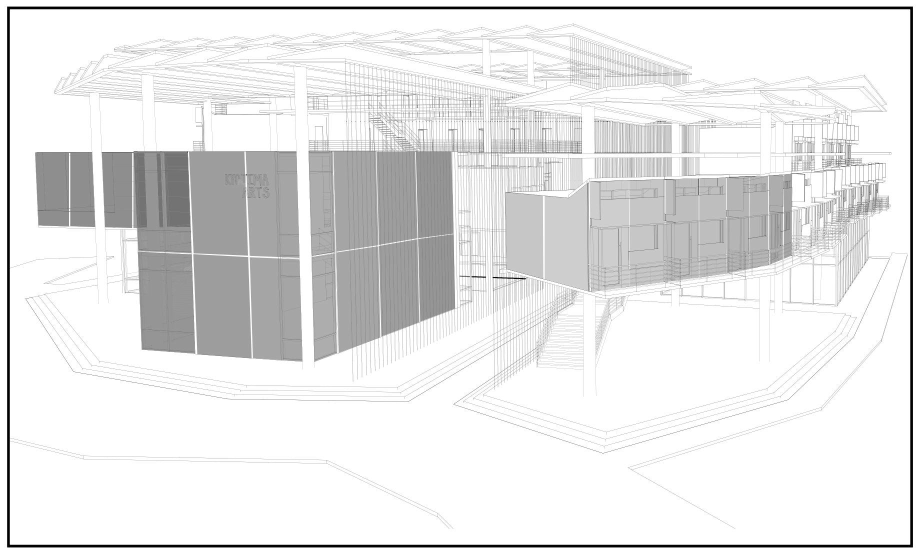
Daylighting



Solar & Wind Power

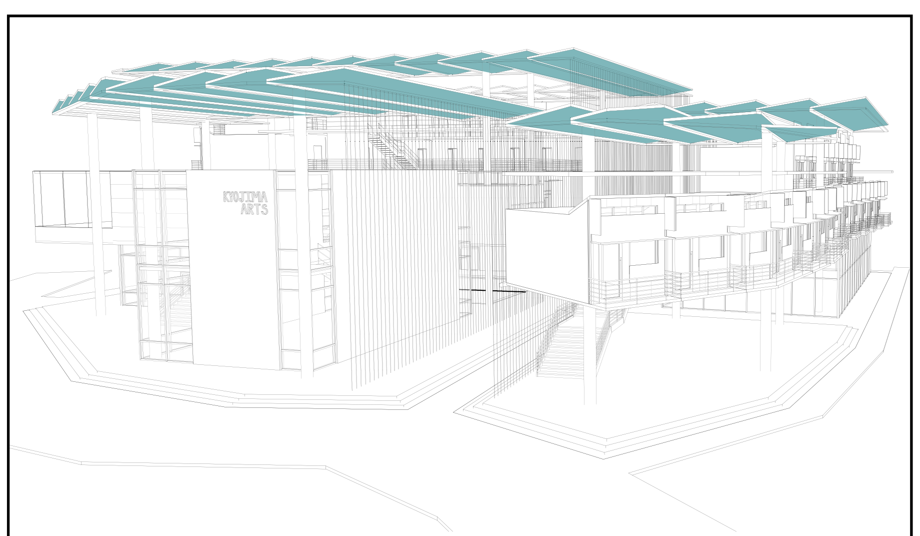
Prefab Generator Goals

BUILDING LIFE CYCLE



50 Year Skin

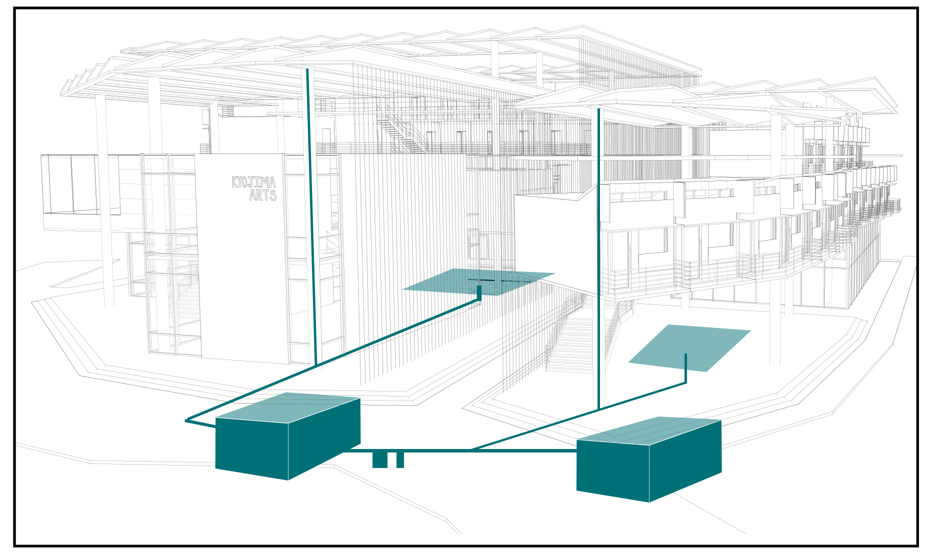
High Performance Prefab Facade



25 Year Technology

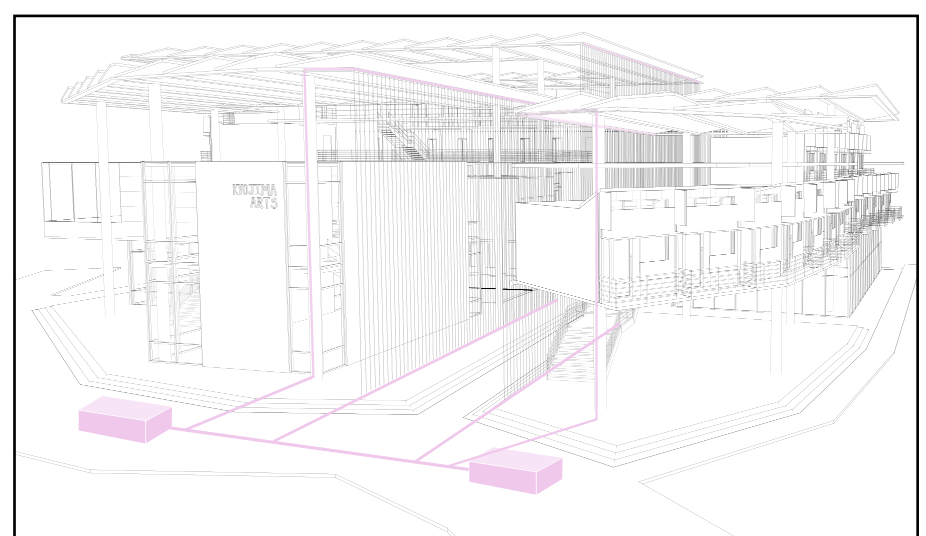
Active Solar Control Solarvoltaics

NET POSITIVE WATER



Rain Water Collection

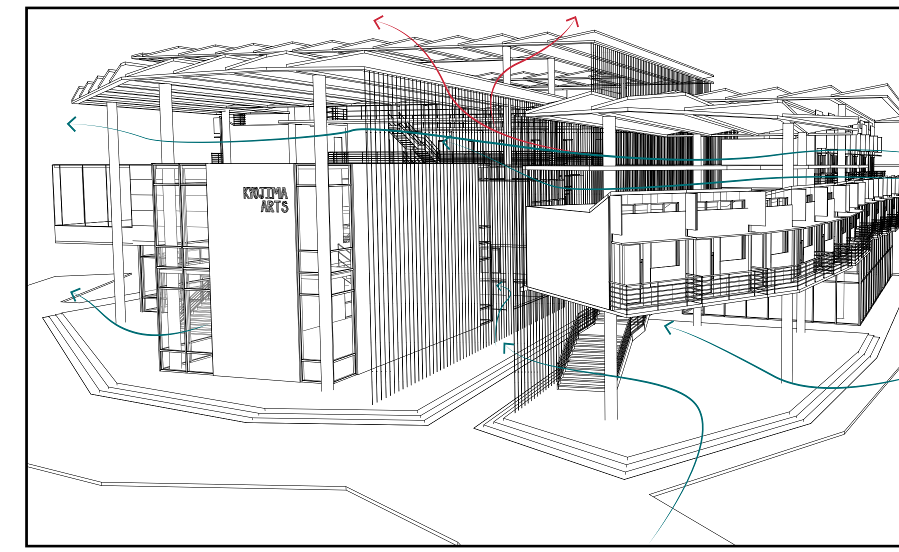
Permeable Pavers - Cistern located undergound



Greywater

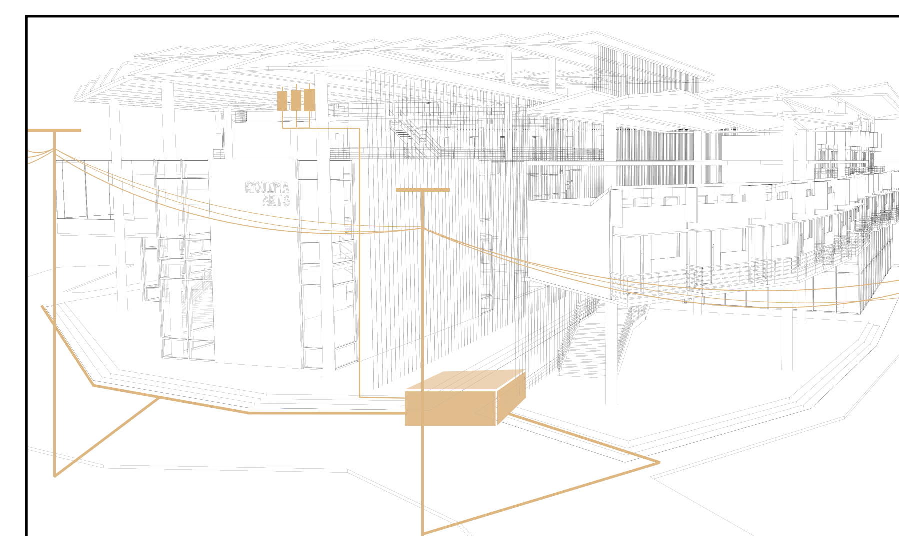
Evapotranspiration & Infiltration

NET POSITIVE ENERGY



Natural Ventilation

Operable Windows - Open Roof - Green Walls



Energy

Grid used as battery

Conclusion

Revitalized Secondary Road

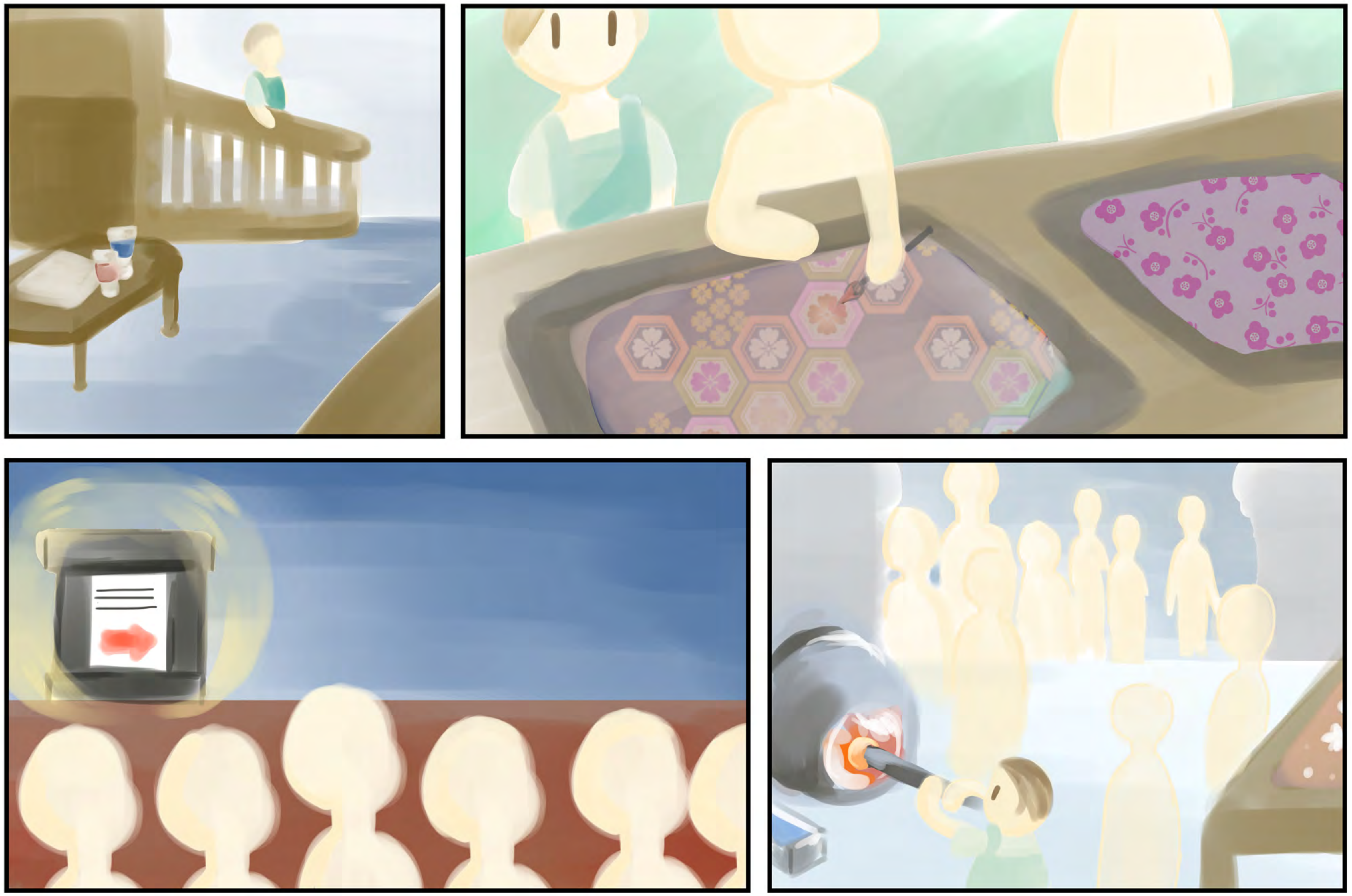
Prefab Generator Street View

Generator Space

Conclusion

Night Activity

Storyboard



Adaptable Village

Mick TANGLAO

The Adaptable Village

Caused by an unprecedented proliferation of individual land ownership, aging neighborhood blocks of Kyojima, Tokyo have become congested and inadequate in various emergency-type scenarios. Originally demarcated as farming lots, these blocks have continually subdivided overtime at a hazardous rate.

However, in this disjointed process came about the characteristic features of older districts in outer Tokyo; winding roads, interstitial alleyways and hidden pocket parks within a fine-grain horizontal layer of mixed-use low-rise buildings.

Thus, the district of Kyojima faces a major challenge for necessary future redevelopment; how can we preserve small-town characteristics while introducing a safer infrastructure?

Opposed to the city's current plan of widening roads and erasing an existing urban fabric, Adaptable Village seeks alternate solutions. There are three types of buildings in Kyojima that are in severe need of redevelopment: aging wooden single-family homes, homes that have become vacant from an aging population, and inner-block buildings accessible only through <1m pathways.

Items exempt from needed redevelopment include recent mid-rise buildings and most block-periphery buildings that shape the existing urban fabric (these tend to be built on a higher budget as street-adjacent lots).

As a result, my studio project proposes a series of inner-block guidelines for future redevelopment of carefully indexed items to improve severe areas in Kyojima.

For each indexed block, future redevelopment demarcations are locked to a cellular, superimposed-grid of 5m x 5m, where goals can be implemented collectively over time within small increments. Guidelines include an even dispersal of marked void spaces to work as interstitial courtyards and new buildings to be raised on pilotis for a flexible open-ground floor network. Within this open-ground network, internal roads can occur where needed, providing existing homes wider emergency-use pathways.

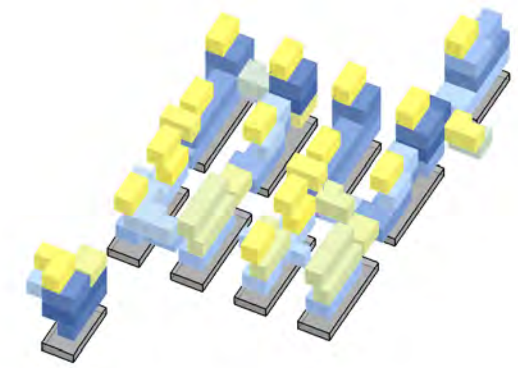
These guidelines lock future developments to provide larger interstitial spaces for existing communities, simultaneously promising higher-density mixed-use programming. To retain sky-visibility rates, a required variation of cellular building heights are also ruled in, limited to a maximum of four stories within each existing low-rise block.

Within these guidelines arise cellular typologies that can adapt over time. Shaped as various tetracube modules that can act as different infill shapes, these can interconnect within the context and accommodate for changing family types over time to reduce future vacancy. Each individual cell benefits each inner-block condition with a porous, multi-level greenery and a contributing open-ground floor. Larger interstitial spaces occur by means of a new minimal building footprint and cantilevered structure. As modules interconnect horizontally, the architecture slowly achieves goals promised within renewal guidelines; a continuation of Kyojima's unplanned, fine-grain symbiosis of greenery, infrastructure and building occurs.

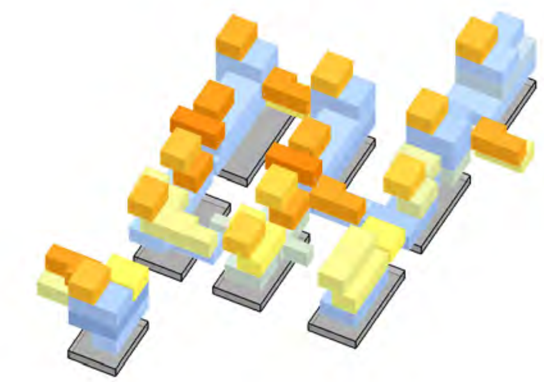
In a specific case-study in one of eight sites, Adaptable Village latches onto an existing Shoutengai (traditional Japanese shopping street). As a singular infill building along the shoutengai, a 5m wide open ground floor reveals an inner-block mixed-use development of interstitial pocket parks and mixed-use programming. Here, a stronger communal access to the block's centroid is forged; a shoutengai in a shoutengai. Over time as each building is renewed within set guidelines, a proposed open-ground floor network continues to reveal itself, interweaving in and around it's context.

Adaptable Village
適応し変化する

Modeling



Use of Green Materials



Larger Footprint

Scorecard

幸福

資源

強靭性

適応し変化する Adaptable Village

Intrablock-Infill along Kira-kira Street
30% Stakeholder Redevelopment

Typology:

Adaptable Village is a set of urban renewal guidelines designed to incrementally improve congested neighborhood blocks

Goals:

1. Redesign congested blocks to be disaster-resilient
2. Increase green space and density simultaneously
3. Preserve Kyojima's winding roads and block periphery

適応し変化する Adaptable Village

Issue:

Current neighborhood blocks are aging and inadequate in several emergency-type scenarios.

The existing urban fabric consists of a hazardous proliferation of individual land-ownership.

This scenario resulted in a loss of emergency-use pathways for some older neighborhood blocks.

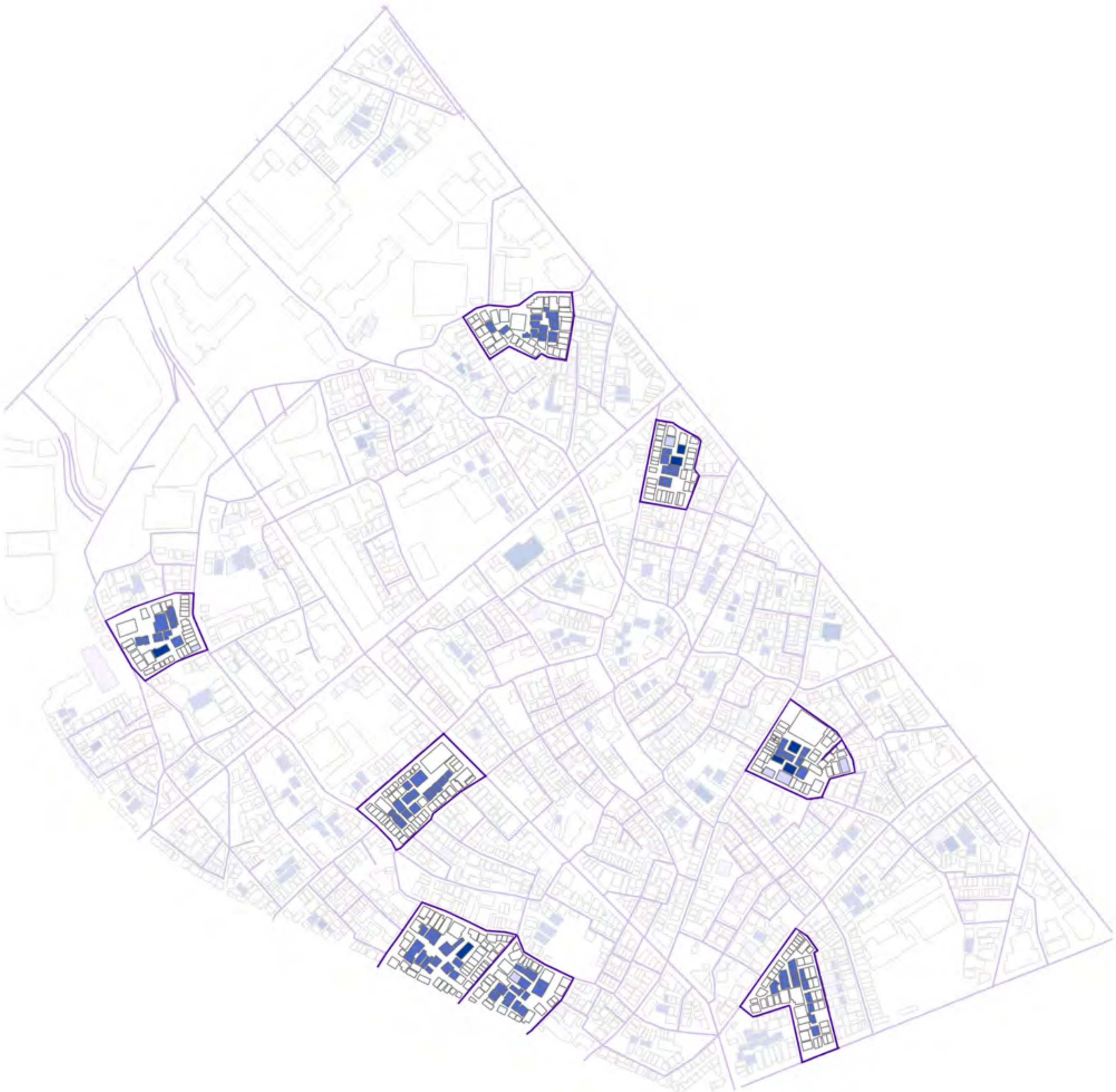
Rather than widening roads and erasing current urban fabric, is there an alternative in redesigning a safer infrastructure for present day Kyojima?

Site:

Hazardous sites are analyzed by an index containing...

1. Aging, wooden single family homes
2. Vacancy data
3. Buildings oriented towards block core

Current Alleyways



Site Index

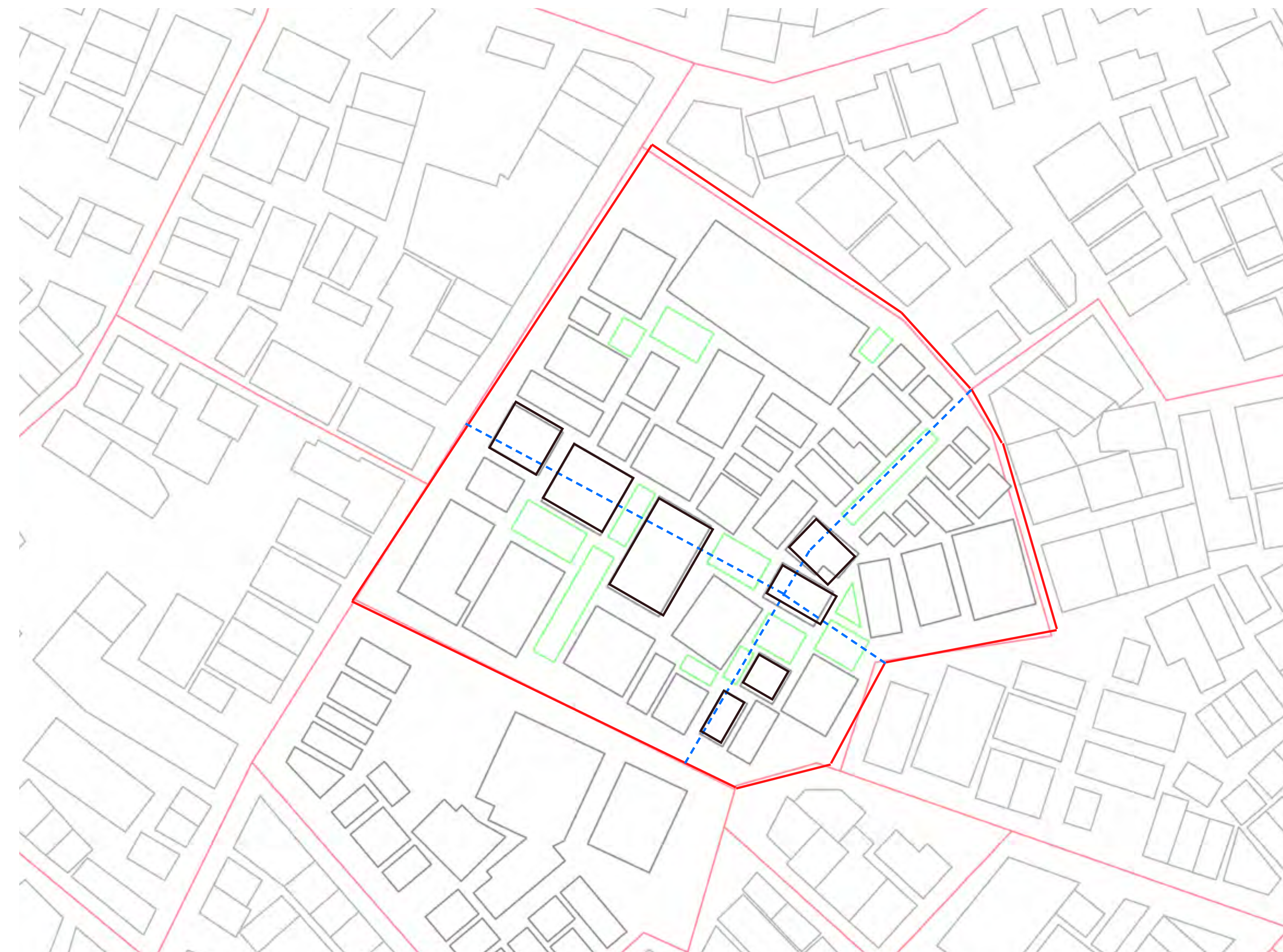
適応し変化する Adaptable Village

Existing Site:

For each of the eight selected sites, we can start to conceptualize different interventions, incrementally occuring over time as an urban renewal guideline.

Existing single family homes

Internal roads: Zero
Number of blocks: 1



Possible Block Intervention: Emergency-use pathways

Internal roads: Two
Number of blocks: 4

適応し変化する Adaptable Village

Urban Renewal Guideline:

Future inner-block developments are restricted to skinnier housing cells that collectively retain new guidelines:

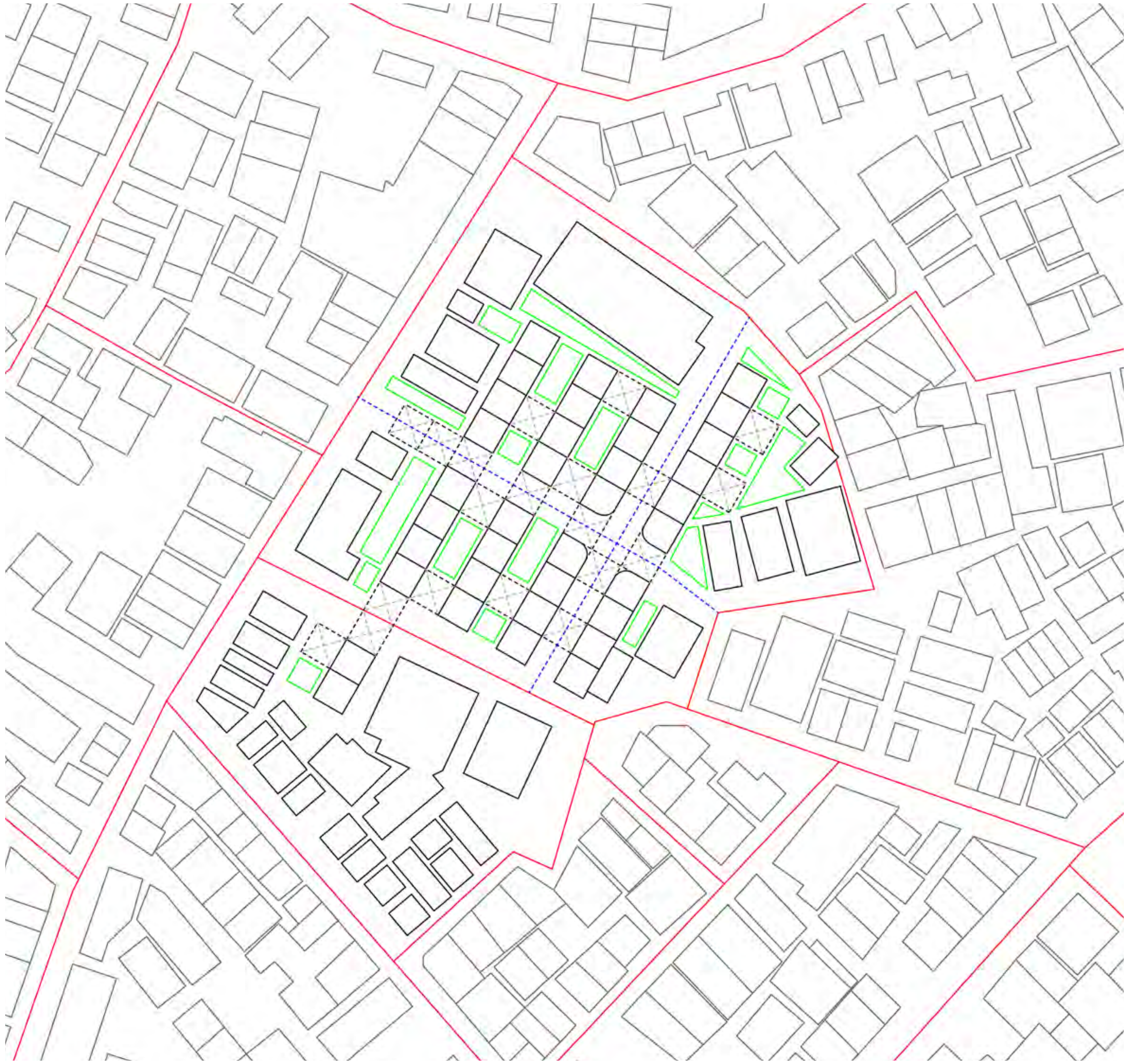
1. Strict dispersal of interstitial courtyards
2. Subdividing internal roads
3. Open ground floor
4. Variation of buildling heights

Items exempt from redevelopment:

1. Recent mid-rise buildlings
2. Non-aging buildings on the block periphery

Collage

Massing co-existing with current urban fabric with internal roads operating as entrances inside each block



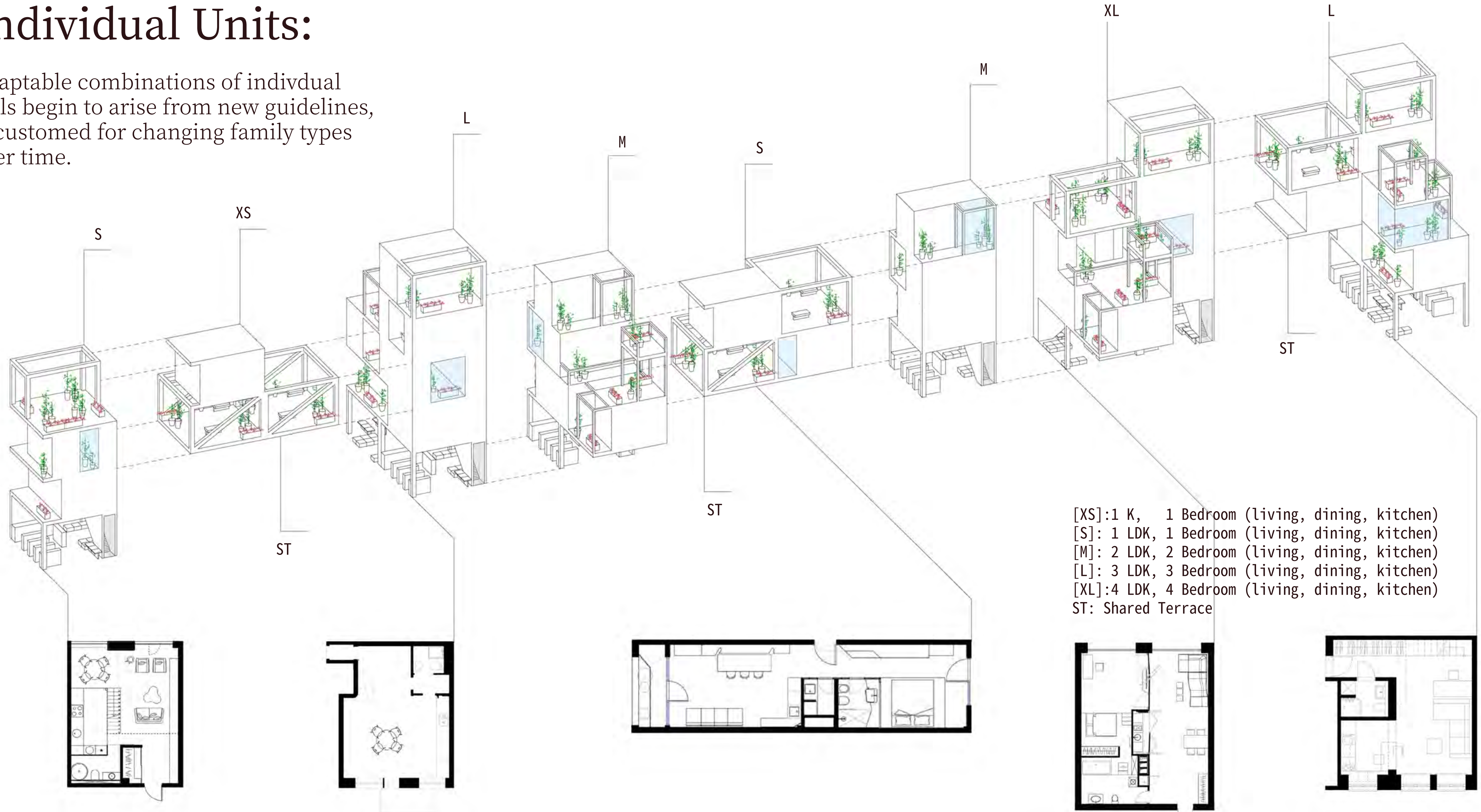
Urban Renewel Masterplan (1 of 8 sites)

Superimposed housing cellss collectively operate on a 5 x 5 M grid retaining strict guidelines for future redevelopment

適応し変化する Adaptable Village

Individual Units:

Adaptable combinations of indivdual cells begin to arise from new guidelines, accustomed for changing family types over time.

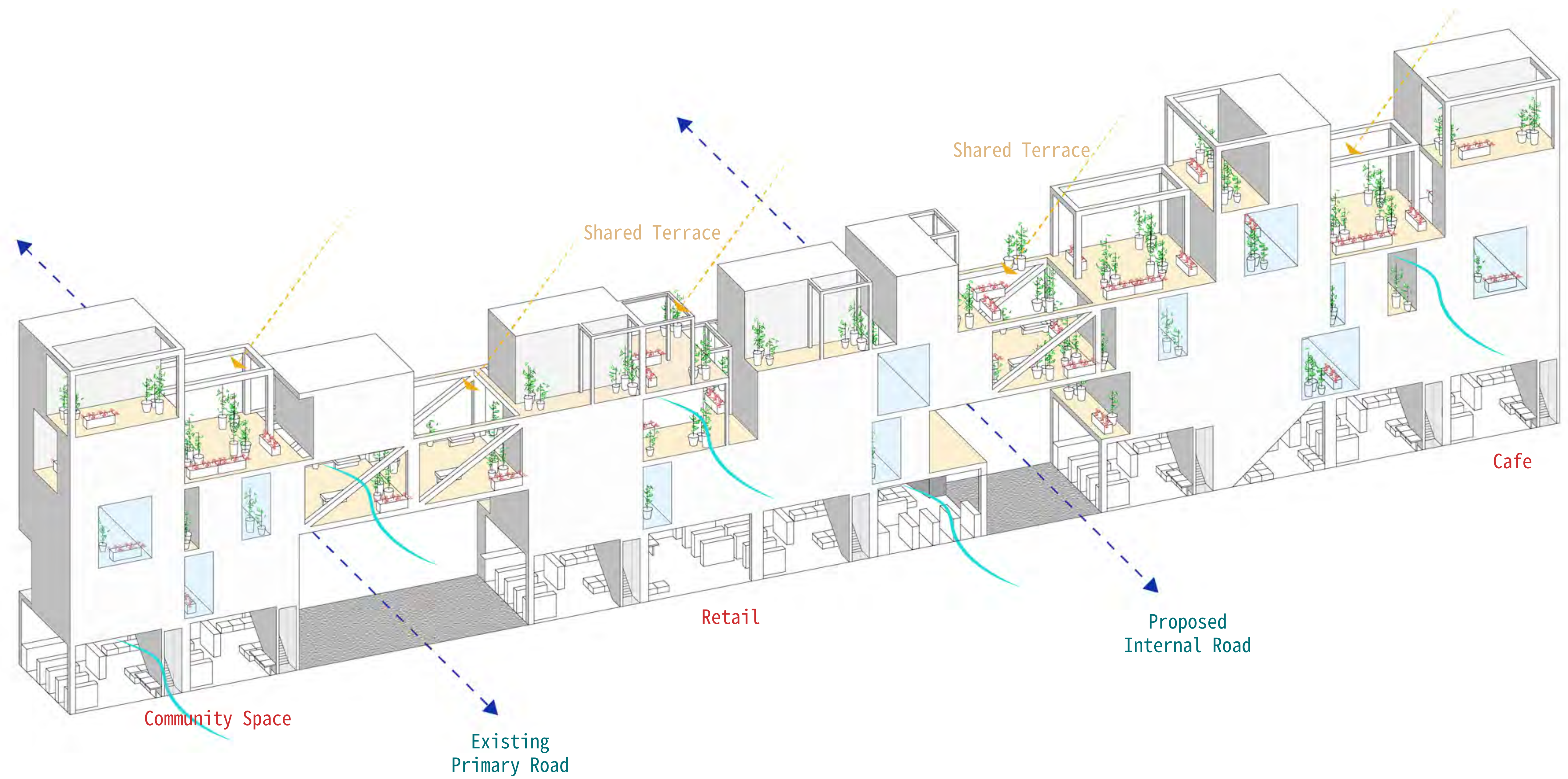


[XS]:1 K,   1 Bedroom (living, dining, kitchen)
[S]: 1 LDK, 1 Bedroom (living, dining, kitchen)
[M]: 2 LDK, 2 Bedroom (living, dining, kitchen)
[L]: 3 LDK, 3 Bedroom (living, dining, kitchen)
[XL]:4 LDK, 4 Bedroom (living, dining, kitchen)
ST: Shared Terrace

適応し変化する Adaptable Village

Incremental Community:

With individual cells operating collectively within renewal guidelines, a diverse tight-knit community begins to develop.

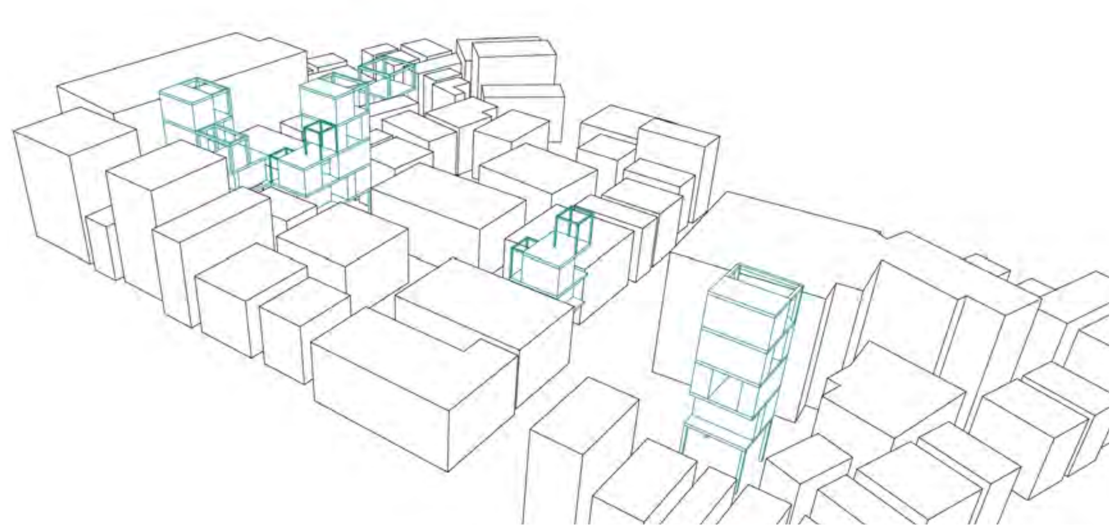


Slice of Vertical Village

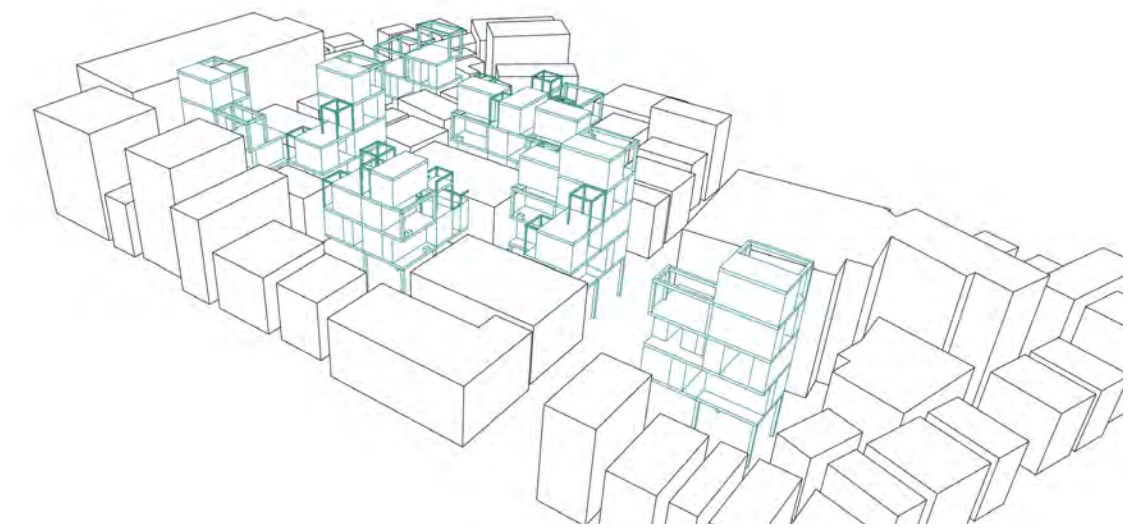
適応し変化する Adaptable Village

Site Implementation:

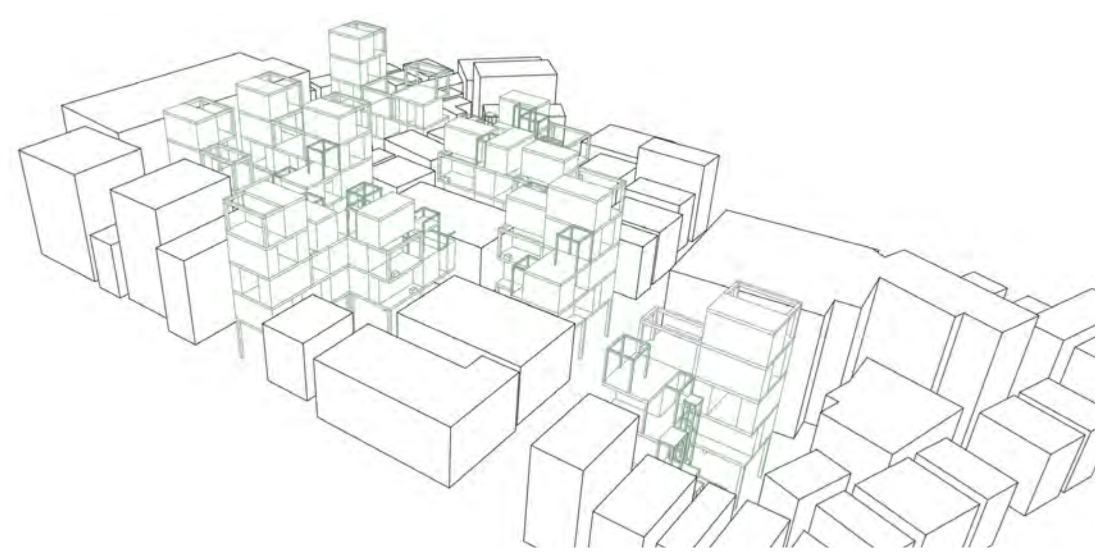
Guidelines preserve outer-block residental buildlings by building from the core and capitalizing on current infill spaces.



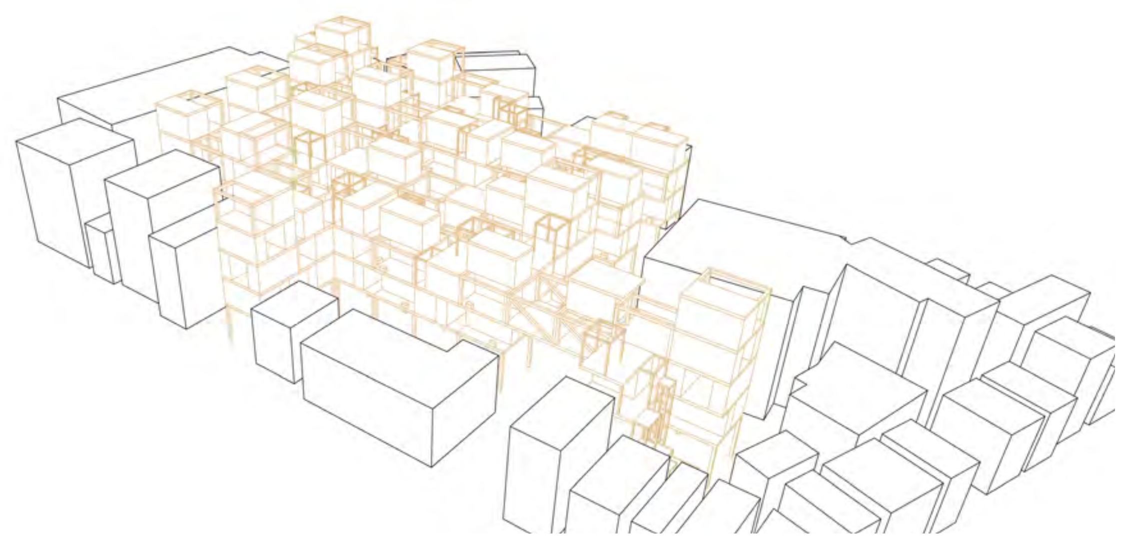
5% Stakeholder Redevelopment



15% Stakeholder Redevelopment



30% Stakeholder Redevelopment



100% Stakeholder Redevelopment

適応し変化する Adaptable Village

30% Stakeholders:

Adaptable Village sustains itself throughout phasing, even if only
30% of single-family home stakeholders are in conjunction.

In this scenario, the interstitial space is doubled.

Plan
30% Stakeholder Redevelopment

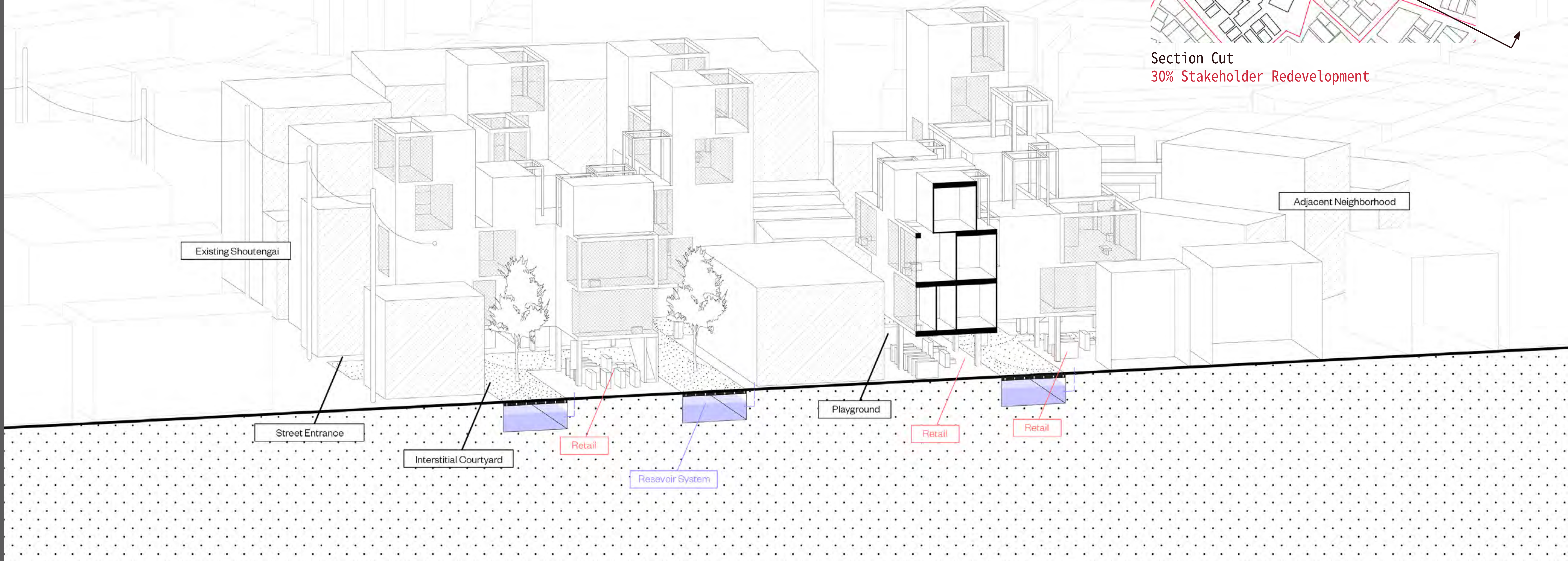
New Buldling Footprint: 1773 M^2
Interstitial Footprint: 641M^2
(14.6% of total block)

Bird's eye view
30% Stakeholder Redevelopment

適応し変化する Adaptable Village

30% Stakeholders:

A sophisticated variation of 3D interstitial spaces begins to occur as guildelines reinforce the next series of inner-block redevelopment.



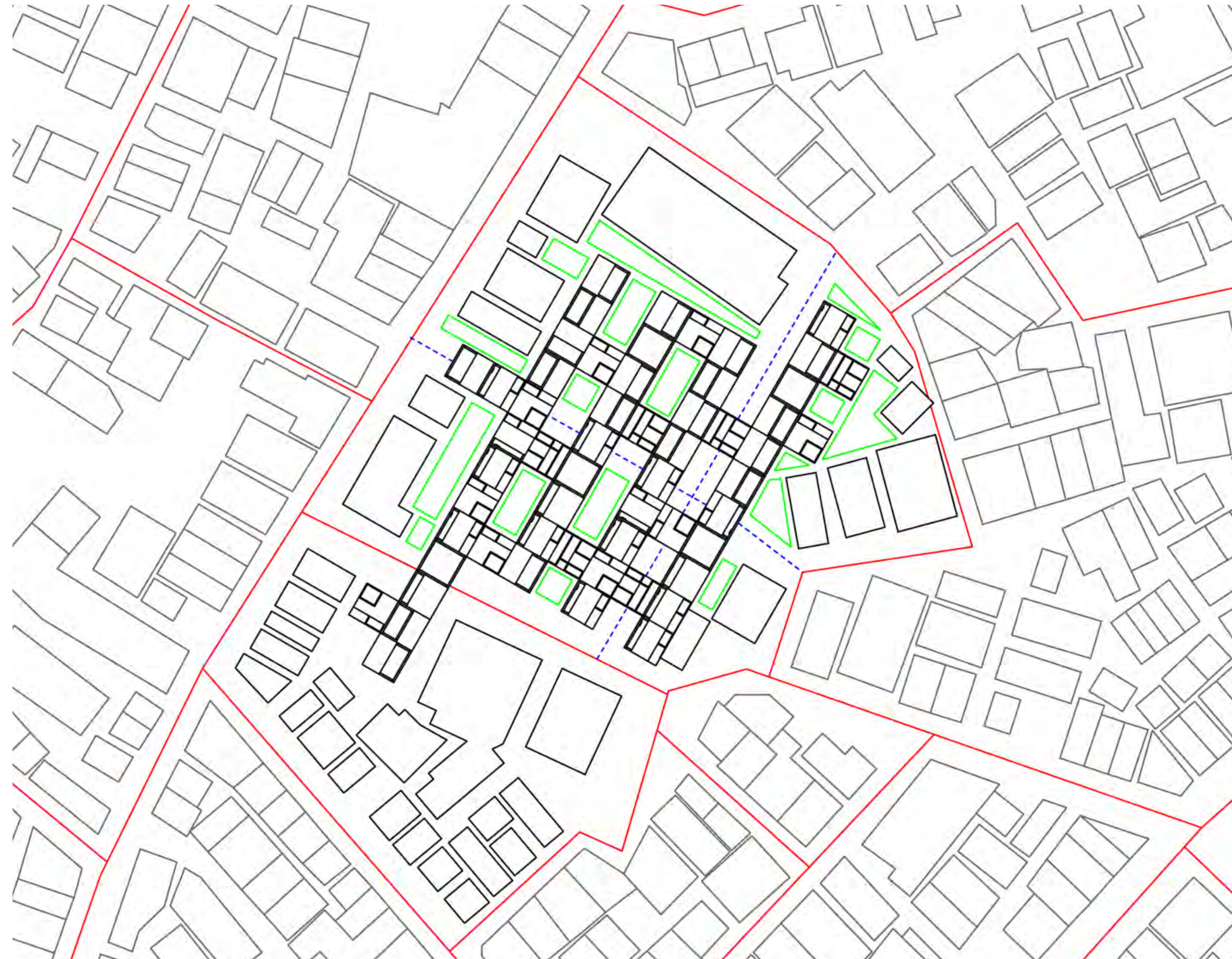
Section Cut
30% Stakeholder Redevelopment

適応し変化する Adaptable Village

100% Stakeholders:

Adaptable Village can become a full pedestrian-oriented complex interwoven with interstitial courtyards and internal secondary streets.

Interior Secondary Street
100% Stakeholder Redevelopment



Ground Level
100% Stakeholder Redevelopment

適応し変化する Adaptable Village

100% Stakeholders:

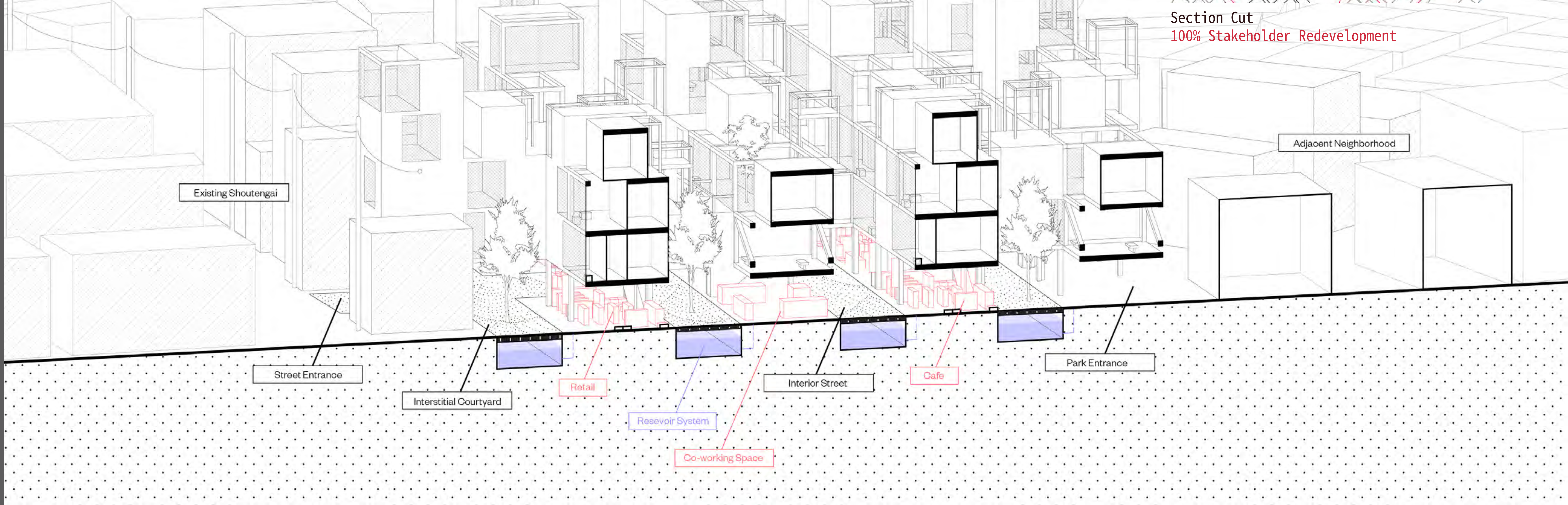
With an interstitial footprint covering 25% of the total block area, interstitial space would increase by four times the original amount.

Birds Eye View
100% Stakeholder Redevelopment

適応し変化する Adaptable Village

100% Stakeholders:

Over time, the existing block transforms into a full pedestrian oriented complex, interwoven with courtyards and internal secondary streets.



適応し変化する Adaptable Village

Incremental Open Space:

With broader interstitial area, higher visibility rates become appropriate for emergency, retail and social use in-between the existing fabric.

Adjacency to existing urban fabric
100% Stakeholder Redevelopment

適応し変化する Adaptable Village

Internal Streets:

Adaptable Village is a full pedestrian oriented complex with proposed internal secondary streets going through it's buildlings.

Interior Street
100% Stakeholder Redevelopment

適応し変化する Adaptable Village

Inner Block Living:

Adaptable Village improves spatial conditions within current blocks, encouraging social interaction, wind flows and sky visibilty rates.

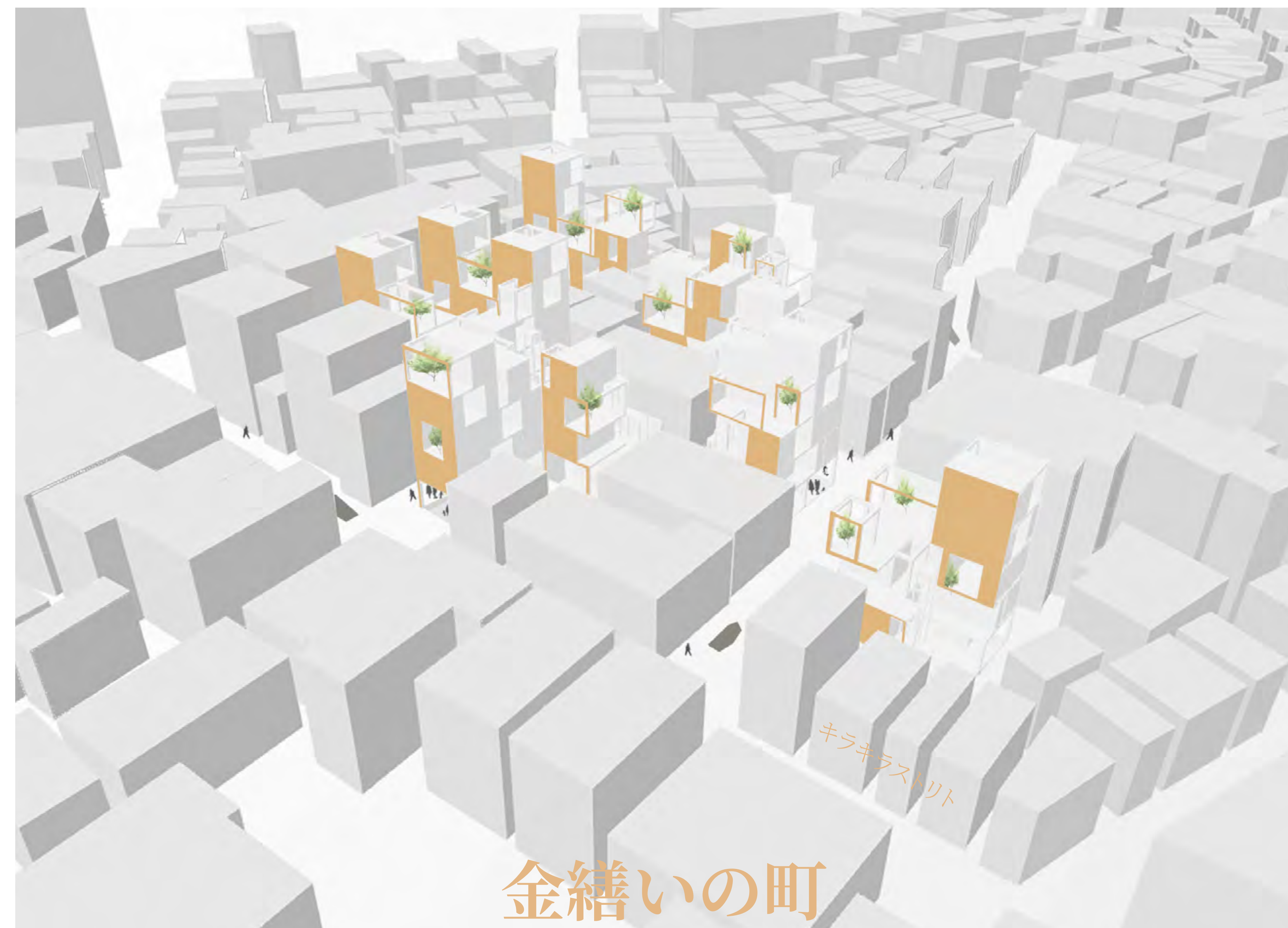
Courtyard
100% Stakeholder Redevelopment

適応し変化する Adaptable Village

Branding:

This process integrates itself onto indexed sites, each as their own individually branded Villages.

Smart Community + Sumida Modern



Colored branding for each implemention
30% Stakeholder Redevelopment

適応し変化する Adaptable Village

Precedent:

Adaptable Village precedes existing interstitial relationships
of infrastructure, buildling and greenery found in Kyojima.

Kyojima Alleyways

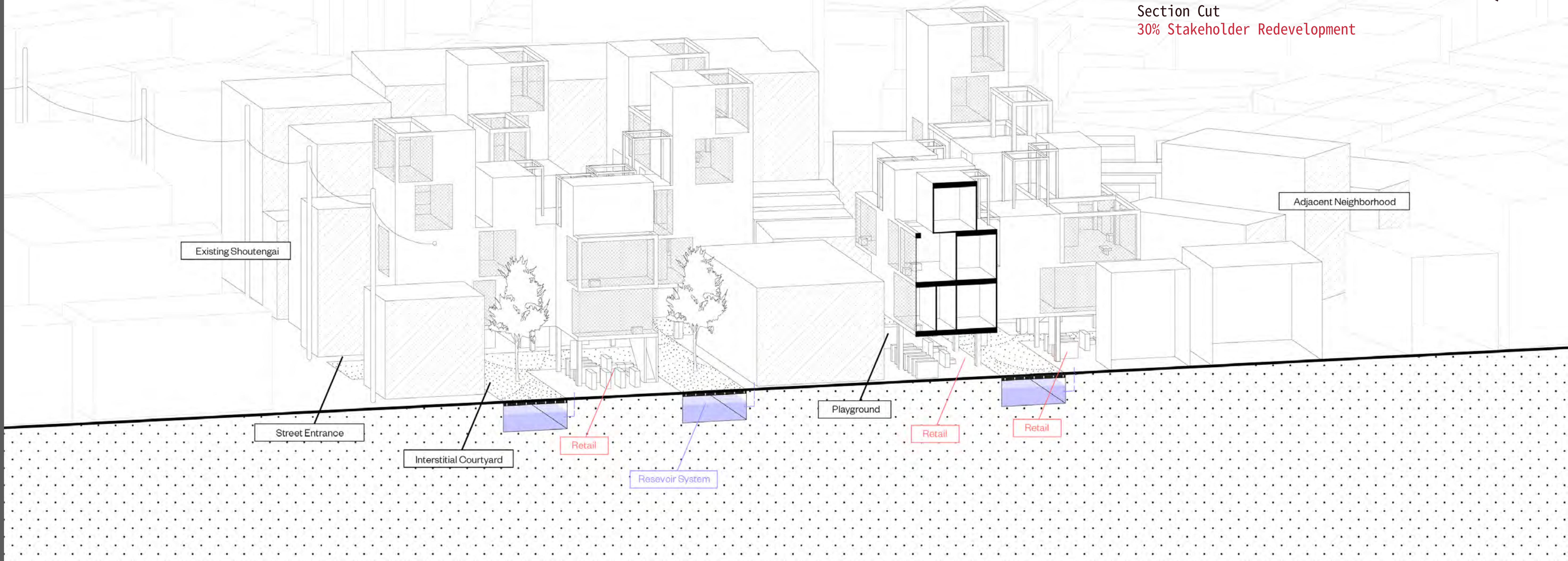
適応し変化する Adaptable Village

Conclusion:

Adaptable Village is a set of urban renewal guidelines designed for a mixed engagement of stakeholders.

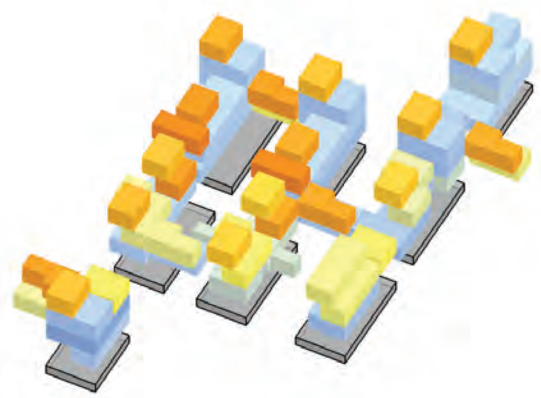
It occurs over time, incrementally adding larger interstitial mixed-use spaces within the congested urban fabric.

Section Cut
30% Stakeholder Redevelopment

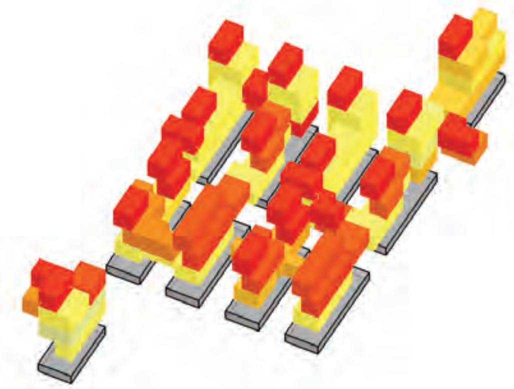


Storyboard

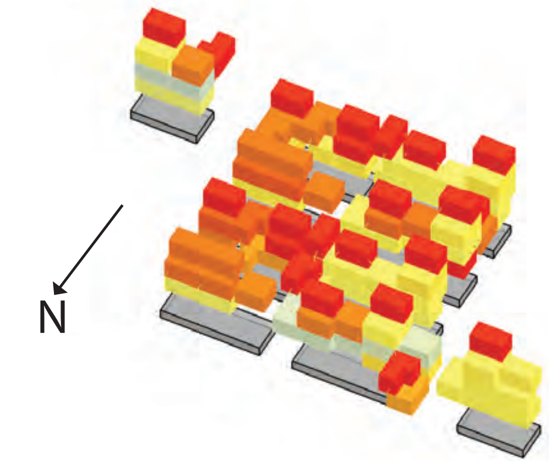
Energy Consumption--Design Adjustments and Energy Savings



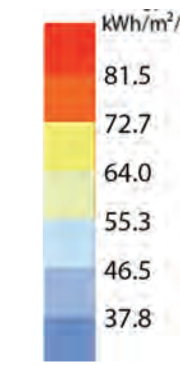
larger footprint 50%

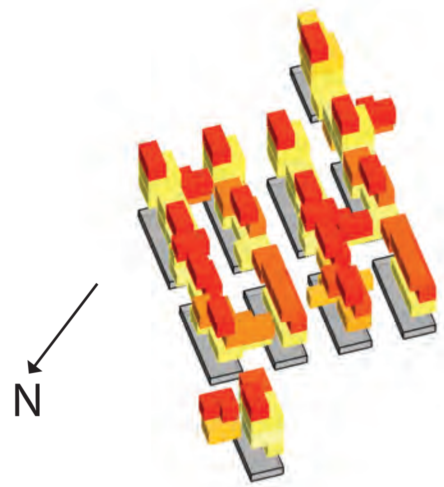


high density 15%

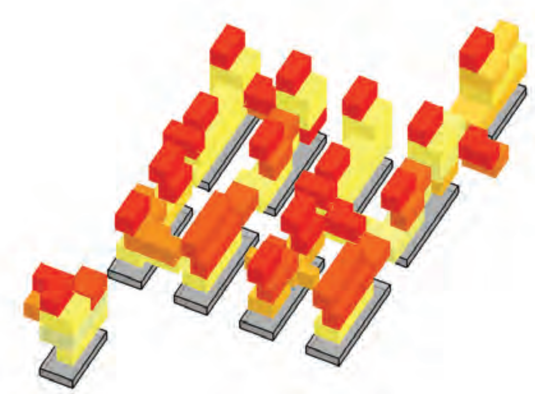


N-S orientation

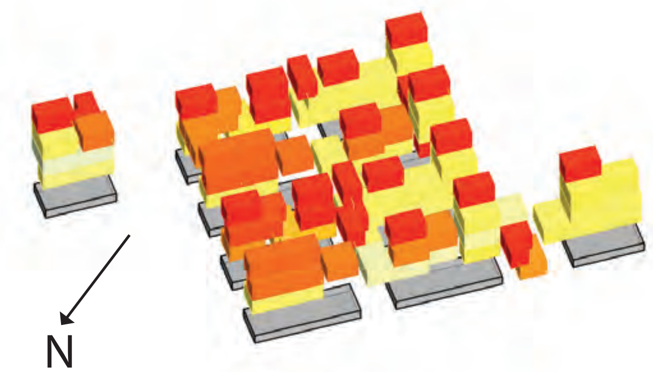




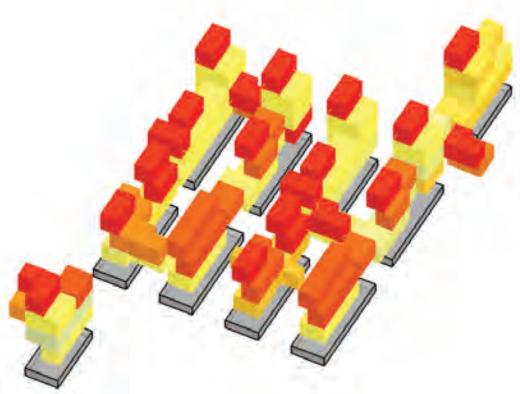
NE-SW orientation



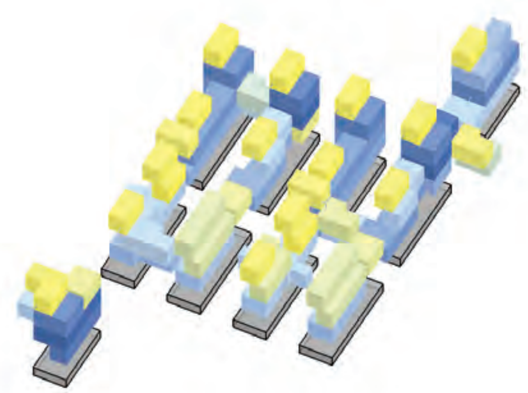
original



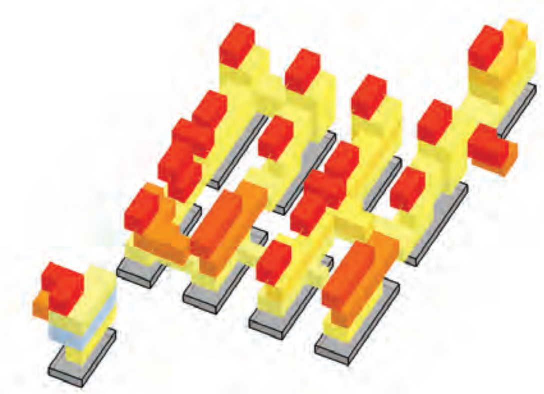
SE-NW orientation



larger windows 10%

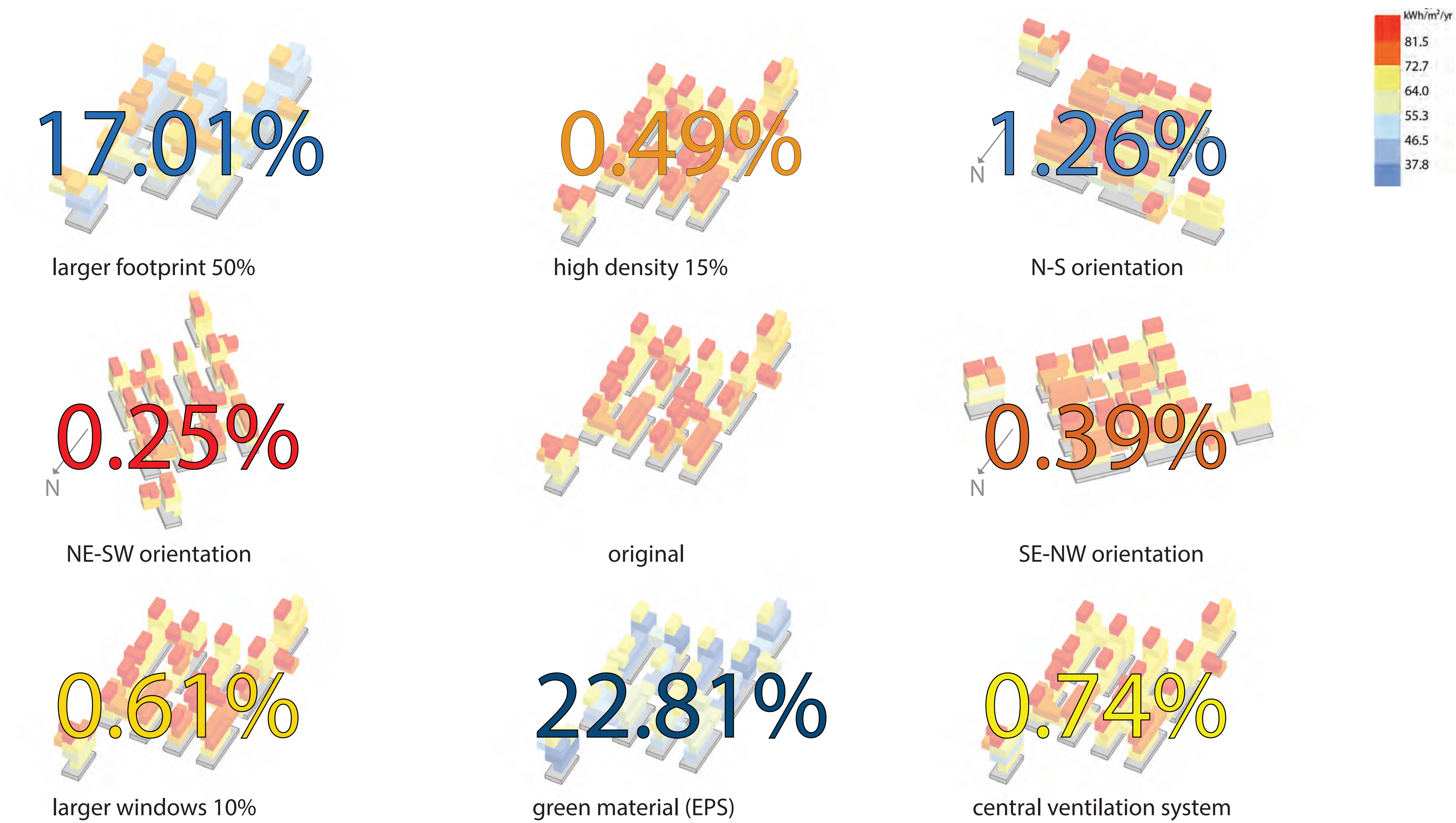


green material (EPS)



central ventilation system

Energy Consumption--Design Adjustments and Energy Savings



Energy Consumption--Summary of Design Adjustment

Energy Consumption-- Summary of Design Adjustment

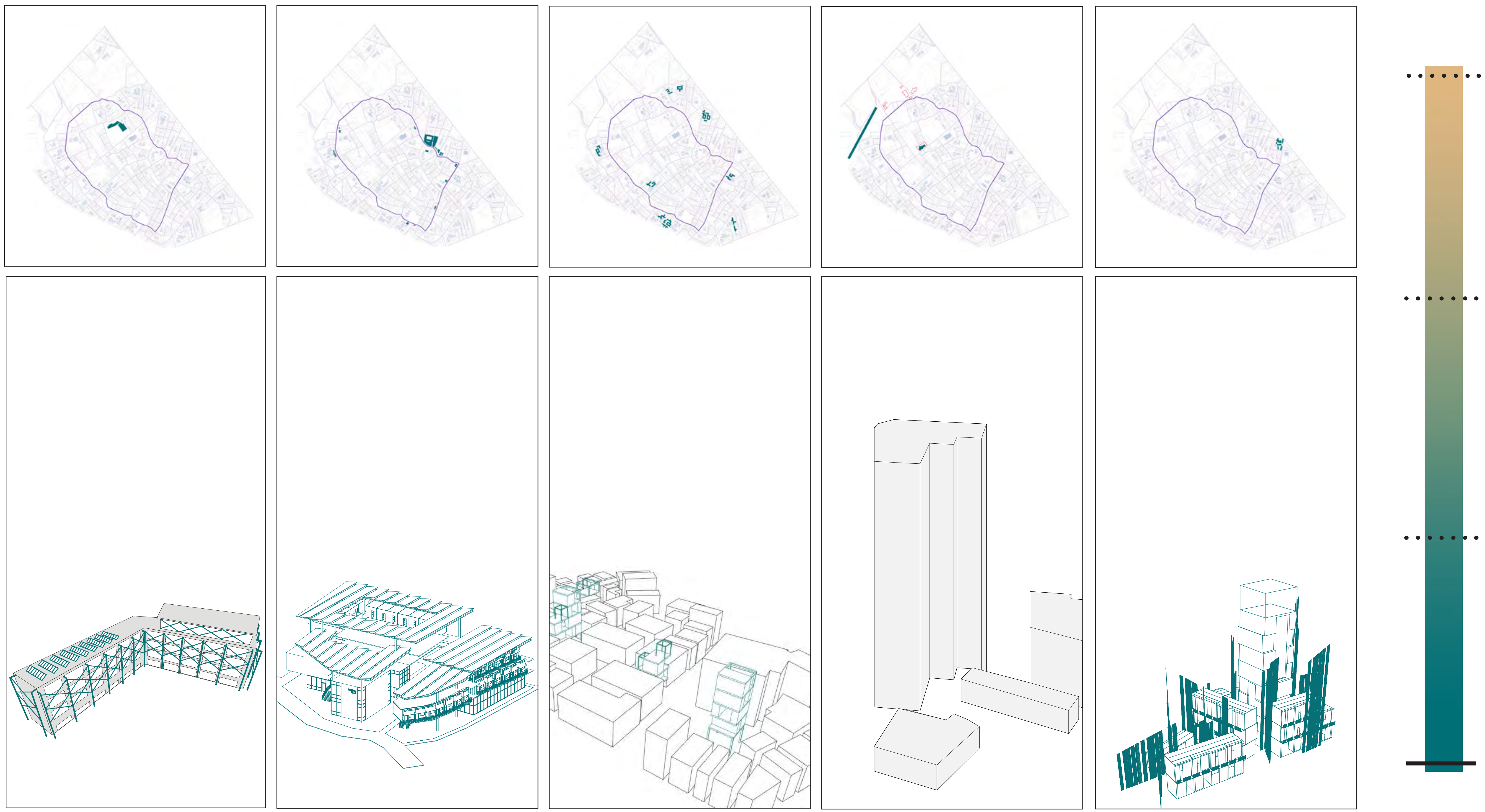
- Adopting the two most efficient adjustments, the energy consumption of the prototype is about 21% lower than the overall performance of the exiting single family houses.

- This prototype can increase the PV panel installation ratio, so even it consumes more energy than the existing SF house, the overall performance of consumption and production is better:

- Without the two adjustments, the maximum energy production is about 38% of the energy consumption. The gap between production and consumption is about 41% lower than the the existing sf houses with a similar FAR.

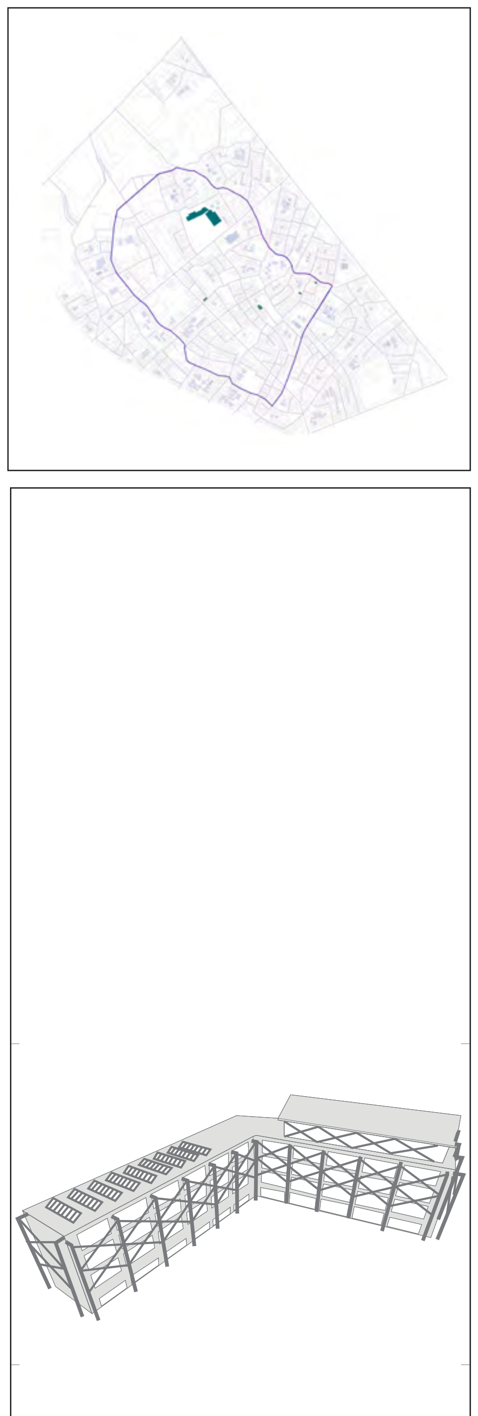
Progress of Implementation

Progression - 5 Years

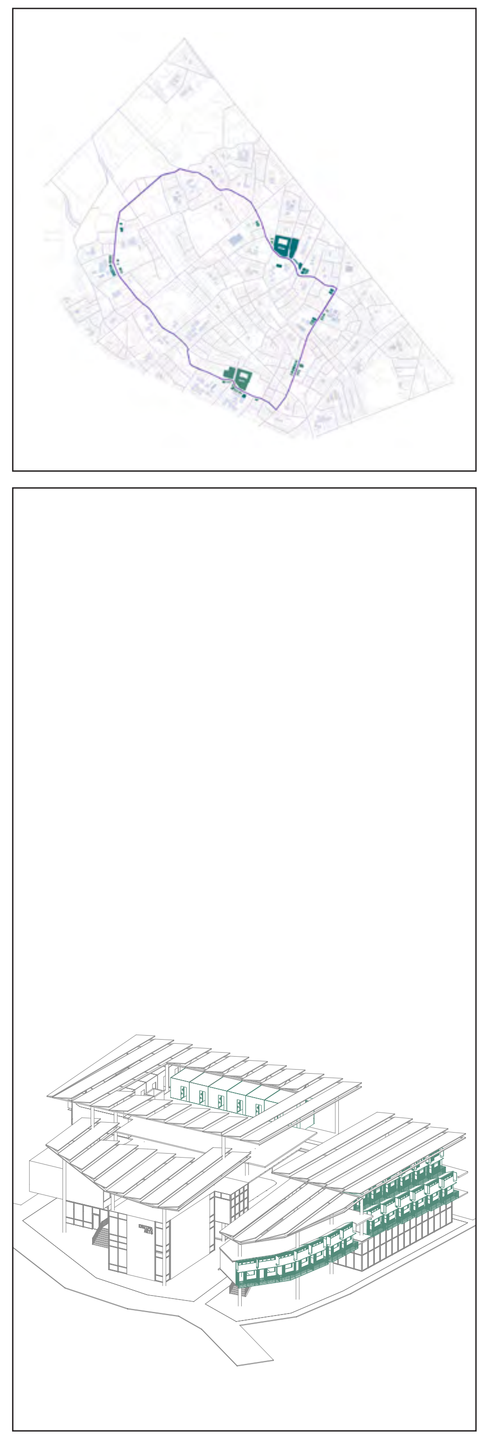


Cultivation Centers | Prefab Generator | Adaptable Village | Eco-Cell | Beacon | Progression

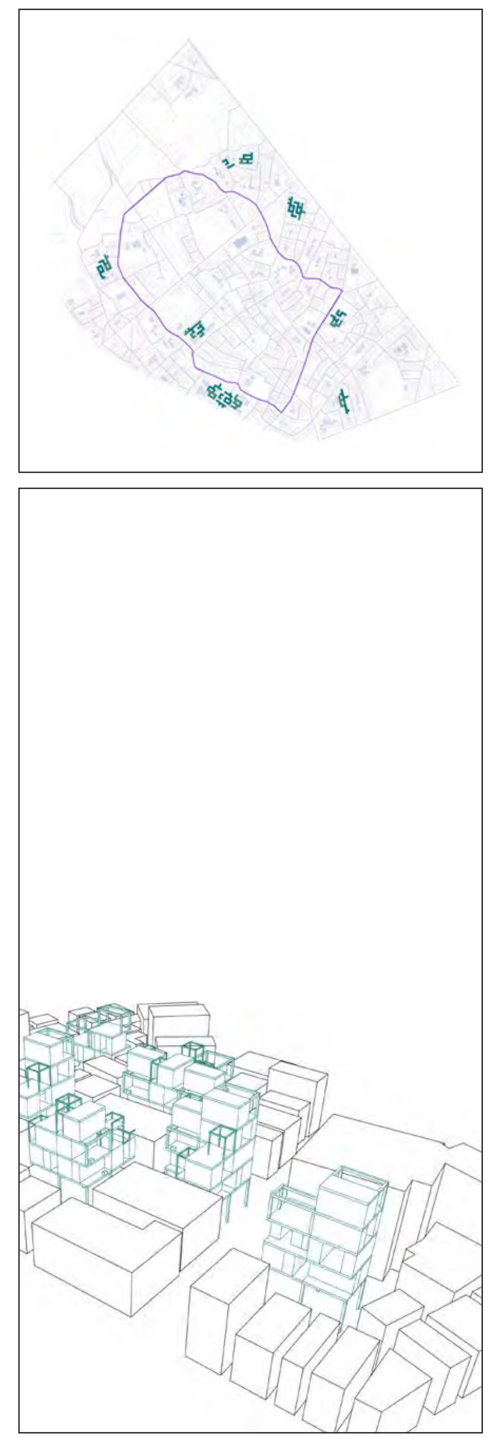
Progression - 10 Years



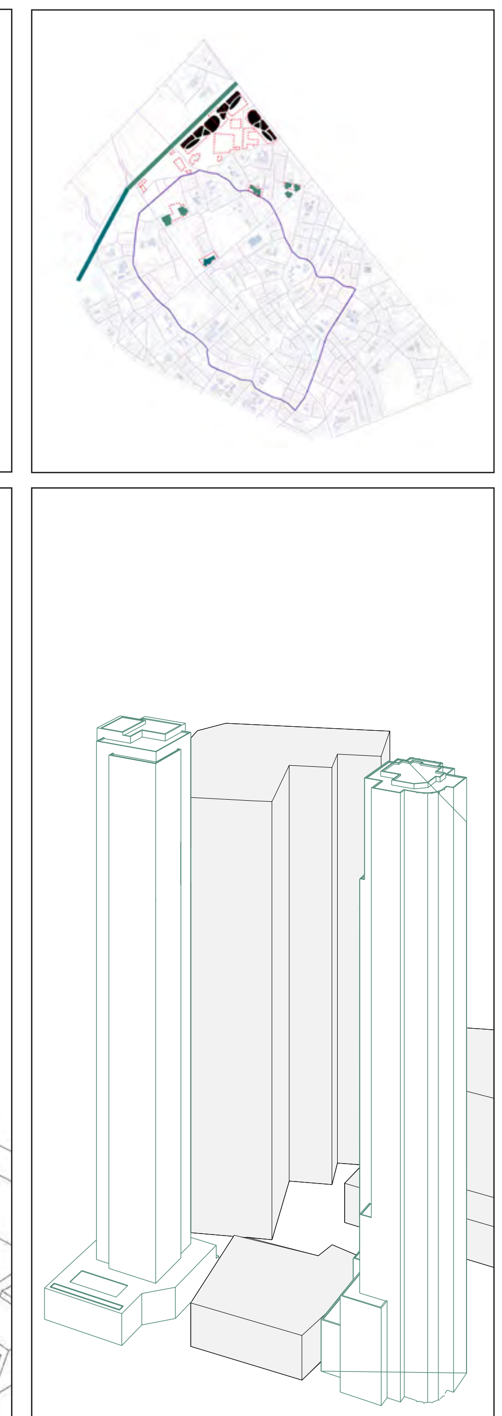
Cultivation Centers



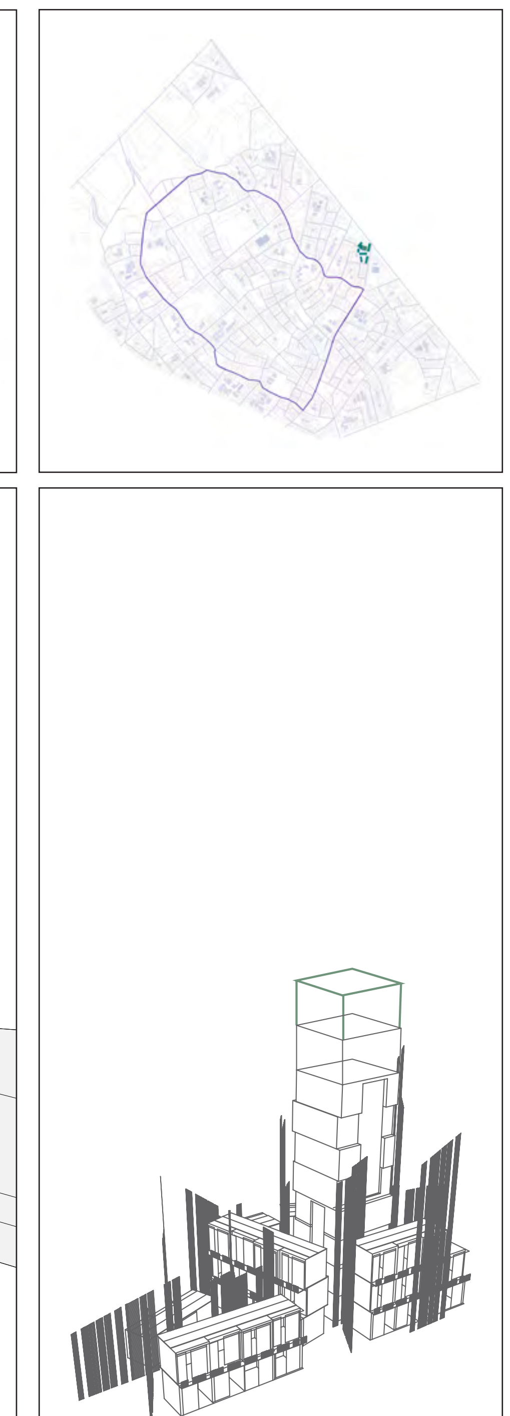
Prefab Generator



Adaptable Village



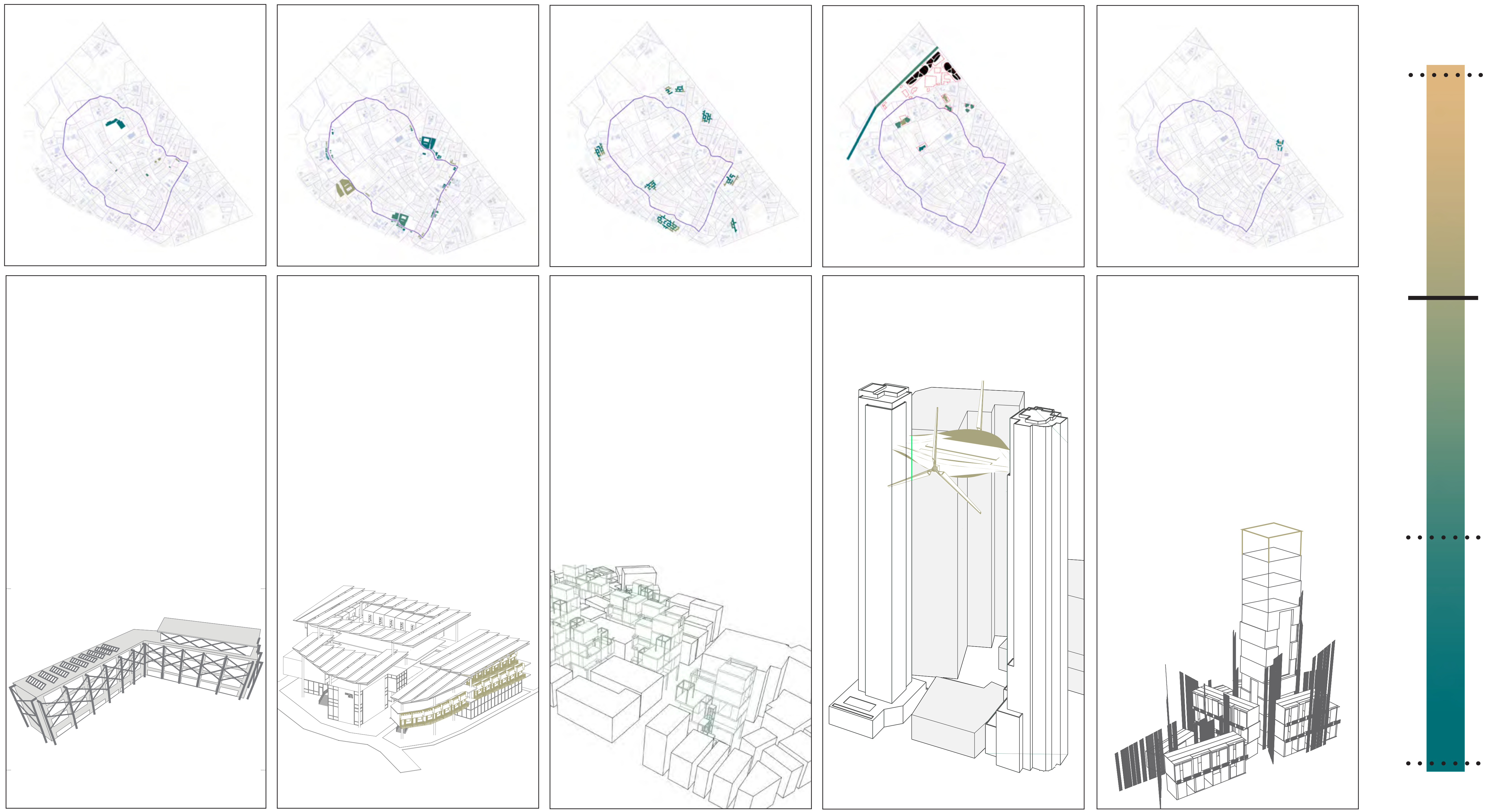
Eco-Cell



Beacon

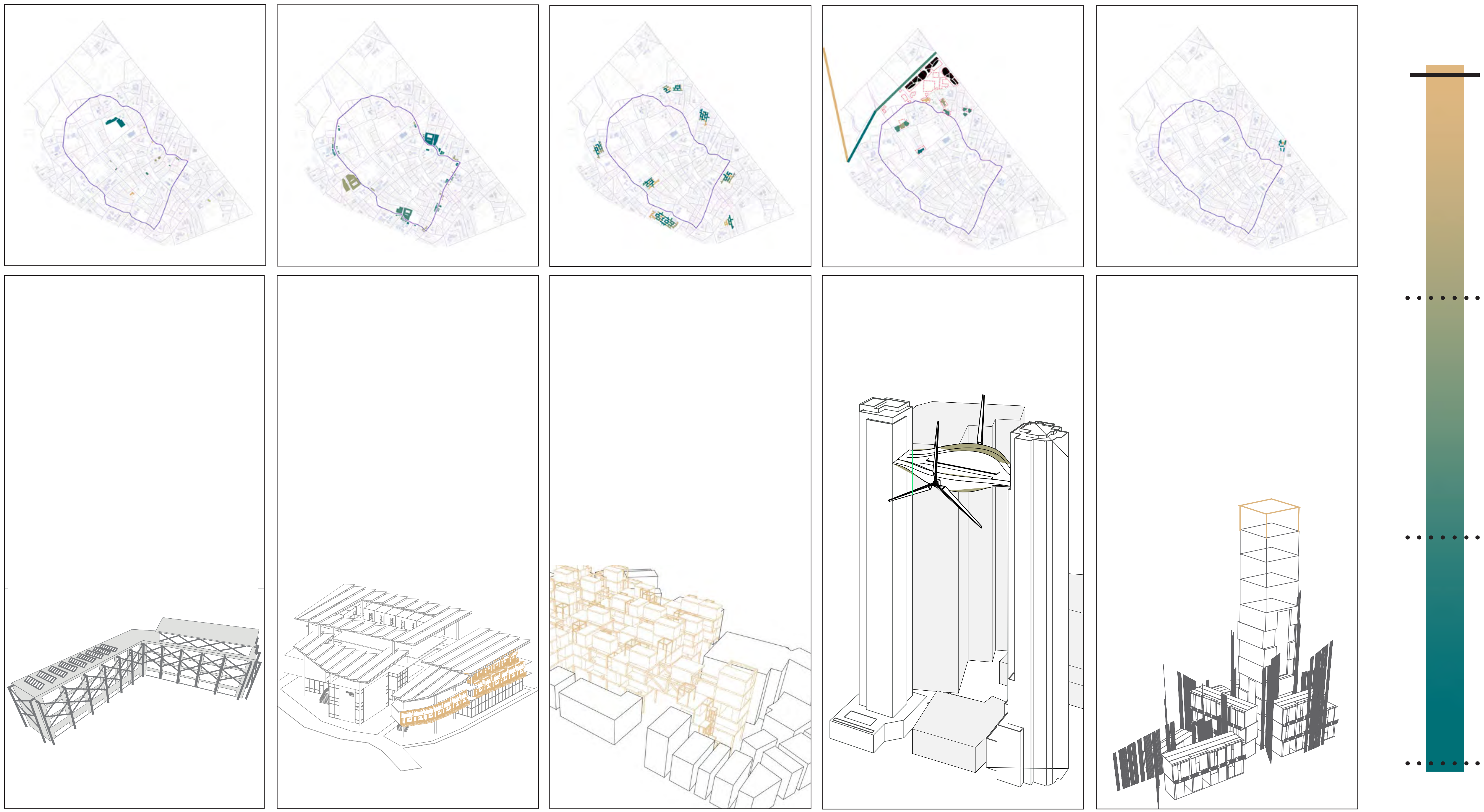
Progression

Progression - 15 Years



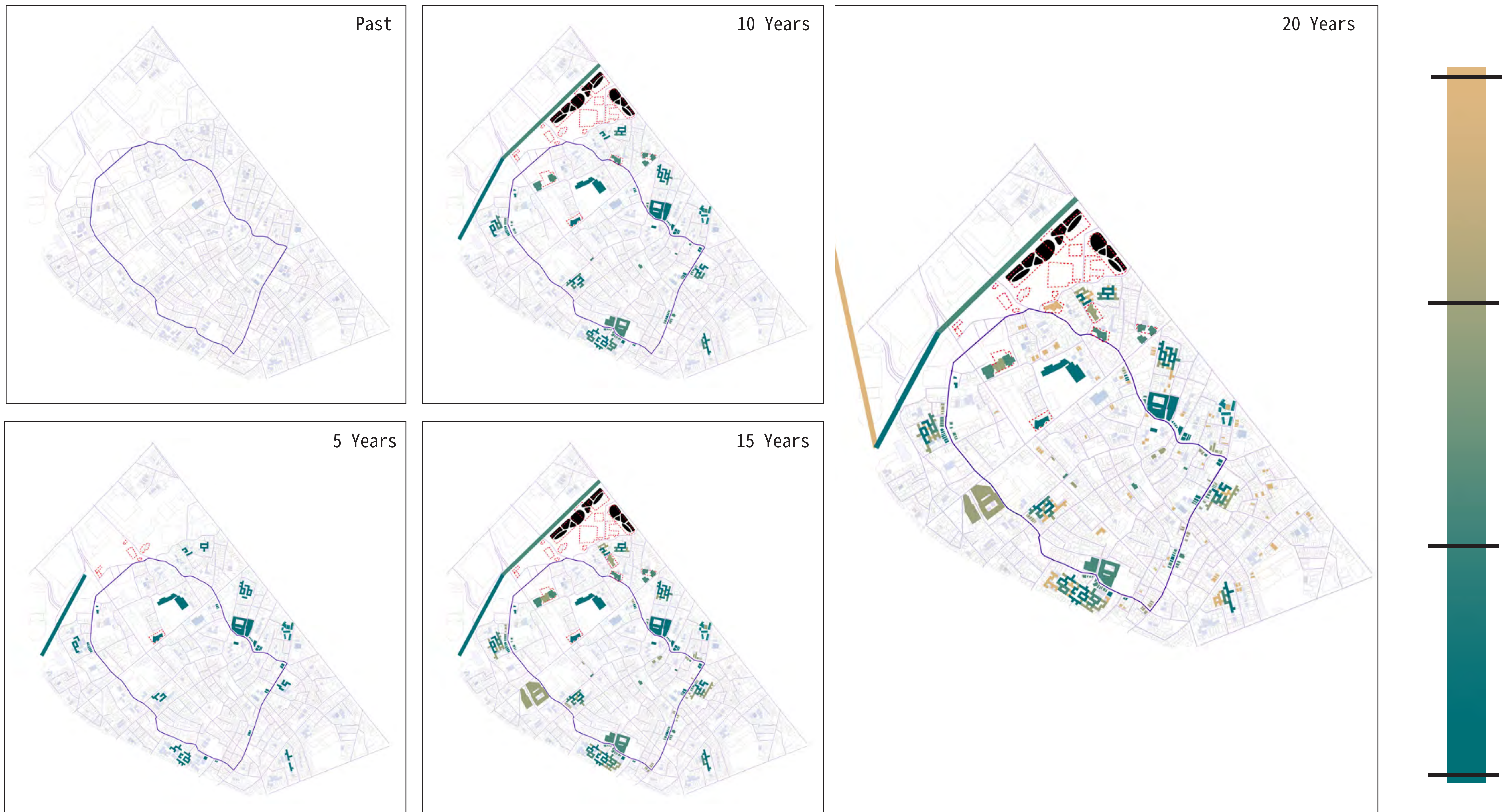
Cultivation Centers | Prefab Generator | Adaptable Village | Eco-Cell | Beacon | Progression

Progression - 20 Years



Cultivation Centers   Prefab Generator   Adaptable Village   Eco-Cell   Beacon   Progression

Progression - Overall



Prefab Generator Cultivation Centers Adaptable Village Eco-Cell Beacon Progression