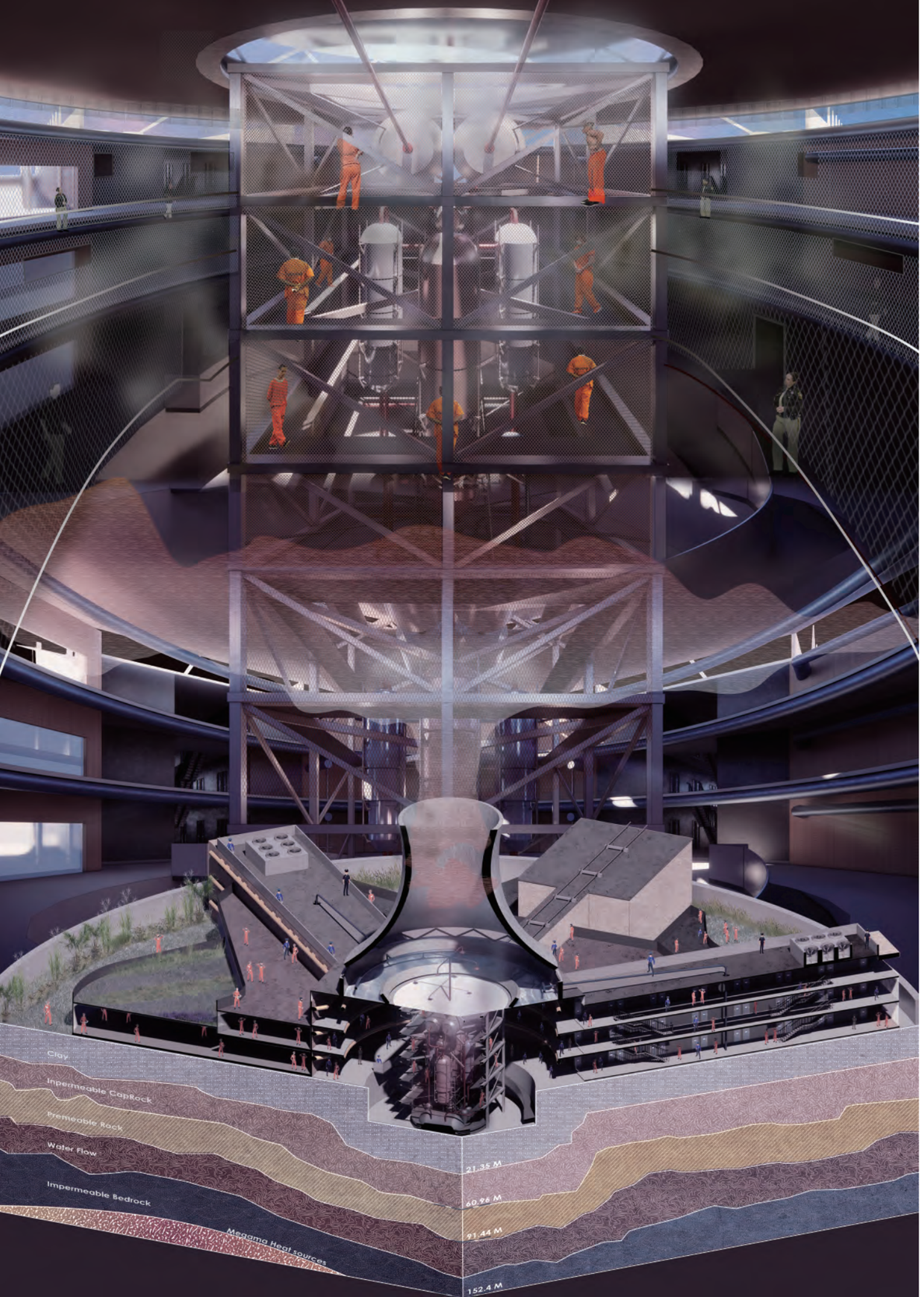
Portfolio

CHIEN CHENG

Columbia University
GSAPP Projects 2024-25

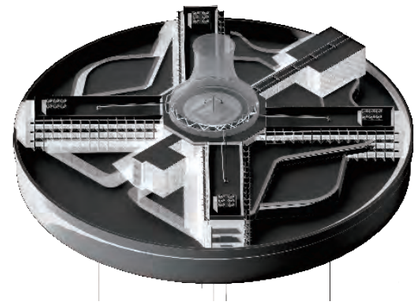
Master of Science
Advanced Architecture Design

Content



1 EXCAVATING EXISTENCE ENERGY

Renewable Energy in Jails-Individual Work



GSAPP_AAD Summer Semester

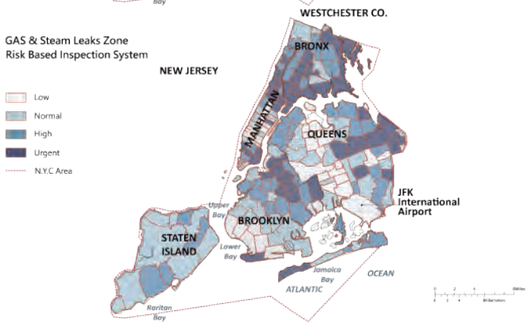
Academic work:	**Independent Work**
Category :	Inceration System, Geothermal Energy, Jails, Labor
Location :	Anna M. Kross Center, 1616 Hazen St, Flushing, NY 11370
Design period :	2024.May-Octobor
Project Instructor:	Laura González Fierro

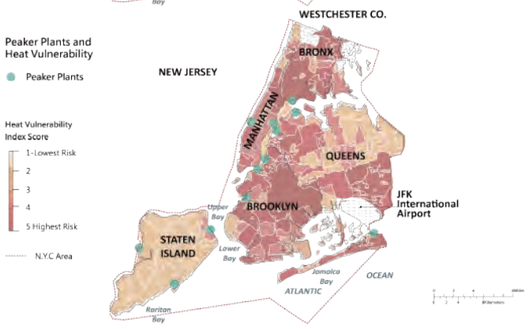
Could we envision an scenario where sustainable energy can benefit other sectors in society, specially one of the most vulnerable communities?

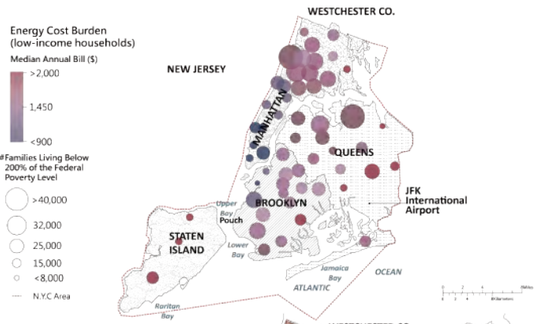
Based on a series of studies on geothermal energy in New York City, I propose the idea of using islands to address some of the mainland's challenges. Rikers Island, for example, has long been a contentious issue—a jail island that has gradually transformed in response to policies but remains a significant problem for the government and a reviled facility in the eyes of the public. While the government has proposed various futures for Rikers Island, most plans focus on completely erasing the existing facilities.

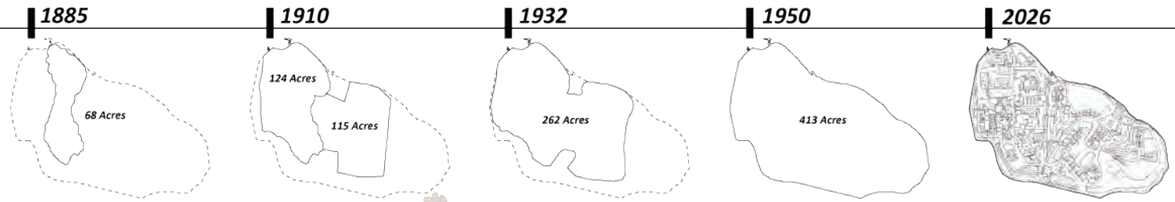
However, through my research on underground geological geothermal potential, I found that the bedrock beneath Rikers Island may have significant potential for geothermal energy extraction. Therefore, I propose transforming the island's incarceration center into a renewable energy facility that utilizes geothermal energy.
By integrating geothermal energy plants into the existing jail units, we can disrupt the traditional centralized layout and create more interactive spaces for inmates. This transformation can facilitate skill development and temporary detention, helping inmates more easily reintegrate into society and pursue a better future.

Energy Issues in NYC



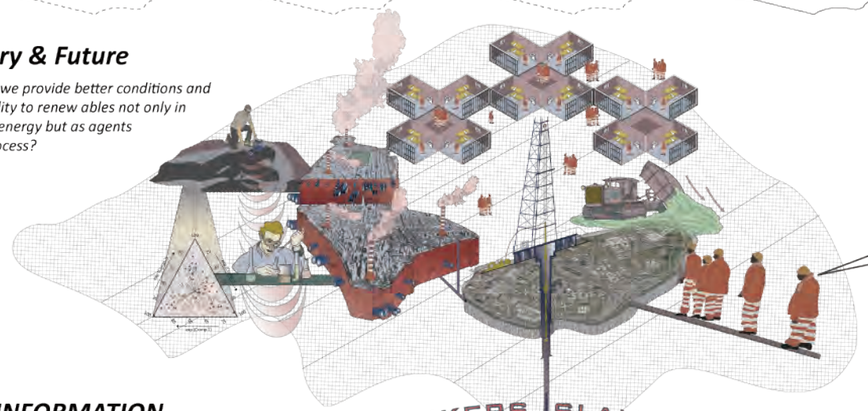






History & Future

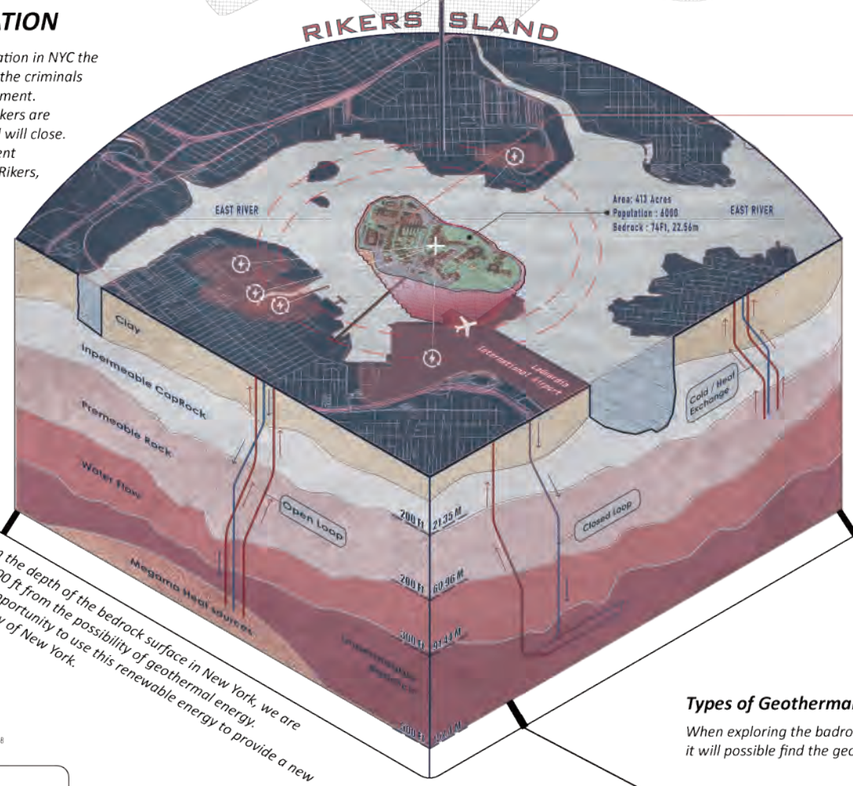
How can we provide better conditions and accessibility to renew ables not only in terms of energy but as agents in the process?



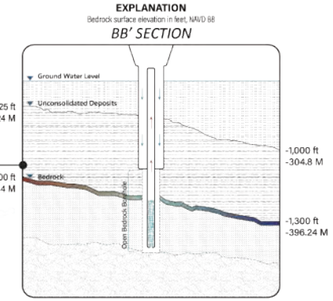
SITE INFORMATION

Because of the center location in NYC the government usually send the criminals to this island for imprisonment. However, many jails on Rikers are unsuitable to support and will close. Due to the bad environment and the low demands on Rikers, the government plan to shut down all of incarceration systems on Rikers in 2026.

I think Rikers Island can be a good example as a prototype of geothermal plants mixed with jail.



Take a deep look from the depth of the bedrock surface in New York, we are actually only 300 ft-1300 ft from the possibility of geothermal energy. Therefore, it is a great opportunity to use this renewable energy to provide a new source of power for the city of New York.



Started from 2016, there are different proposals from the government to shut down the jails on Rikers and relocate in other cities.

Due to the bad environments on the island and the lower demand, there are different proposals from the government to shut down the jails on Rikers and relocate in other cities started from 2016, .

However, is it suitable jails relocated on the center of NYC?
Is there any other option?
Can Rikers Island be a good example as a prototype of geothermal plants mixed with jail?

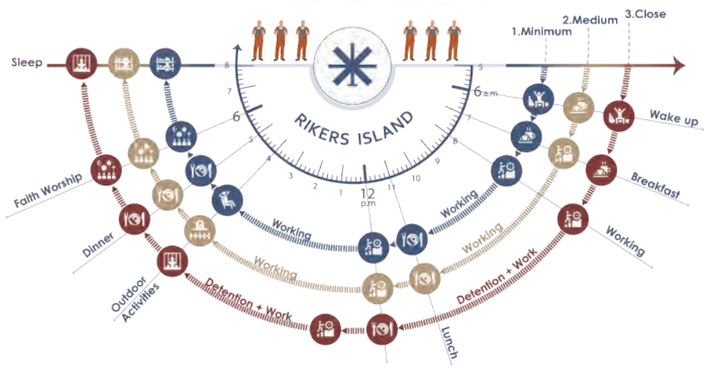
Renewable Energy Island
A Better Future for Inmates, and for NYC?
an we imagine and overlap between

The limited incarceration unit is often overcrowded and with inhumane treatment. No matter it is a cellular individual unit or a multi-person unit.

1 unit can supply:
400 prisoners
360 jobs

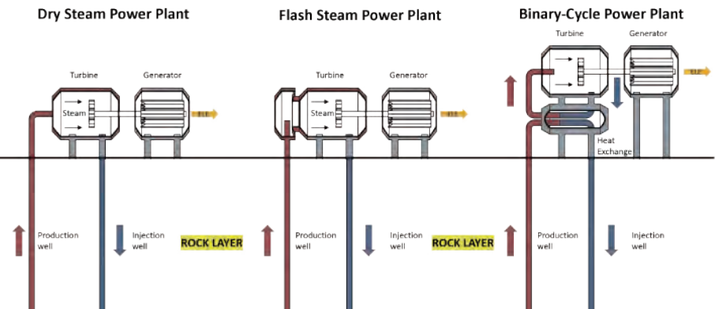
Geothermal works:
120 prisoners/ 1 sheet
360 prisoners/ 3 sheets

24hr schedule on Rikers Island



Types of Geothermal Power Plant

When exploring the badrock layer under ground, it will possible find the geothermal energy.



The problems of jails on Rikers Island

$556,539/ year

10,000/ daily

Budget of $860 million/ year

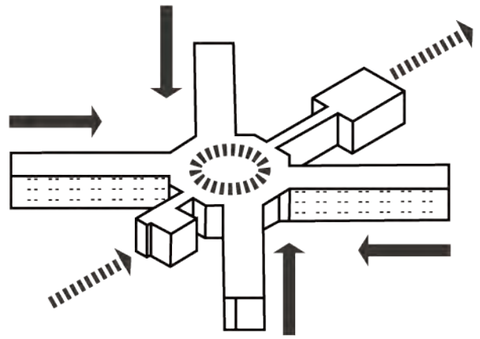
Prototype of Jails

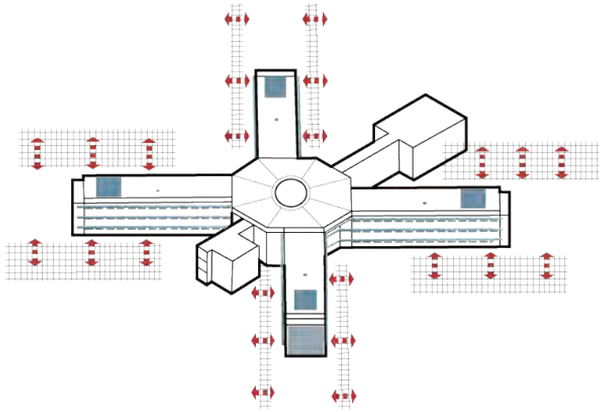
SITE
Anna M. Kross Center the oldest and largest incarceration on Rikers Island

Diagram

1. Original Unit

Using the central public space to supervisor each cells, however the cells imprison too many people



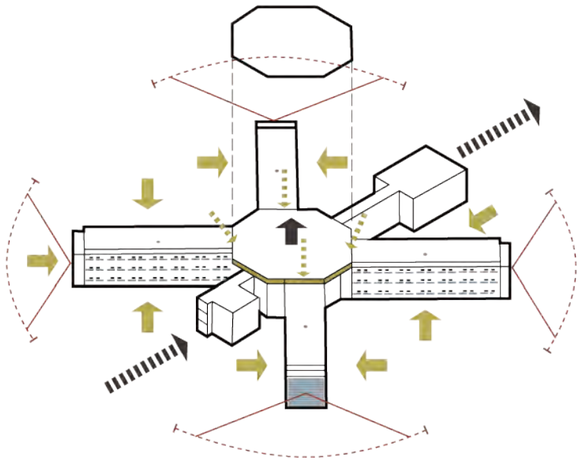


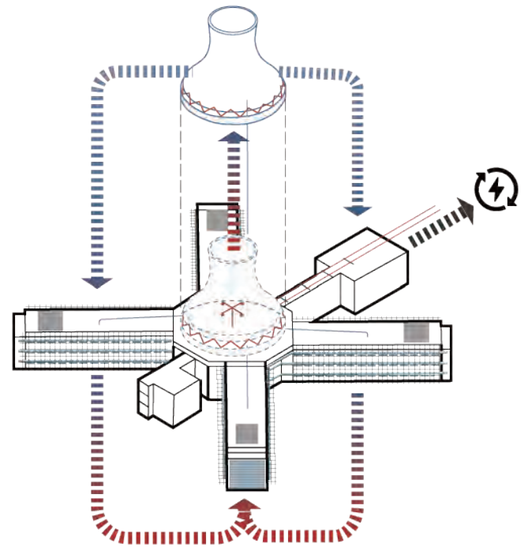
2. Structural Reinforcement

Adding the exoskeleton to reinforce the building, and support more public space to activities.

3. Increase Natural Light

Enhance more natural light into cells, improving not only the public space but also the cross prototype



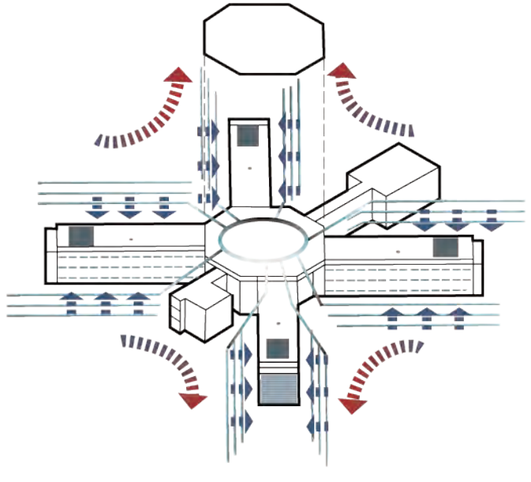


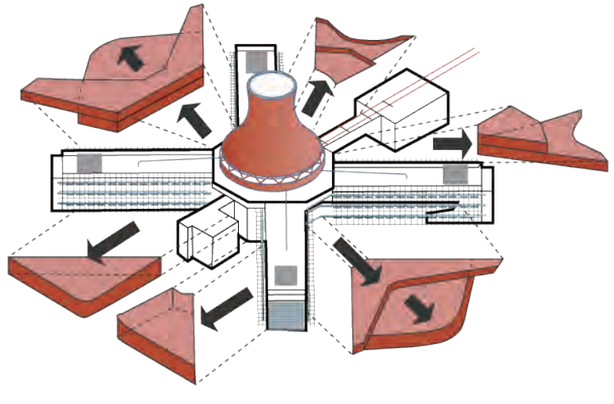
4. Geothermal Power Plant

Adding the geothermal equipements in the center core, support the skill learning for prisoners and be easy supervised by jailers.

5. Improve Ventilation Environment

Inhale the airflow from the elevation, using the new ventilation pippe to improve the air in the unit. The air will be lead to the central core, release with the warm air



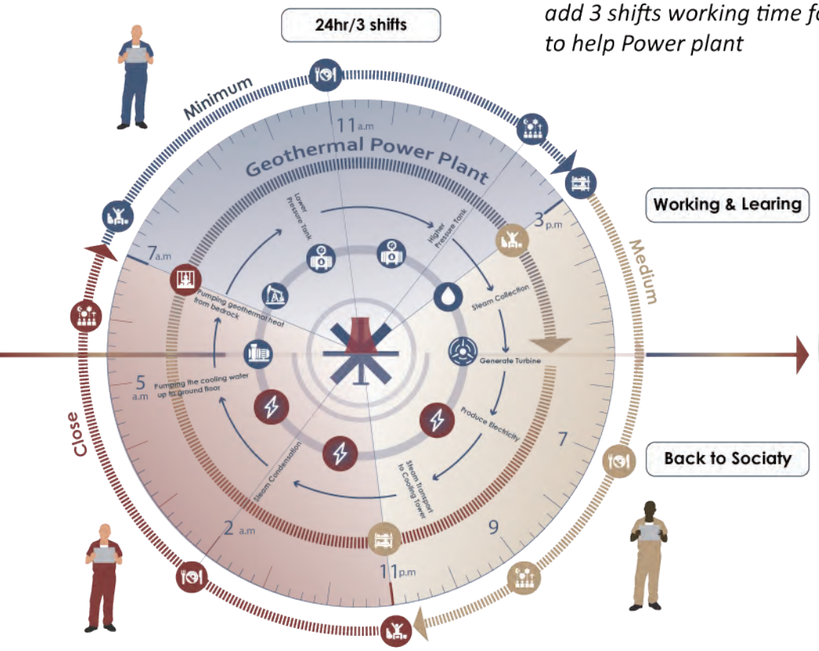


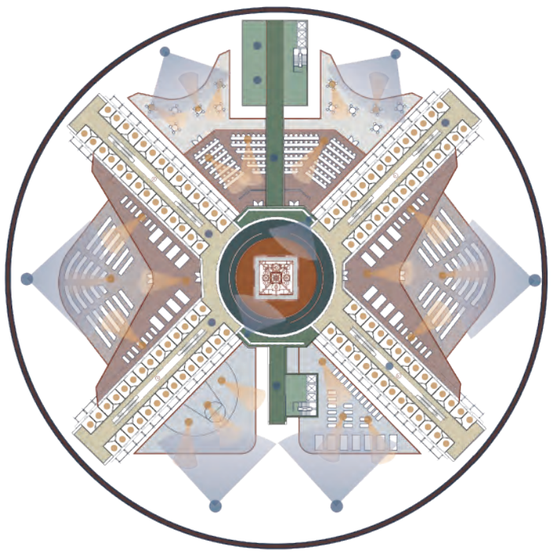
6. Reverse Common Space

Redesign the jail's prototype with the fingertip space, creat more public space for prisoners. Transform the nagetive facilities into positive

Reverse NIMBY

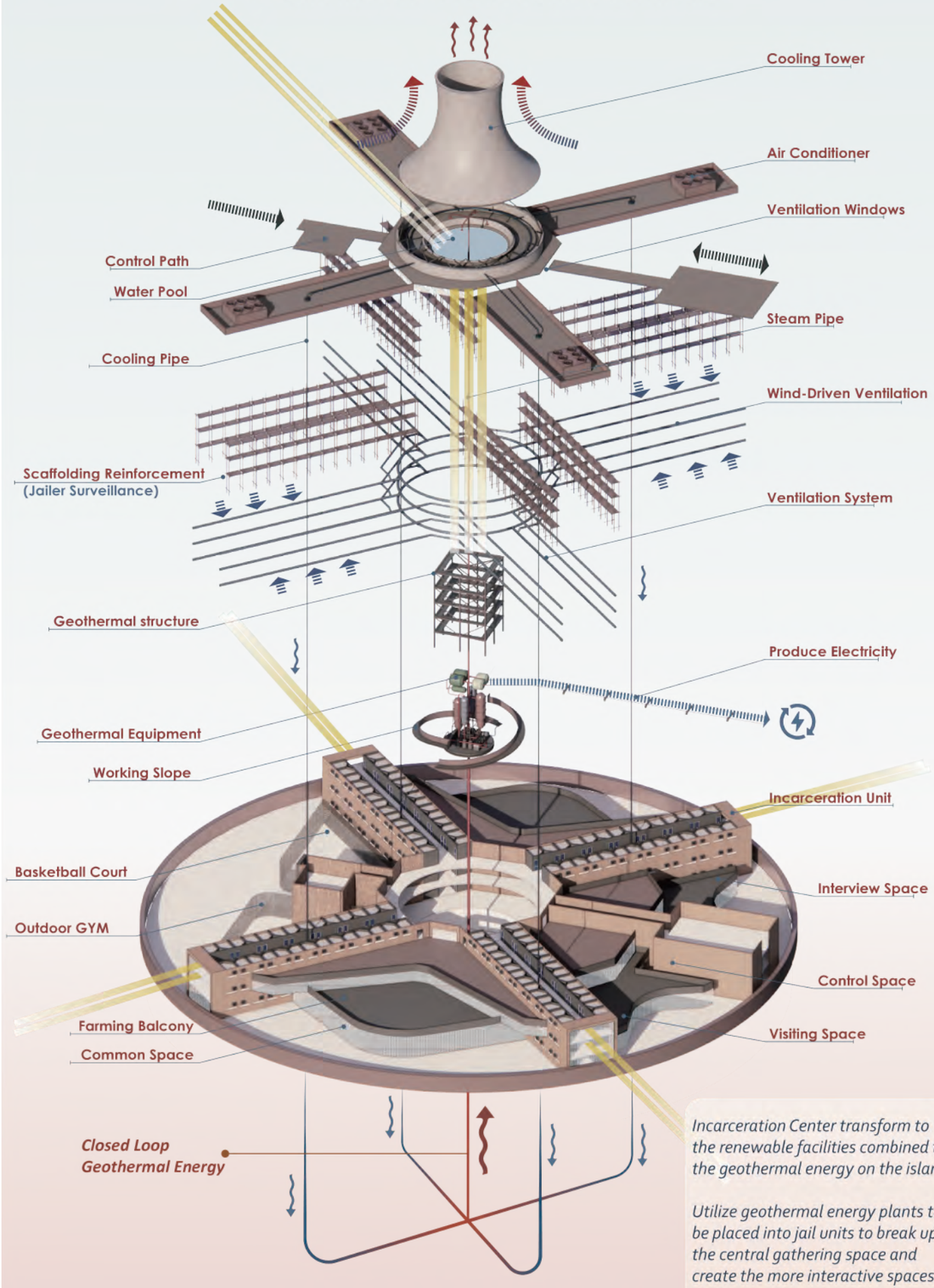
Place geothermal power plant can add 3 shifts working time for prisoners to help Power plant





1.Day Shift:Time: 8:00 AM - 4:00 PM
2.Evening Shift:Time: 4:00 PM - 12:00 AM
3.Night Shift:Time: 12:00 AM - 8:00 AM

Geothermal Power Plant X Incarceration Unit



Incarceration Center transform to the renewable facilities combined to the geothermal energy on the island.

Utilize geothermal energy plants to be placed into jail units to break up the central gathering space and create the more interactive spaces for the inmates.

Renewable Energy X Social Cycle

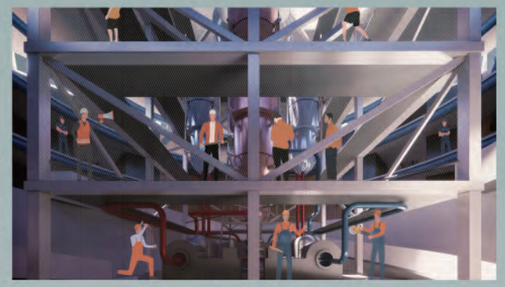
Prisoner's daily life

1. Cell Unit

2. Cross Corridor

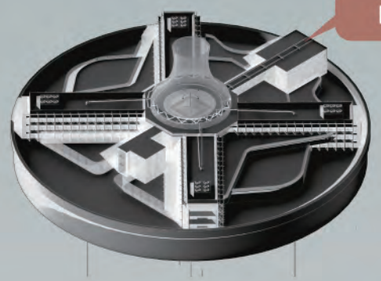
3. Public Space

4. Outdoor GYM



5. Geothermal Job Site

Power transmission: Island to Land



Bronx
Population: 144.3 Million
0.002x 1443000 = 2900 GWh/ Year

Rikers Island can povide 5% daily electricity
to Bronx each year
20 x8= 160 GWh/ Year

Queens
Population: 236.4 Million
0.002x 2364000 = 4700GWh/ Year

Electrical Consumption
1 Person= 0.002 GWh/ Year

Industry near Rikers Island
20 x3= 60 GWh/ Year

Accessible Energy

"Could we envision a scenario where sustainable energy can benefit other sectors in society, specially one of the most vulnerable communities?"

How can we provide better conditions and accessibility to renewables not only in terms of energy but as agents in the process?

+3225cm Tower Top

Cooling Tower

Cooling Water

Bath House / Reward

+1410cm Cooling Tower

+1270cm Cooling water pool

Cooling Water

Turbines / Generator

LP Condenser

HP Condenser

+960cm 4F

Heat Exchanger

+650cm 3F

Pump

Circulation Ramp

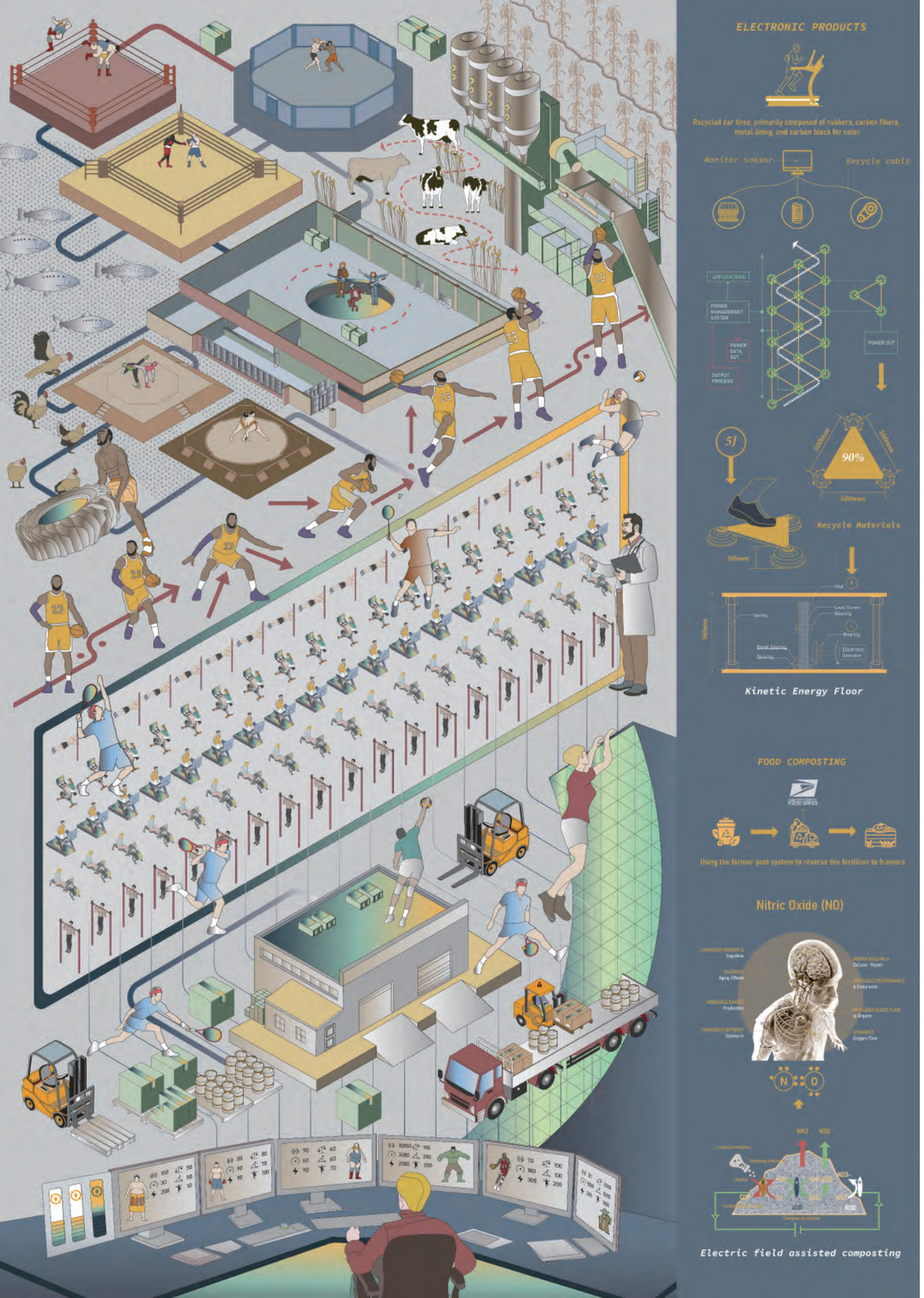
+340cm 2F

Steam & Hot Water

+30cm 1F

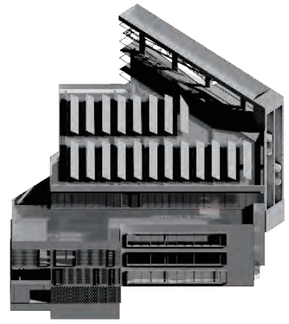
Incarceration System Section

Scale: 1/200



2 URBAN ENERGY HUB

Transforming Post Offices into an Alternative Power Source



GSAPP_AAD Fall Semester

Academic work:	**Independent Work**
Category :	USPS, Return System, Knetic Energy, Energy Hub, Reverse Logistics
Location :	2645 Atlantic Ave, Brooklyn, NY 11207
Design period :	2024.Octobor- December
Project Instructor:	Cyrus Peñarroyo

How can we reform reverse logistics and revitalize the postal system through energy generated by kinetic power?

Modern reverse logistics—returns, packaging, and transport—often harms the environment. Though technology has made life easier, its environmental cost is frequently overlooked.

Historically, post offices led logistics innovation, using kinetic energy to move goods. Reimagines the post office as a renewable energy hub, it transforms returned electronics, urban food waste, and fresh produce into power. Individuals contribute kinetic energy, which generates electricity to support the building and the surrounding city.

A vertical ramp streamlines returns and integrates renewable systems that store energy in battery tanks or recycled power bricks made from e-waste and food scraps. Users can directly experience how their effort creates electricity, raising awareness of reverse logistics' impact and promoting well-being.

Looking ahead, the post office could become a vital, zero-emissions energy center, powering EV infrastructure through sustainable reverse logistics.

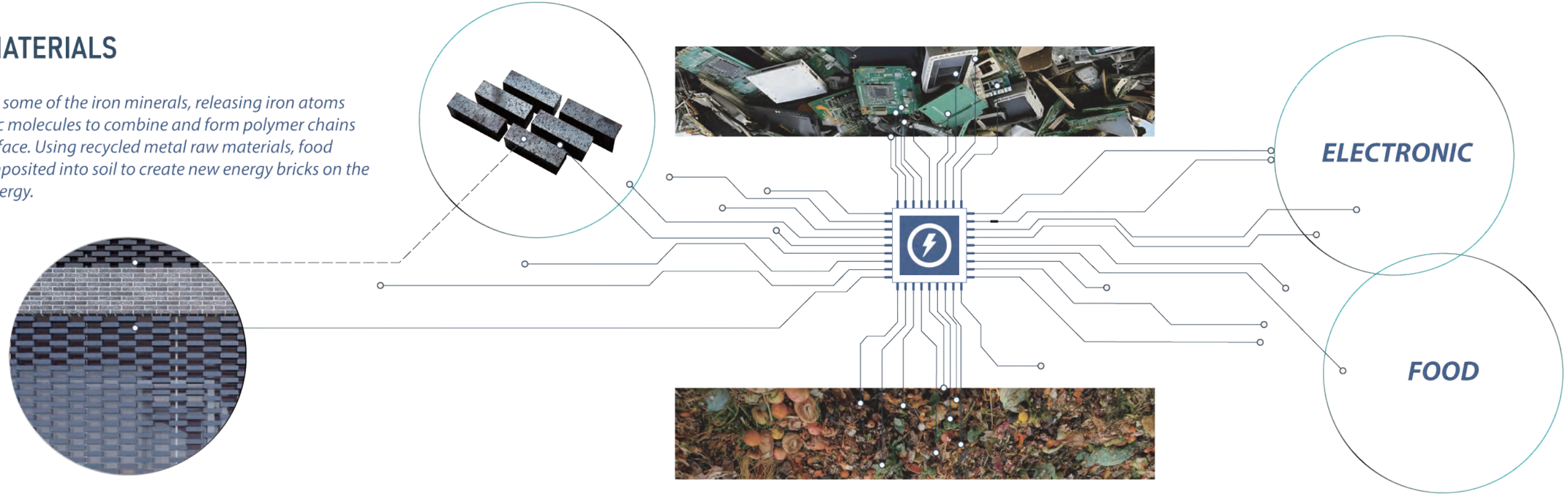
Food Waste Site Analysis

Athletic Fields Site Analysis

RECYCLE MATERIALS

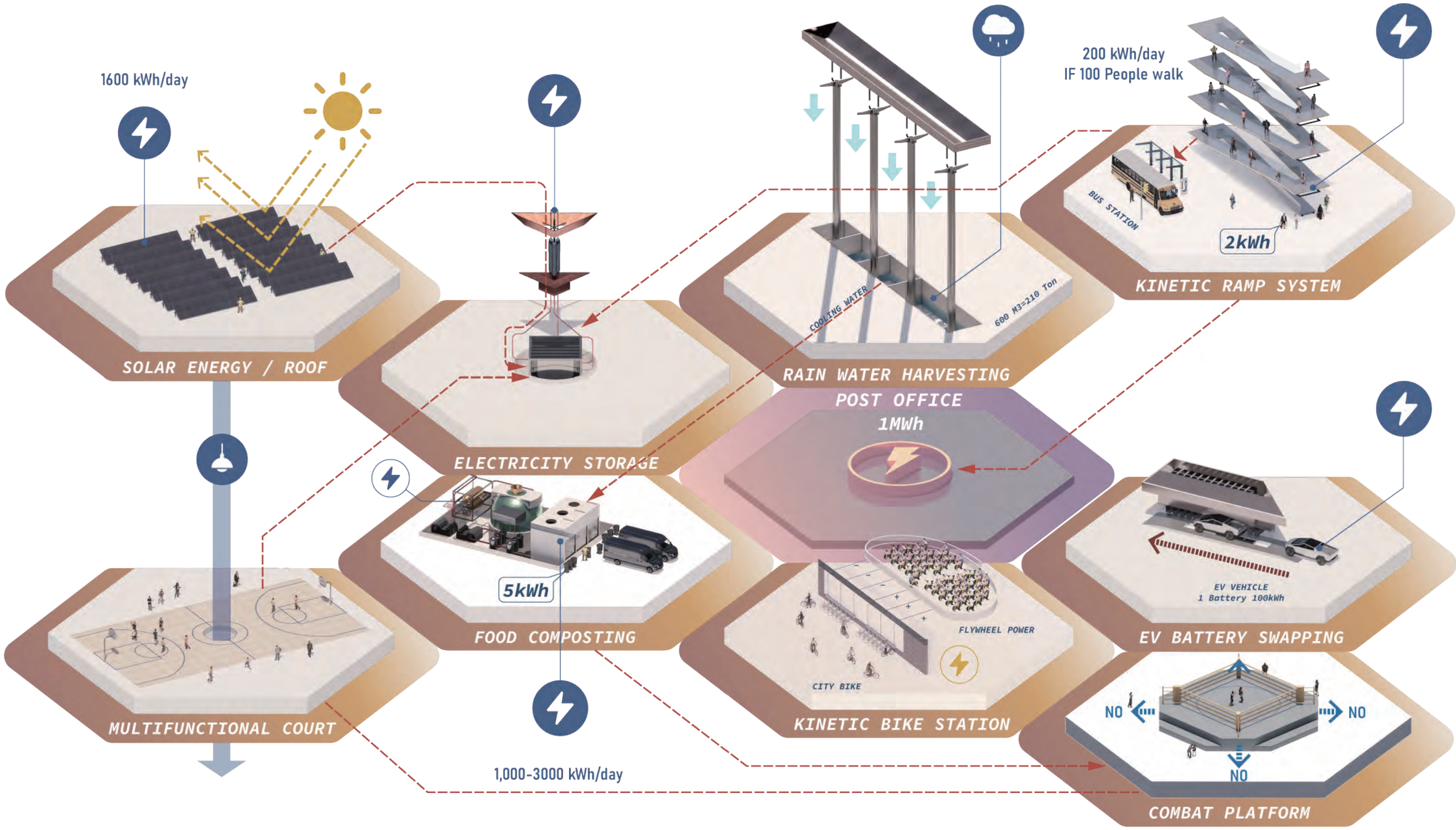
Power brick

The acid dissolves some of the iron minerals, releasing iron atoms that allow organic molecules to combine and form polymer chains that cover the surface. Using recycled metal raw materials, food compost is decomposited into soil to create new energy bricks on the facade to store energy.



ENERGY DIAGRAM

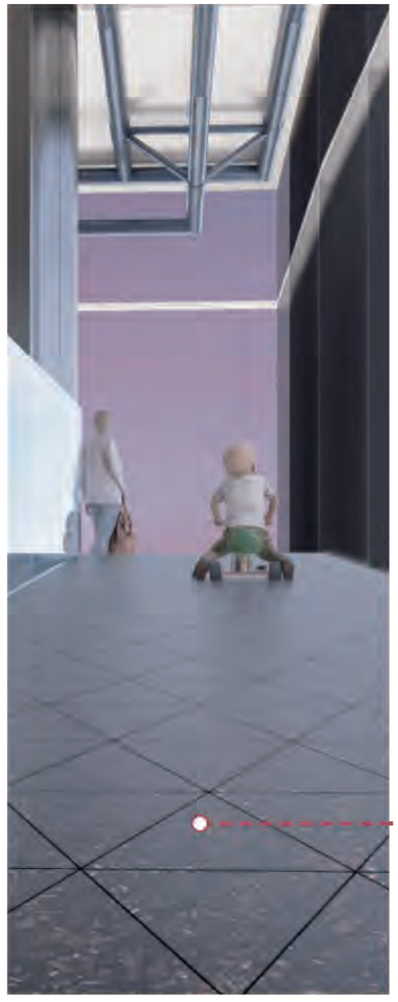
By integrating these energy systems, the post office can transform into a self-sufficient power hub. Beyond meeting its own energy needs, it could also support power conversion for urban transportation systems, public infrastructure, and more. This positions it as a key energy storage and conversion station within the city's ecosystem.

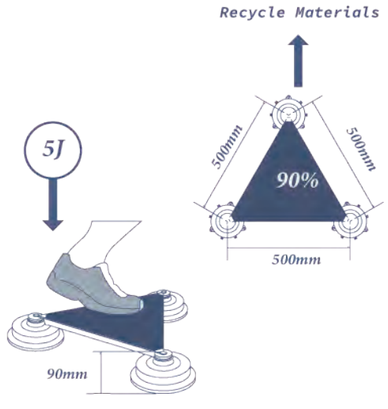


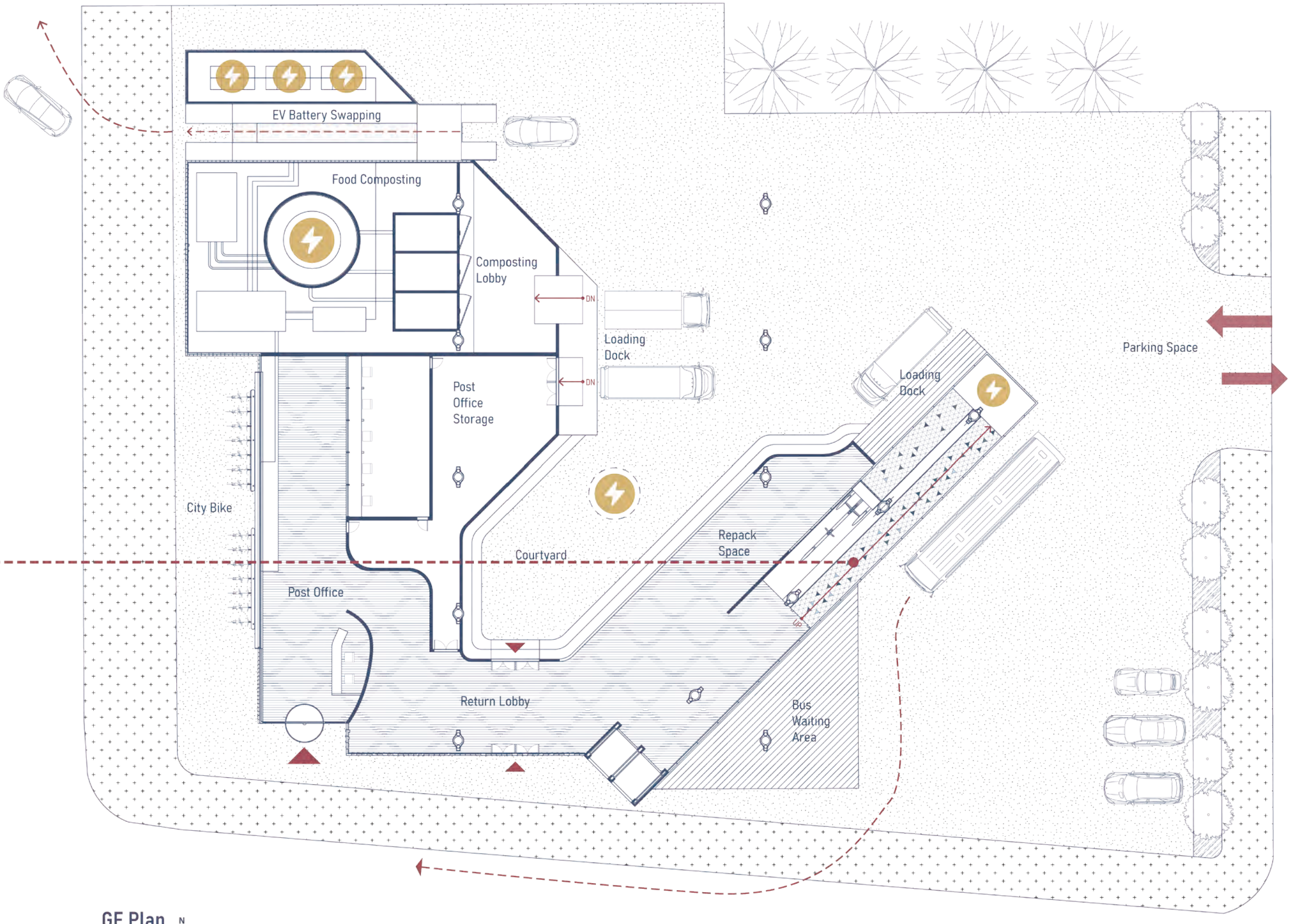
RECYCLE MATERIALS

RECYCLE ELECTRONIC PRODUCTS & FOOD COMPOSTING

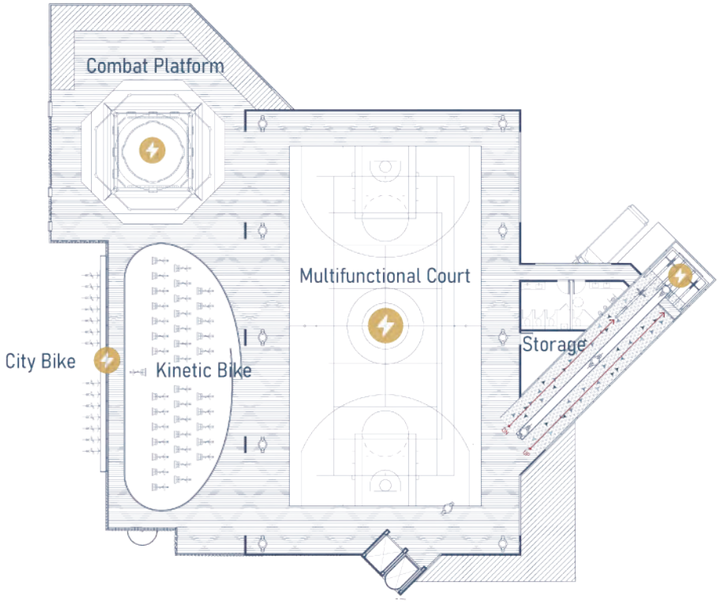
KINETIC RAMP TILES



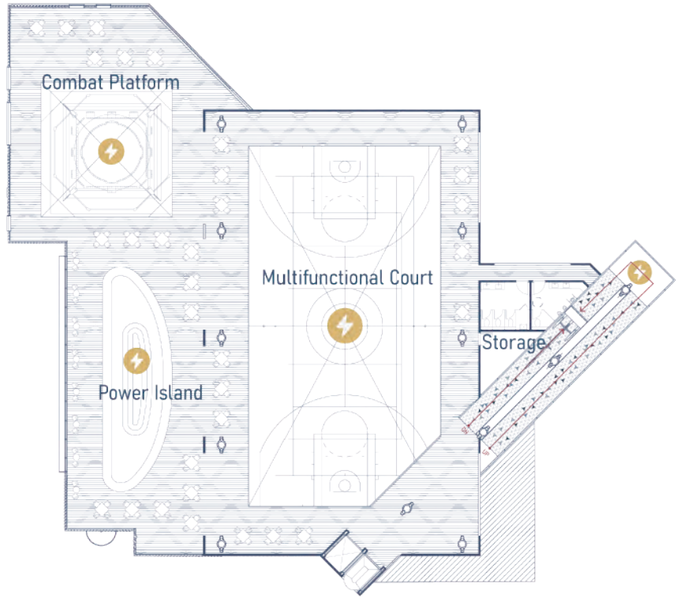




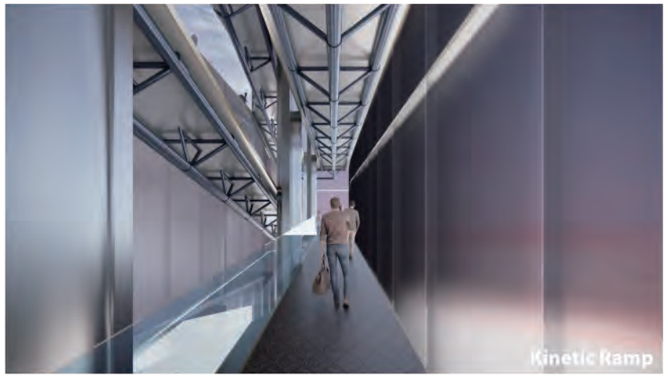
GF Plan
Scale: 1/250

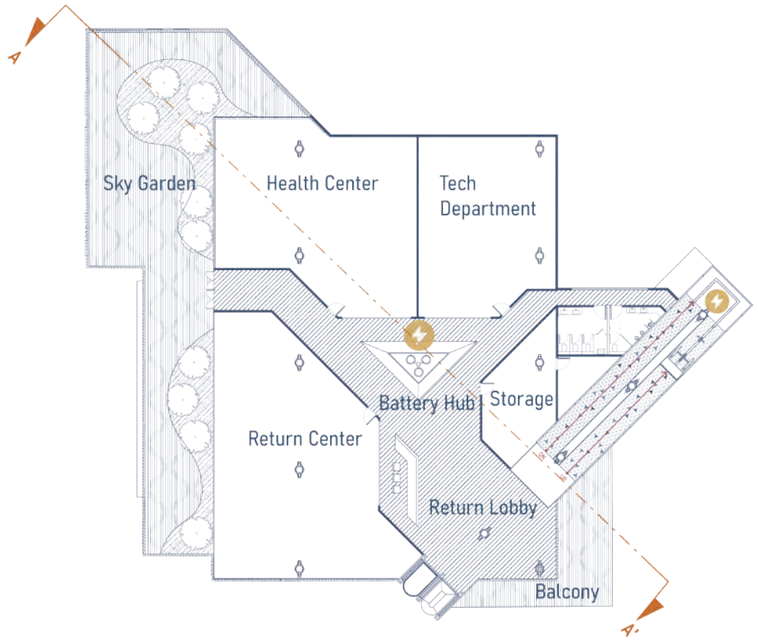


2F Plan
Scale: 1/500

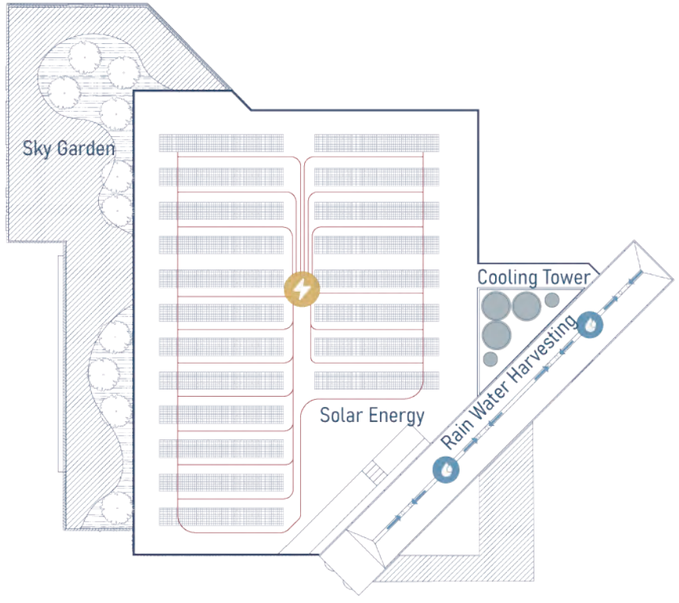


3F Plan
Scale: 1/500





4F Plan
Scale: 1/500

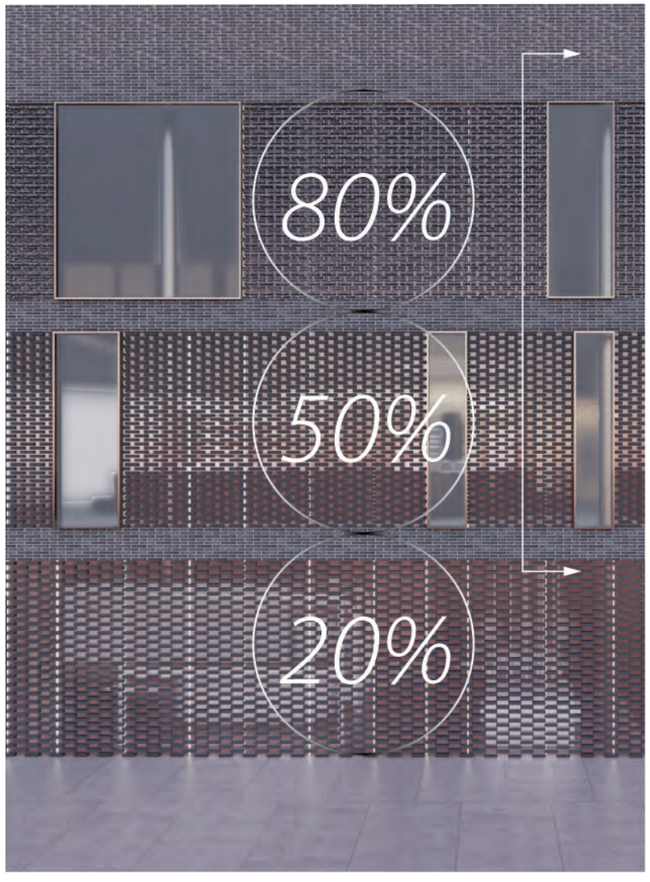


Roof Plan
Scale: 1/500

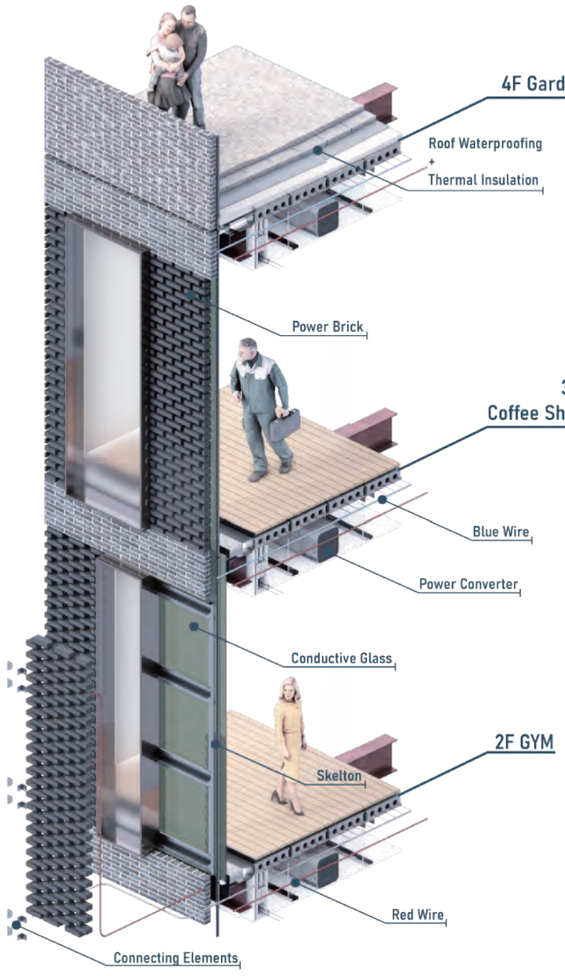
KINETIC ENERGY PROUDUCED BY THE DAILY TRAINING

As a high-tech fitness hub, the post office invites community residents to exercise during their spare time —especially when making returns. The kinetic energy they generate is stored as electricity within the post office. Acting as an energy transfer station, the post office then distributes this power to support public transportation systems and contribute to the city's sustainable energy network.

POWER BRICK DETAIL



The density of the bricks on the facade can be used to determine the amount of electricity stored. As shown in the elevation, the higher the floor, the greater the electricity storage value.



ENERGY DIAGRAM

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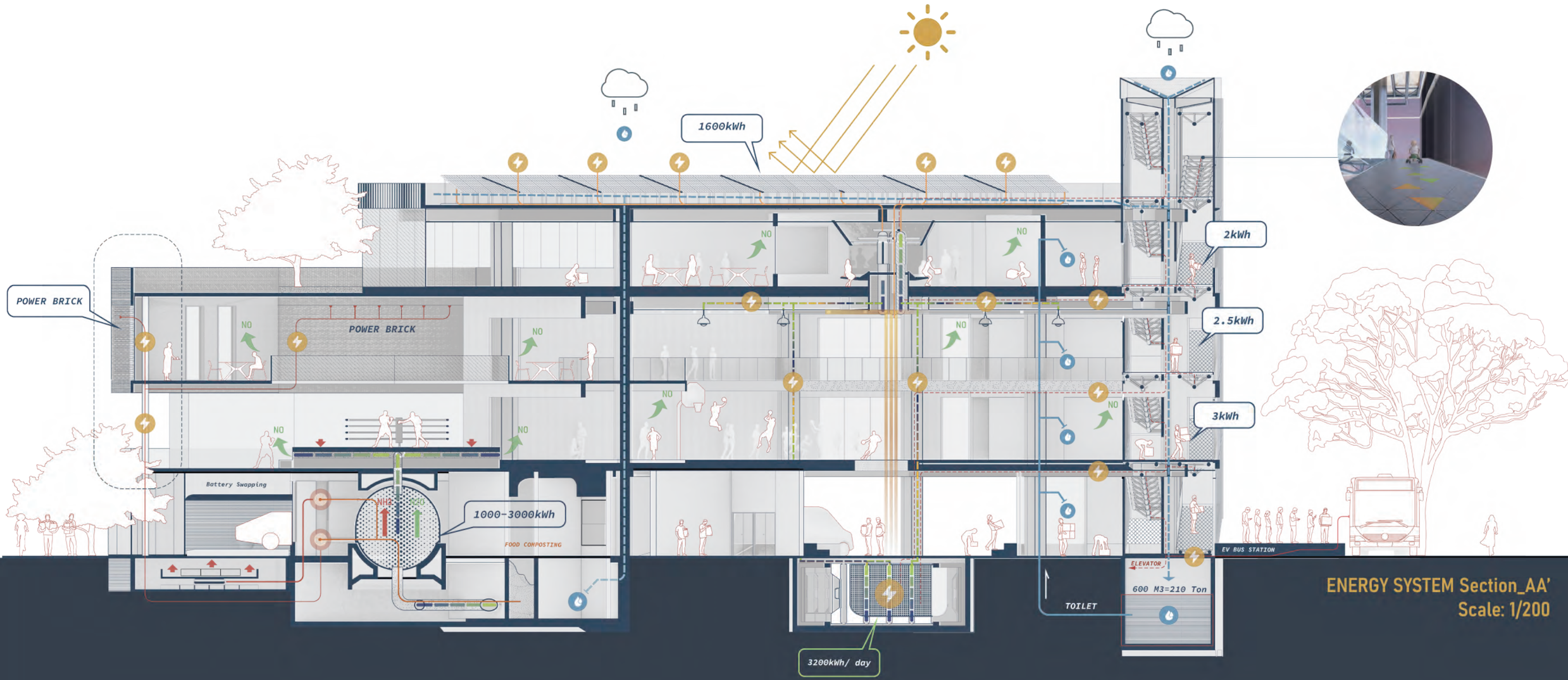
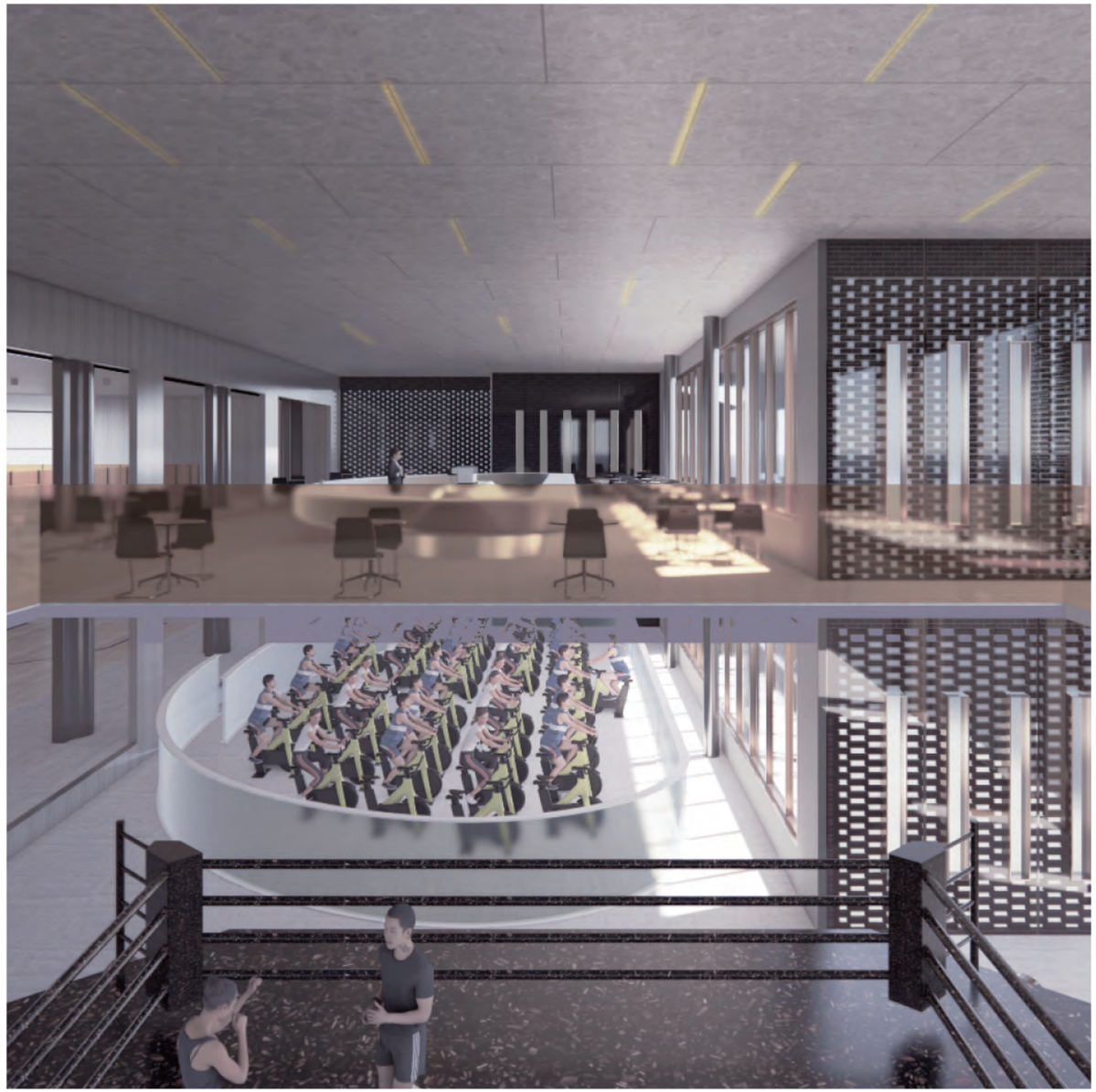
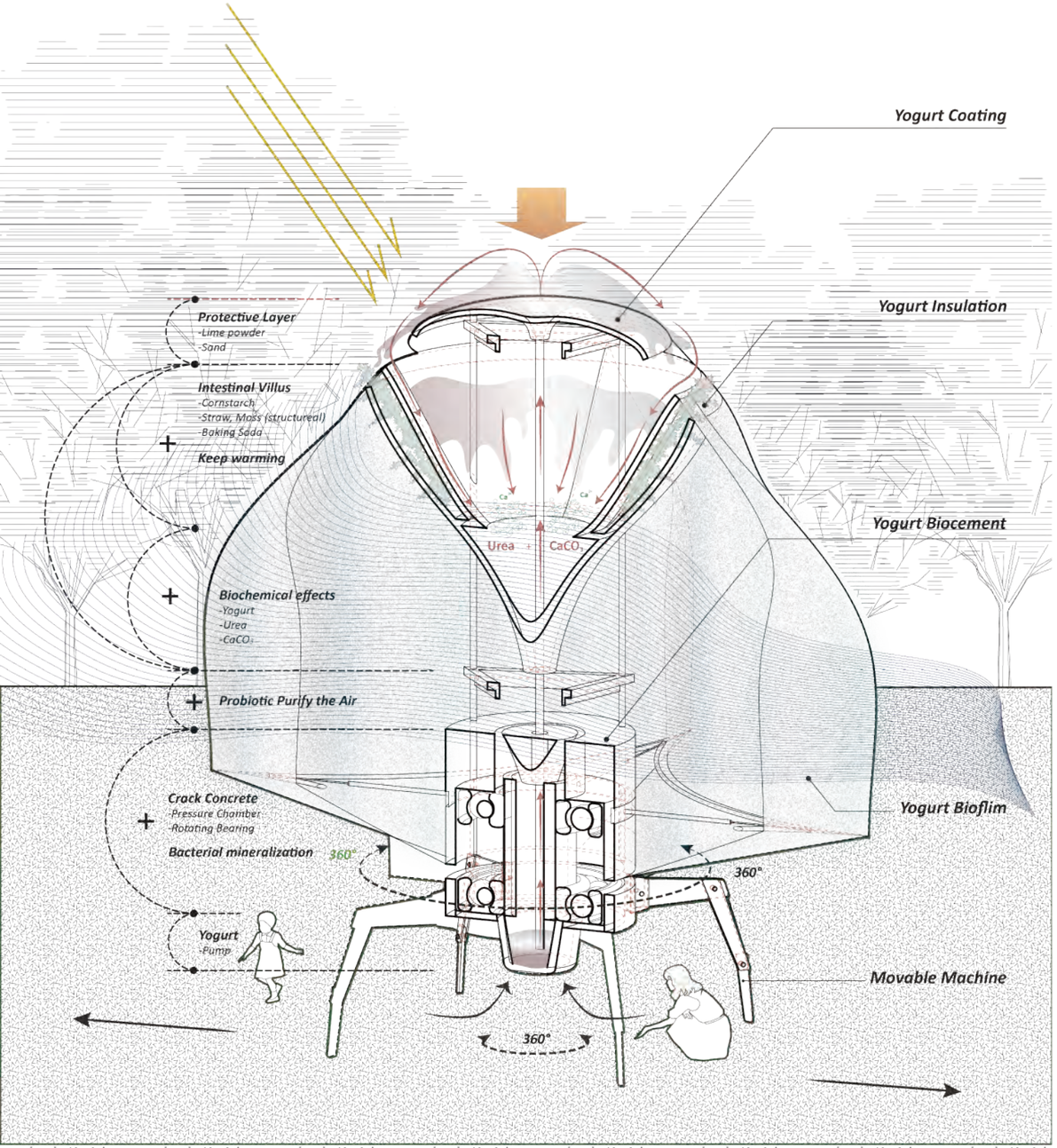


ENERGY SYSTEM Section_AA'
Scale: 1/200

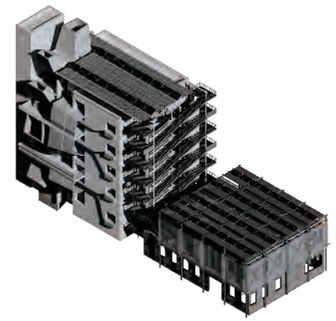

URBAN
ENERGY HUB





3 BUILDING OXYGHALA

Making Greek Yogurt to create the living machine



GSAPP_AAD Spring Semester

Academic work:	**Independent Work**
Category :	Greek Yogurt, Polykatoikia, Living Machine, Micrbiome, Metabolism
Location :	Falirou 54, Athina 117 41, Greece
Design period :	2025.February- May
Project Instructor:	Lydia Kallipoliti

How can we use microorganisms to infiltrate the living environment and indirectly affect the daily life of the community?

Building Oxyghala explores how architecture can form a symbiotic relationship with microbial life, drawing inspiration from Oxyghala, an ancient Greek yogurt. Rich in probiotics like Lactobacillus bulgaricus, yogurt not only promotes digestion and immunity but also serves as a reflection of a region's unique microbial ecosystem. Just as eating local yogurt reveals the microbiome of a place, this project asks: can buildings similarly absorb, interact with, and support microbial life?

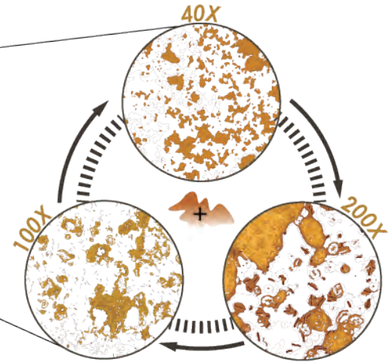
Tracing the historical migration of yogurt through human movement—particularly during the Huns' westward expansion—reveals how fermented dairy spread alongside livestock, microbes, and culture. Building on this idea, a series of material experiments reimagines yogurt as a construction element: from calcium-infused yogurt concrete for self-healing, to yogurt bio-coatings that regulate temperature and biodegrade, to straw-based fillings for insulation formed with baking powder.

These materials are speculatively applied to the renovation of Greek apartment buildings (polykatoikia), using scaffolding systems as a means to "wrap" the old structures with probiotic, regenerative layers. Like the human gut being supported by beneficial bacteria, these buildings are imagined as living organisms—able to ferment, heal, and adapt to their environments.

YOGURT MATERIAL

Raw Milk

Greek Yogurt



Bacteria microbiots in yogurt

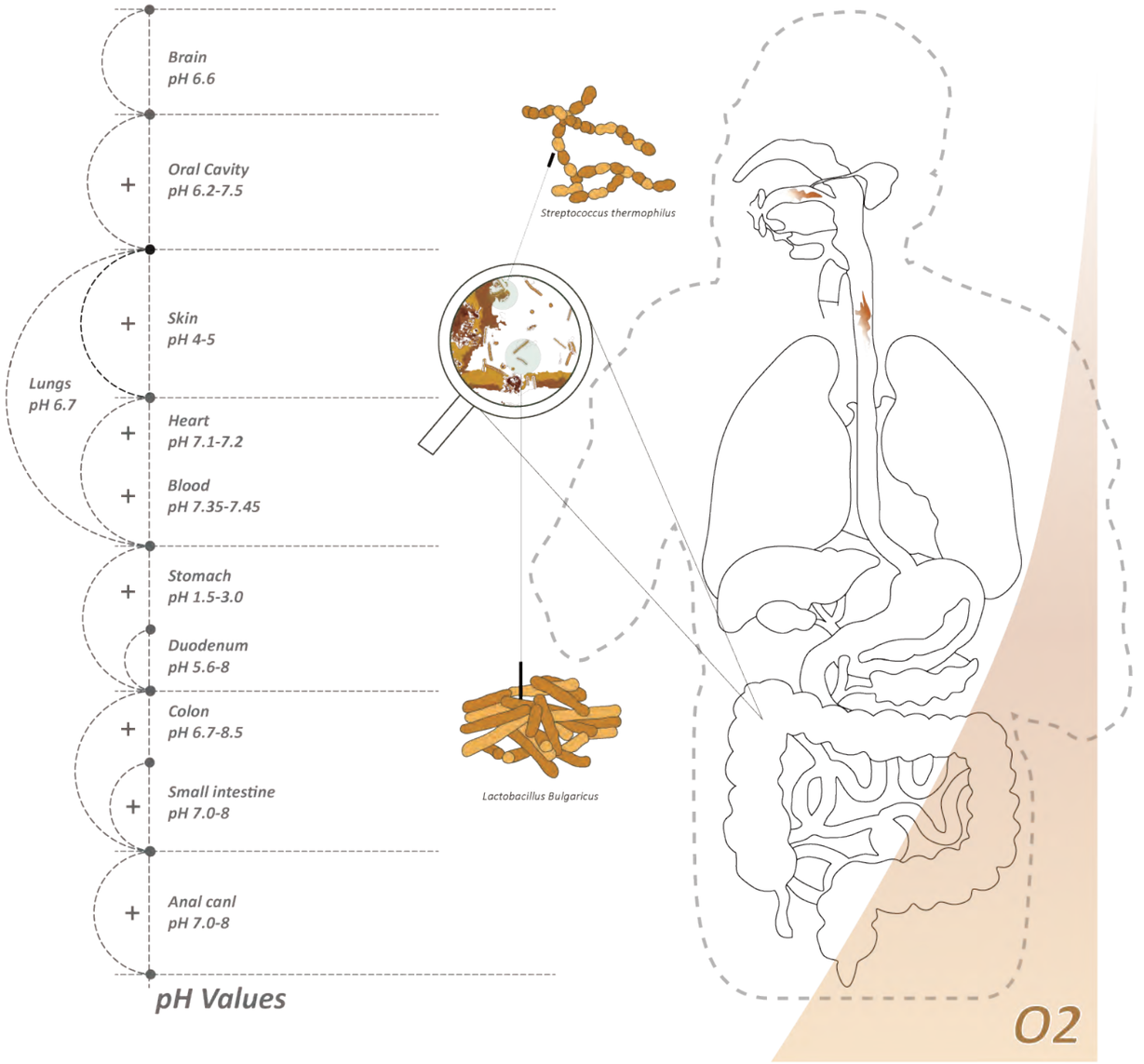
Concrete + Painting

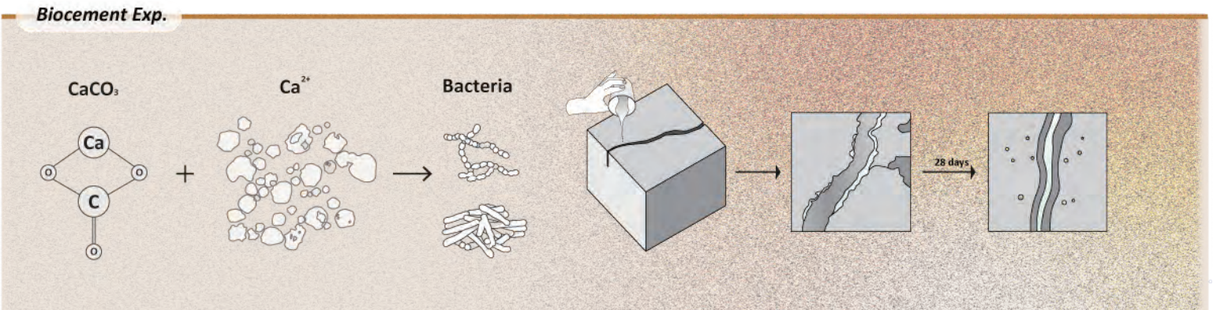
Straw Yogurt Bricks

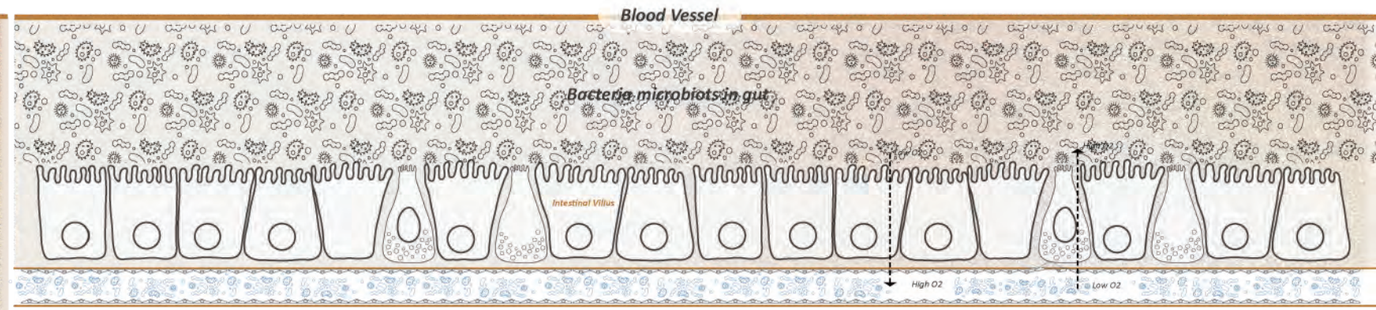
Straw

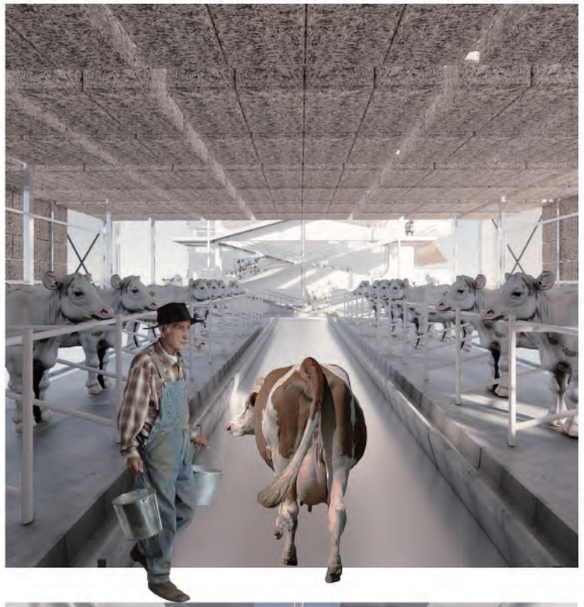
Air purify

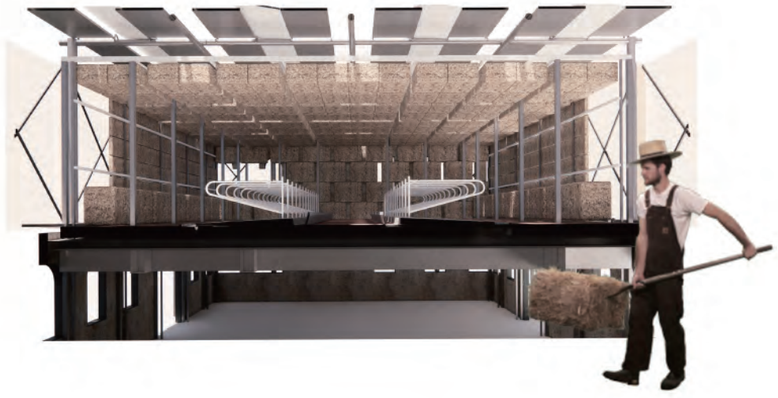
YOGURT IN BODY

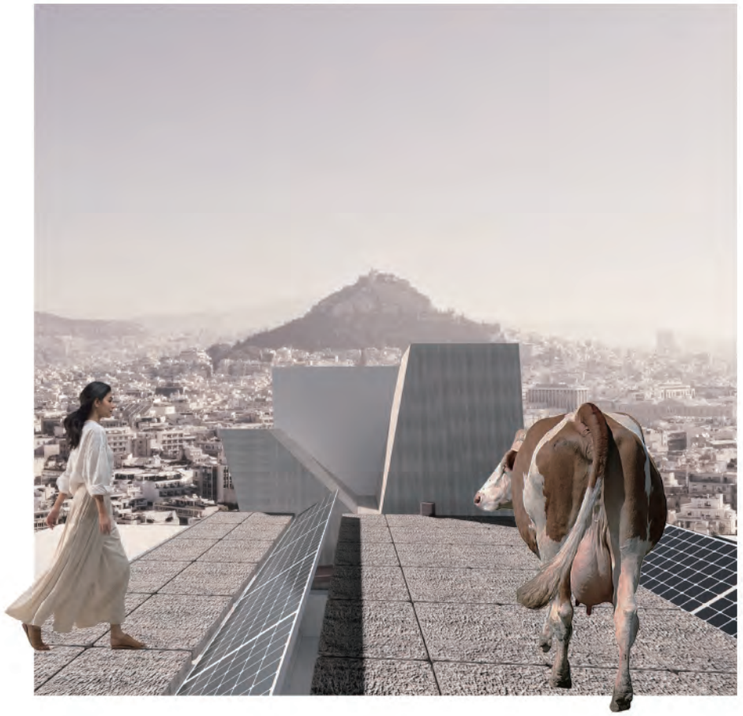




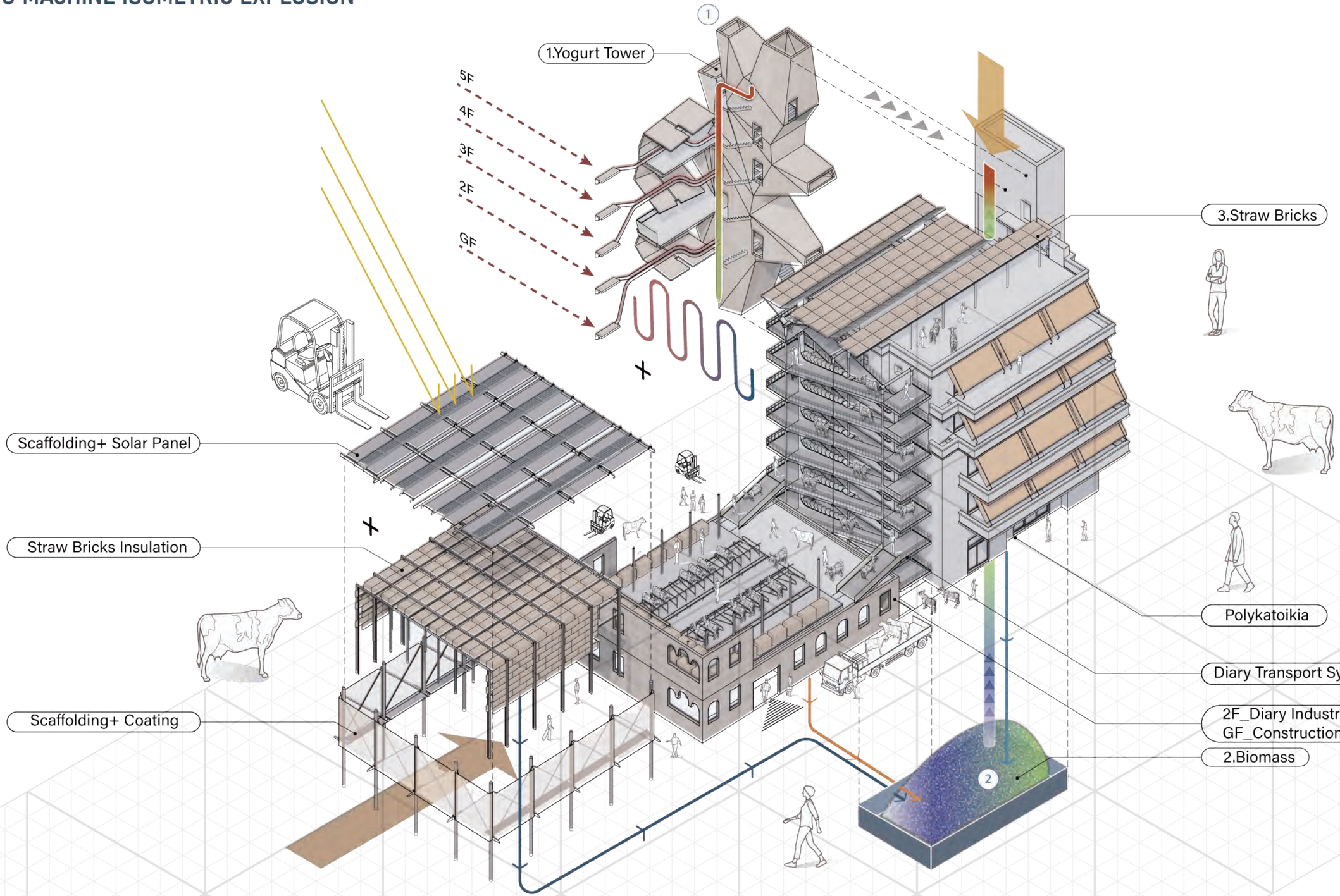








LIVING MACHINE ISOMETRIC EXPLOSION



BUILDING MATERIAL

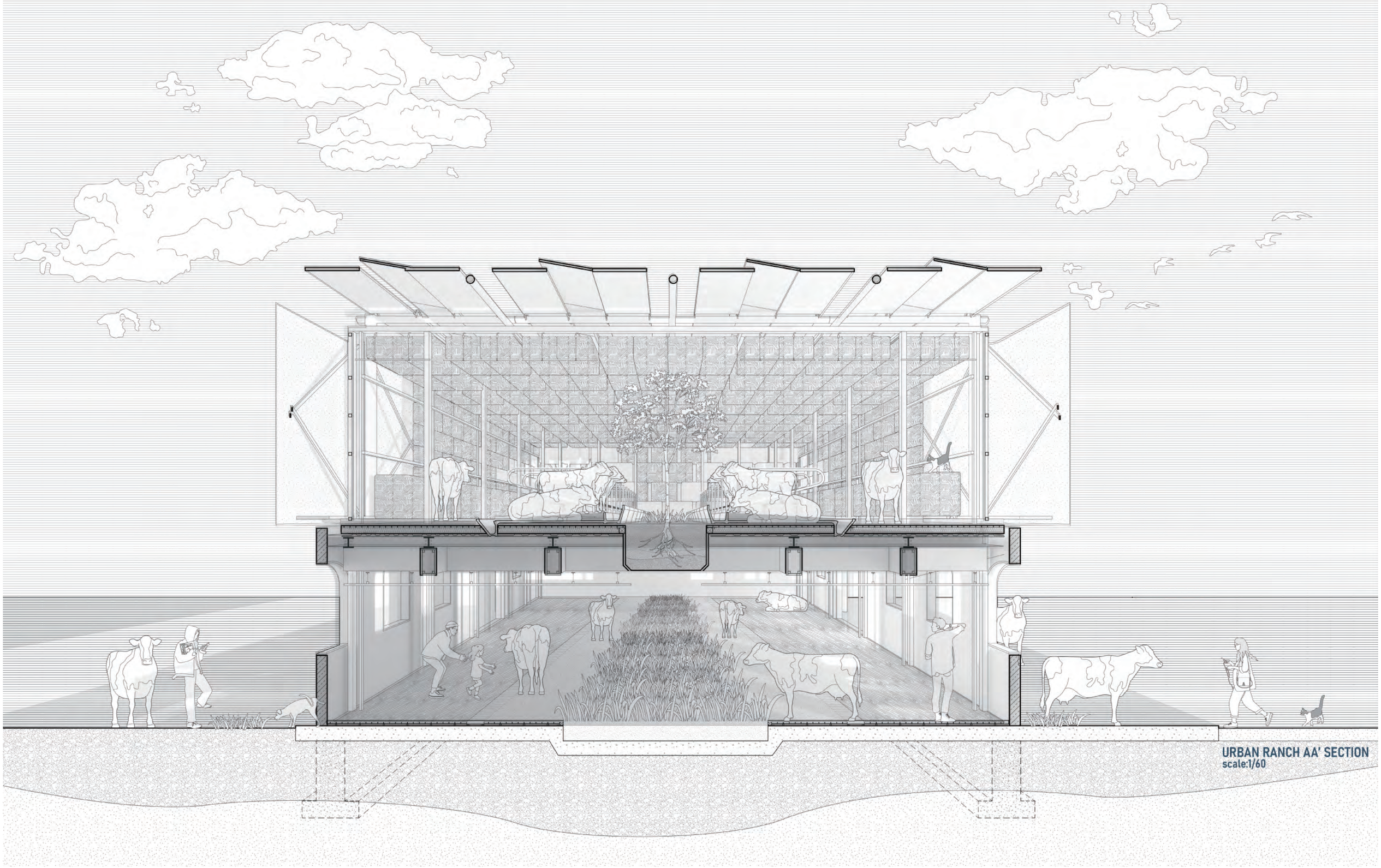
1.Timber

2.Biomass Heating System

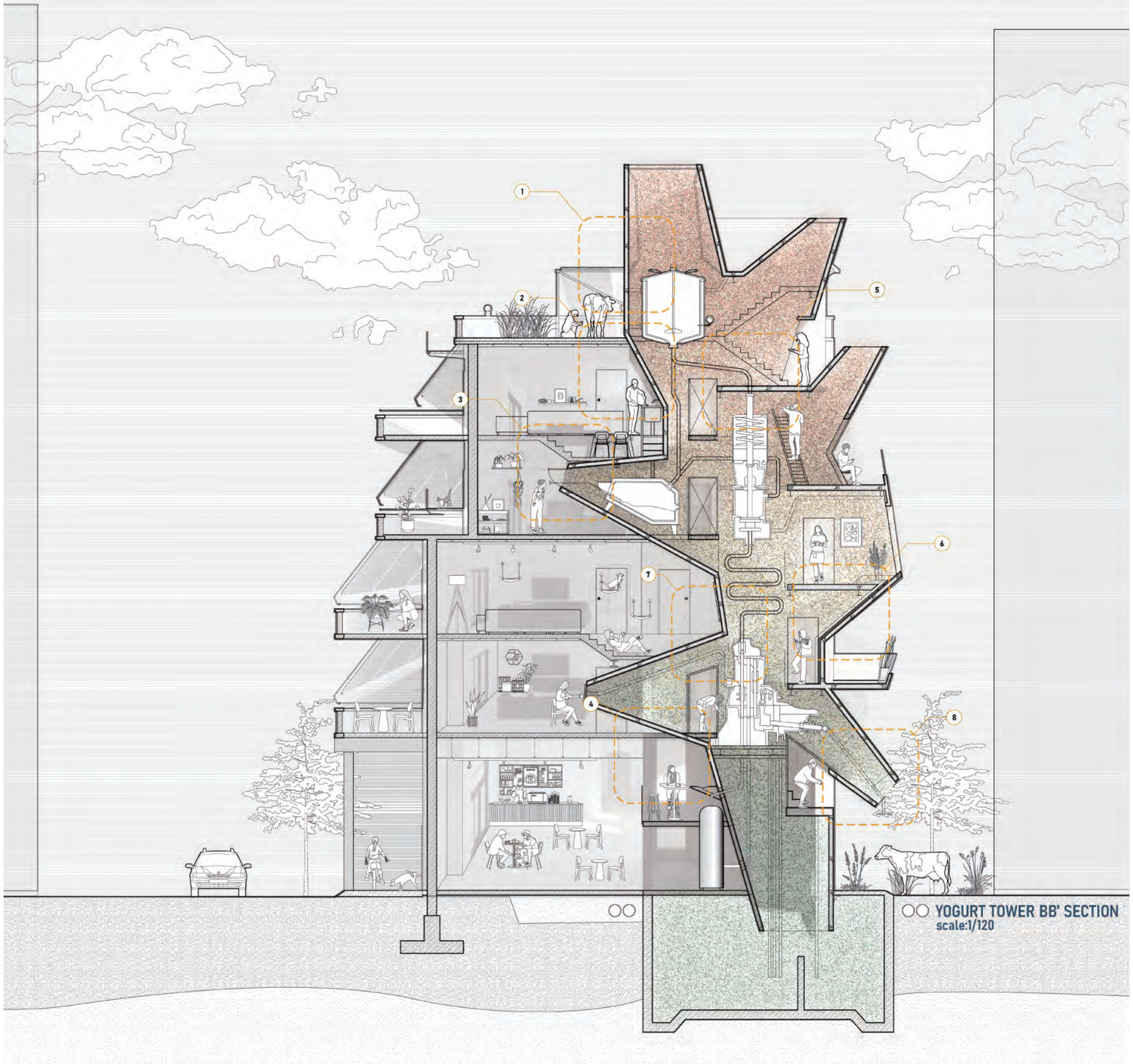
3.Straw Bricks

4.Raw Materials for Yogurt

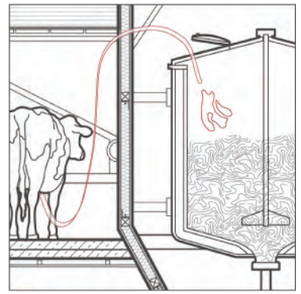
VISION OF MUTUAL BENEFIT & SYMBIOSIS



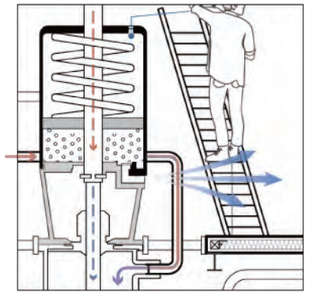
URBAN RANCH AA' SECTION
scale:1/60



YOGURT TOWER BB' SECTION
scale:1/120

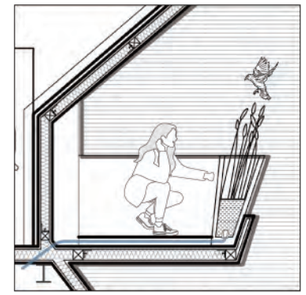


1 RAW MILK PRODUCE & COOLING SYSTEM

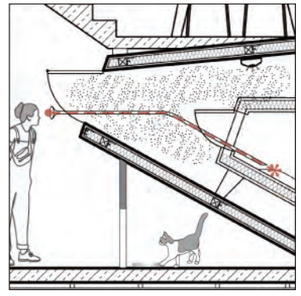


5 HOMOGENIZATION & PASTEURZIATION MACHINE

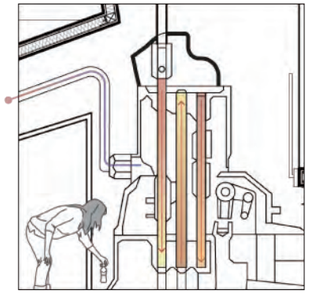
2 RAW MILK SEPERATION



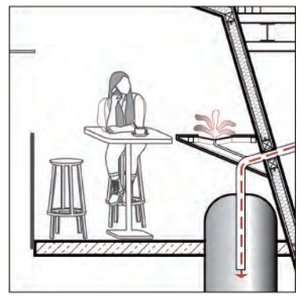
6 PLANTING STRAW ON THE BACK YARD



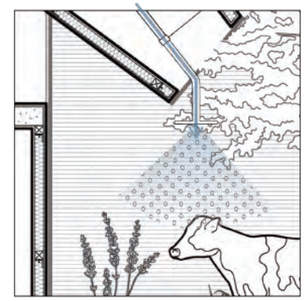
3 YOGURT STARTER CULTURE



7 FERMENTAION & STRAINING Machine



4 YOGURT FOUNTAIN



8 COW WASHING WITH WASTE WATER

4 ( ), fluid borders

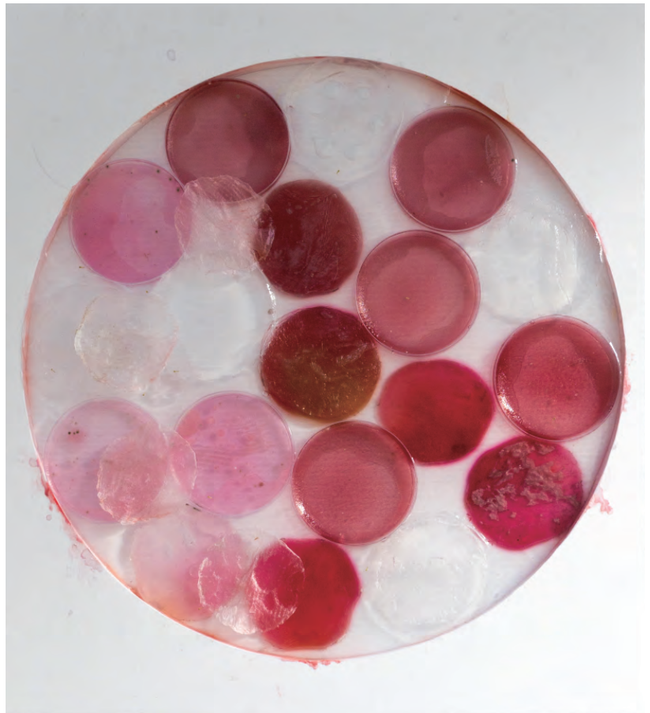
Agar-Agar

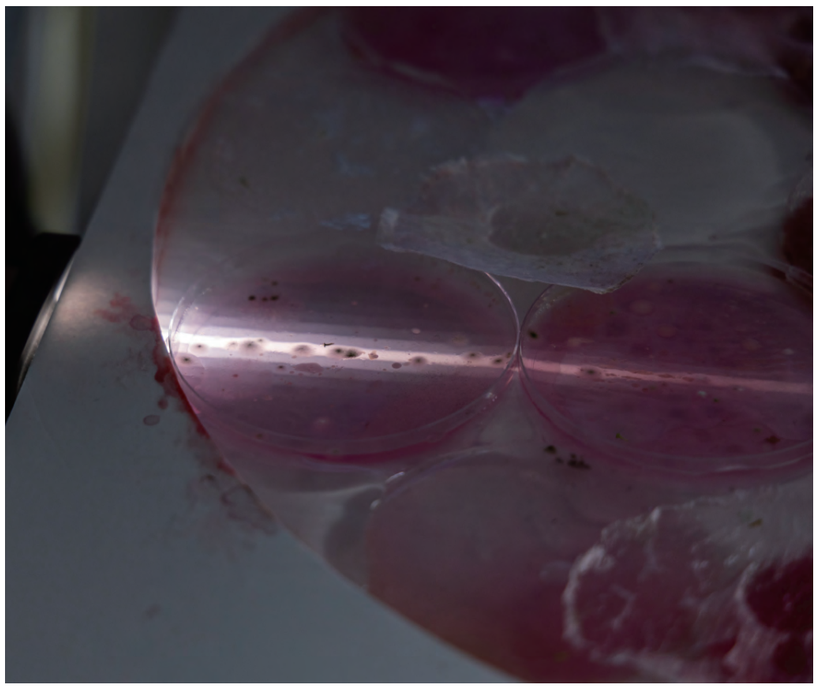
GSAPP_AAD Spring Semester

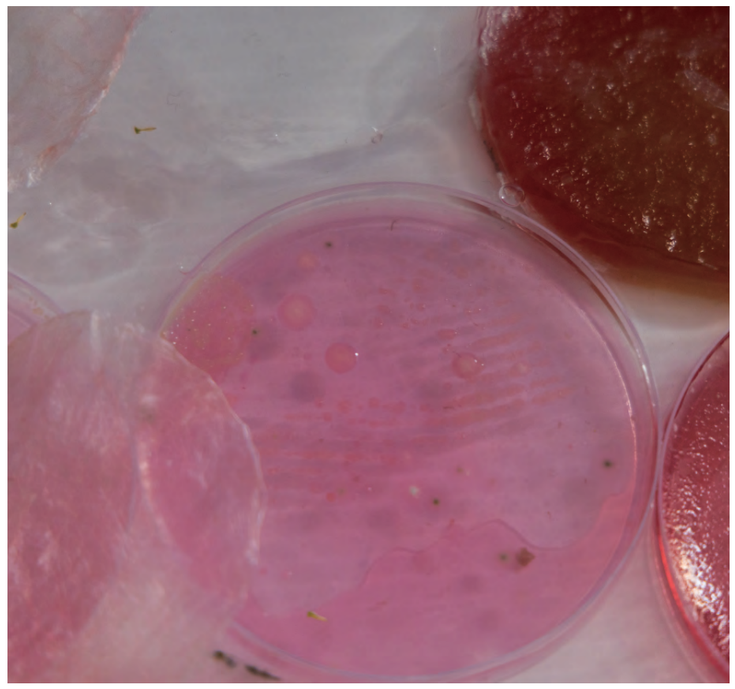
Academic work:	**Team Work**
Teammate :	Hyunsoo Cho
Design period :	2025.February- May
Project Instructor:	Michael Wang

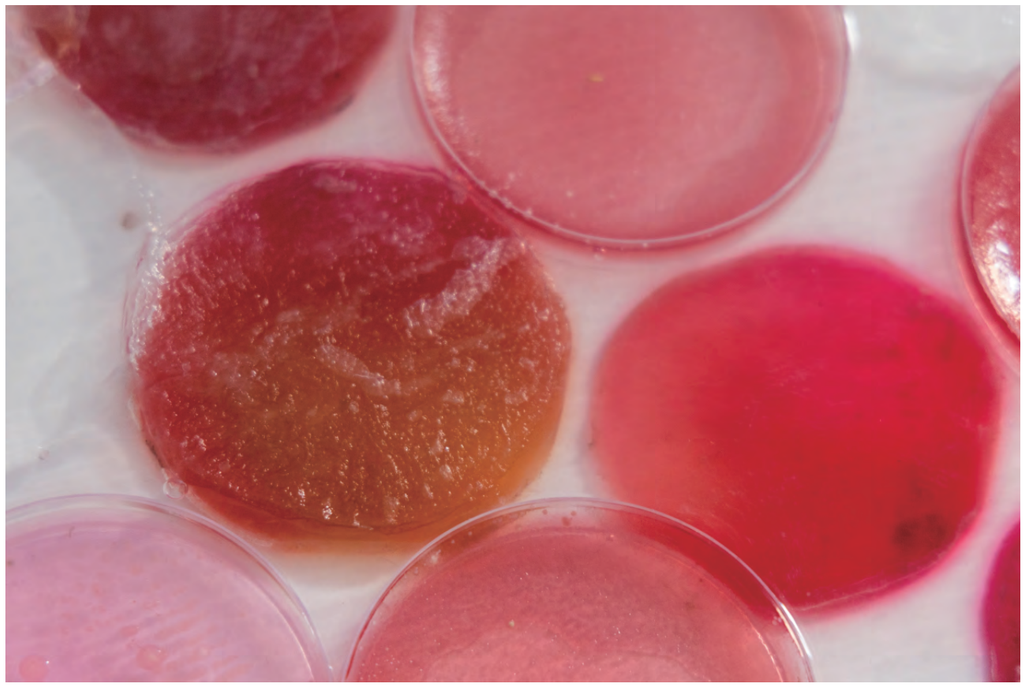
The artwork explores the entangled geopolitics of agar-agar, a material born from the labor-intensive harvest of red seaweed in Southeast Asia and refined into sterile, standardized form in the biotech labs of the Global North. Confronting the invisible flows of power, labor, and material that sustain scientific progress and medical development.

Using industrially standardized agar jellies, those used in Petri dishes to culture life, we stain them back into their original red. As time passes, the red pigment bleeds outward, seeping across the transparent jellies, slowly overtaking the sterile clarity with the memory of its origin. This slow diffusion acts as both a metaphor and a method: a re-territorialization of biotech's sanitized, white-cube logic by the unruly, overlooked life-worlds of those who harvest the sea.







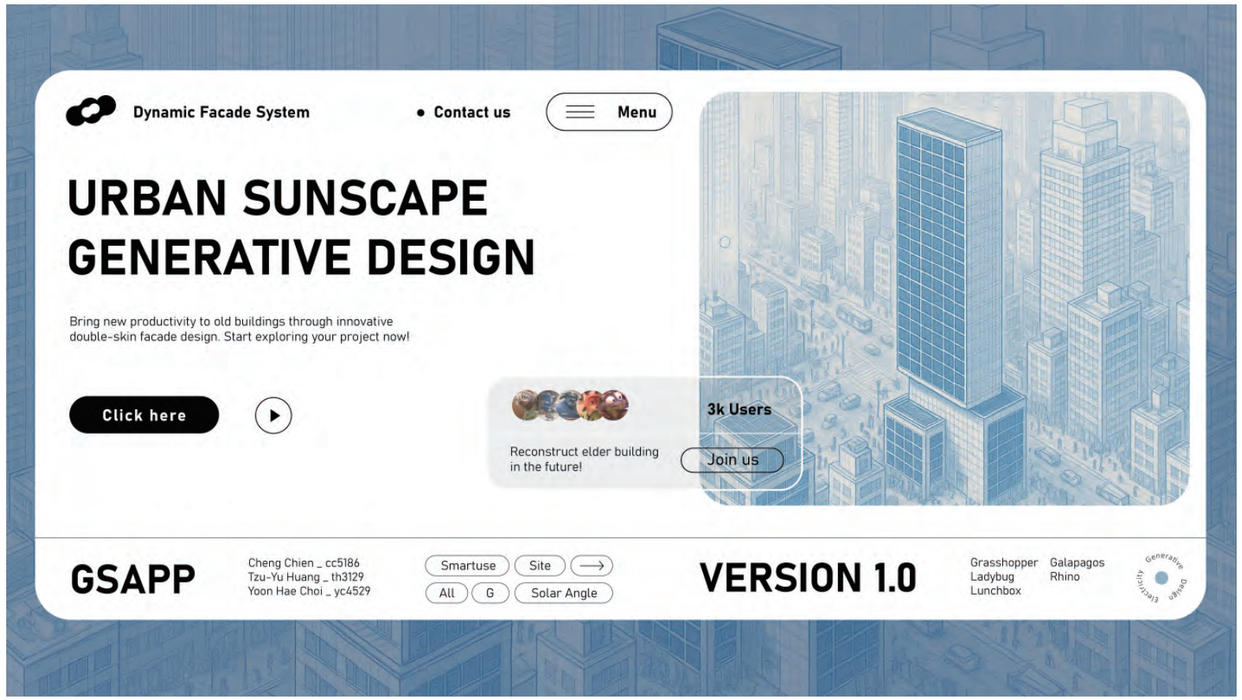


5 Urban Sunscape

Harnessing Solar Energy through Kinetic Facade Innovation

GSAPP_AAD Spring Semester

Academic work: **Team Work**
Teammate : Tzu-Yu Jason Huang, Yoon Hae Choi
Design period : 2025.February- May
Project Instructor: Danil Nagy



Introduce

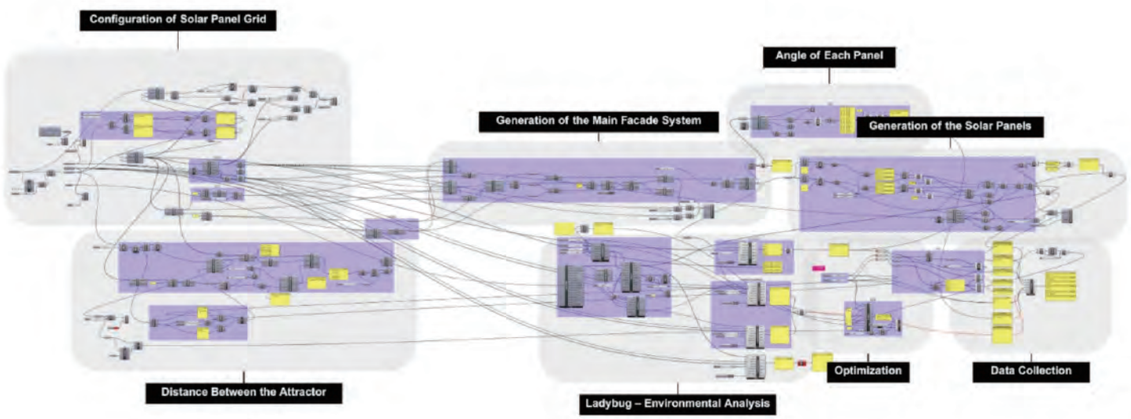
Today, building facades — serving as the interface between indoor and outdoor environments — play a critical role in environmental performance. Yet, their broader impact on the urban environment is often underestimated. As cities grow denser and vertical surfaces expand, the increased elevation surface area contributes to greater heat absorption, intensifying the urban heat island effect at night and driving up energy demands for cooling.

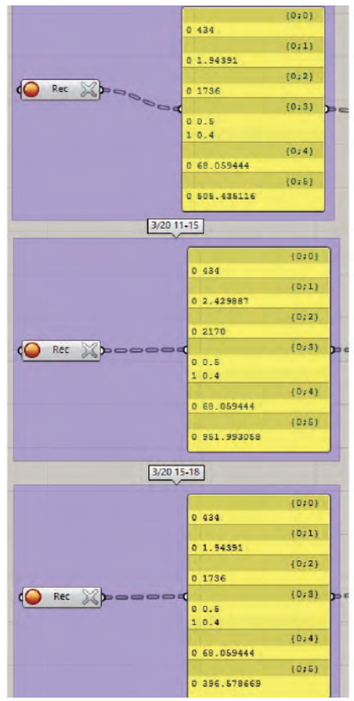
Our design concept, Urban Sunscape, reframes this challenge as an opportunity by transforming facades into active, energy-generating systems through a kinetic solar panel double-skin facade. This strategy not only improves a building's environmental performance but also delivers measurable benefits to users, including reducing energy consumption, generating renewable energy, and ensuring a strong return on investment.

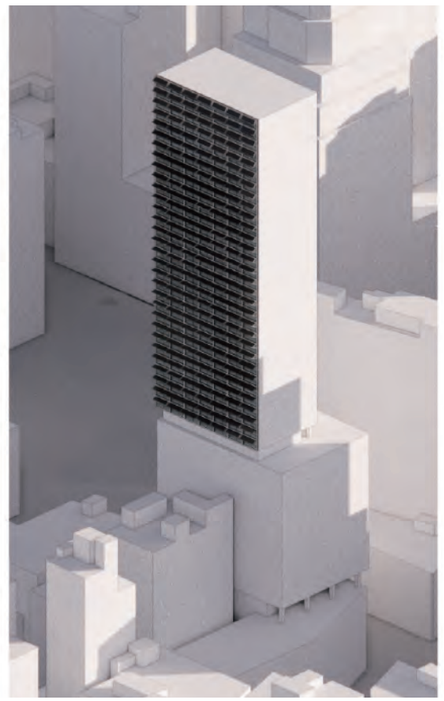
Furthermore, Urban Sunscape adopts a modular design strategy, enabling flexible fabrication and efficient workflow from design to installation. This modularity ensures that the system can adapt to various building types, providing a scalable solution for urban sustainability.

Methodology

The Grasshopper script for Urban Sunscape consists of two main components: a responsive facade system that adjusts the angle of each panel based on the position of an attractor, and an environmental analysis module that incorporates solar radiation and direct sun hours. Using Galapagos, the script optimizes the attractor's location to achieve the most efficient environmental performance within a specified time frame.







Dynamic Facade System

• Contact us

Menu

Site Upload -New York, NY, USA

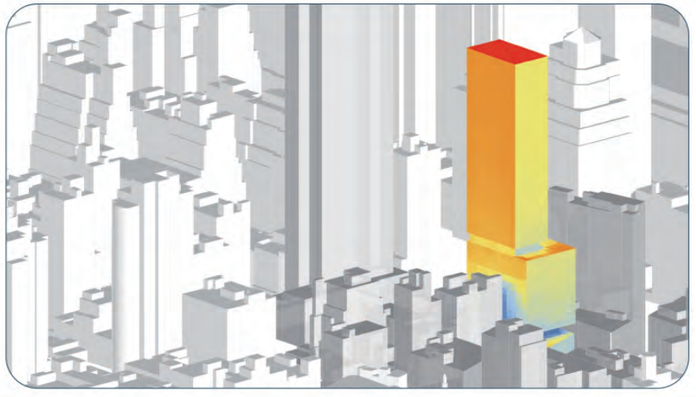
Ladybug -Sun Radiation on South Elevation

Facade Type -Different types based on contexts

Cost -Number, Unit, Installation

Electricity -SOLAR ENERGY. E=A×G×η×PR

ROI -Cost / Electricity saving



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Cheng Chien _ cc5186
Tzu-Yu Huang _ th3129
Yoon Hae Choi _ yc4529

Smartuse Site ⟶ All G Solar Angle

VERSION 1.0

Grasshopper Galapagos
Ladybug Rhino
Lunchbox

Generative Design Electricity

Dynamic Facade System

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Type 1 Type 2 Type 3

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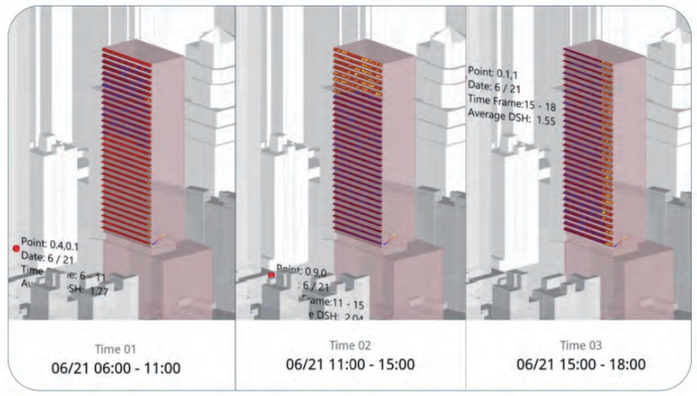

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-Electricity Output 1 2 3 4 5 6 7 8 9 10 11 12

2,135,517.07 kWh / year

-Estimated Saving $ $ $ $$ $$ $$ $$$ $$$ $$$ $$ $ $

430,093.14 USD / year

-Investment Cost 1 / 2 Soalr Panels, Dynamic Facade Structure | Number 434 / 217 | Cost 400 / 1200 | 355,880 / 2,577,960

2,933,840 USD

-Return of Investment Investment Cost 2,933,840 USD / Estimated Saving 430,093.14 USD ≒7 Years

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