

“ ARCHITECTURE WITHIN NATURE ”

SUSTAINABILITY WITHIN THE NEW TECHNOLOGICAL EXPERIMENT

WASTE TO ENERGY CENTER _ RESEARCH CENTER

BİLKENT UNIVERSITY

Faculty of Art, Design and Architecture

1) THE SITE

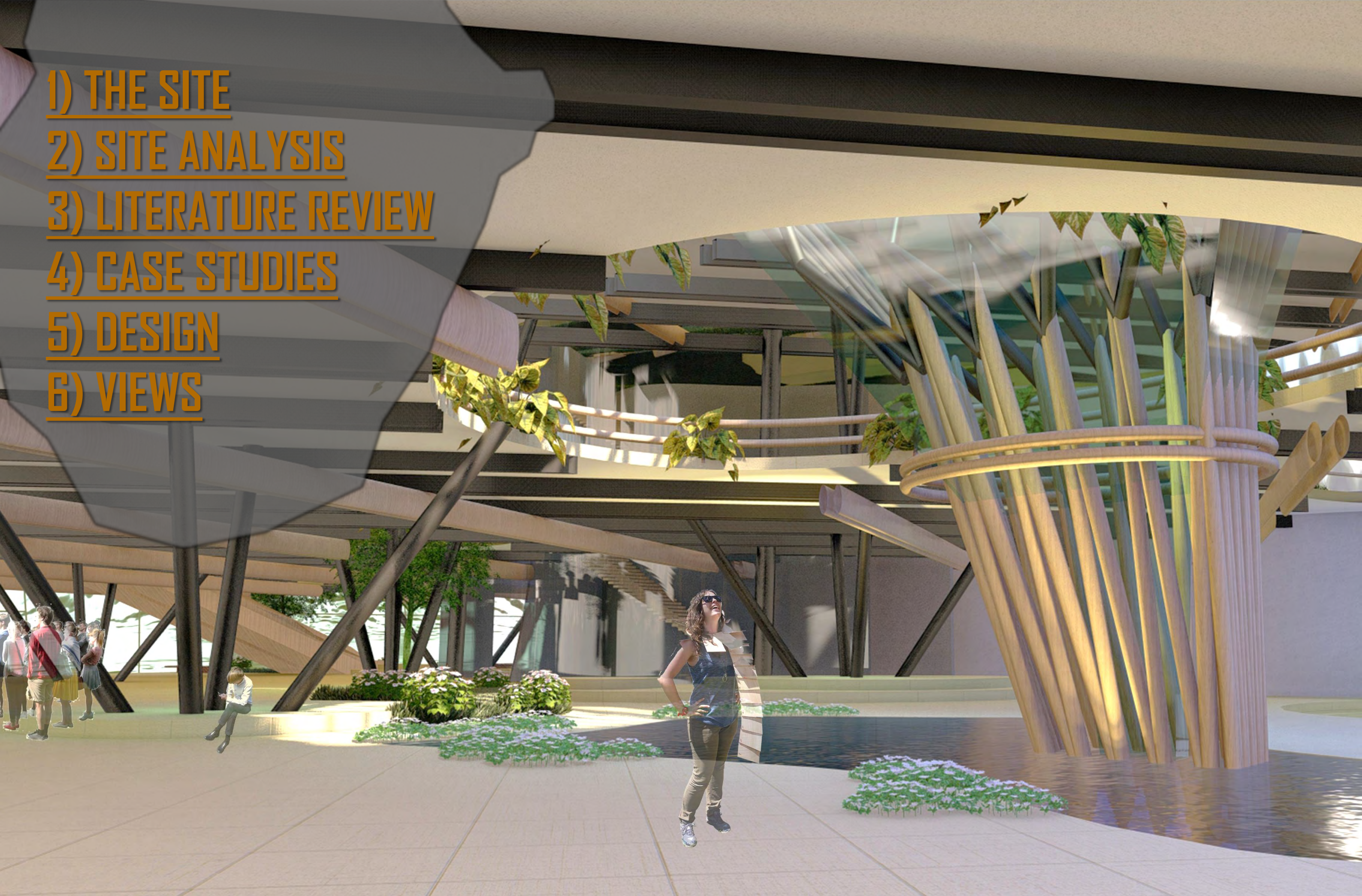
2) SITE ANALYSIS

3) LITERATURE REVIEW

4) CASE STUDIES

5) DESIGN

6) VIEWS





INTRODUCTION

1) THE SITE

General Information

At the intersection of East and West, Helsinki is a key vector in the region known as the Gulf of Finland Growth Triangle. This zone stretches down to Tallinn in Estonia and up to Saint Petersburg in Russia. It is inspired by a similar model used in Singapore, Malaysia, and Indonesia, where cooperation between three neighboring economies is being marshaled to accelerate economic growth. Furthermore, Finland plays a key role in the Nordic region composed of Denmark, Iceland, Norway, and Sweden.

A fast-growing metropolitan area in Europe, Helsinki is facing the greatest urban change in its history since becoming a capital two hundred years ago. In comparison with other European cities, the City of Helsinki is in a uniquely privileged situation. As both the major landowner and the planning authority, it benefits from almost unmatched freedom to plan the future growth of the city. And with a practice of government by coalition, Helsinki starts from a political consensus, the main parties agreeing on sustainable placemaking on a long-term basis.





... About the South Harbor

The Port of Helsinki is now Finland's main port, specializing in unitized Cargo services, containers, trucks, and trailers, as well as passenger traffic. It is the largest port in Finland, and the second largest in the Nordic countries. In 2008, the cargo services were concentrated to the new Vuosaari Harbor. The old South Harbor still hosts lively passenger traffic, including local ferries and cruise ships carrying passengers and goods to and from Tallinn, Stockholm, and Saint Petersburg.





... About Architectural Heritage

The cityscape of Helsinki comprises a range of architectural styles, from neoclassicism to Art Nouveau, to Alvar Aalto and contemporary architecture. The architectural influences of Helsinki are a mixture of Swedish, Russian, and Finnish; the Suomenlinna Sea Fortress interweaves these three together.

Notably, the climate and geography have influenced the grid layout and urban pattern of the key architectural developments of the city. This has resulted in a strong street presence with the use of architectural devices such as light wells, balconies, and small green parks to optimize the precious sun.



Images clockwise from top left: Kamppi Chapel, Finlandia Hall, Uspenski Cathedral, Helsinki Cathedral, Central Railway Station, Parliament House

Images clockwise from top left: Helsinki Olympic Stadium, Suomenlinna Sea Fortress, Old Market Hall, Finlandia Hall

... About Site Issues

Homelessness

Since its launch in 2008, the number of long-term homeless people in Finland has fallen by more than 35% thanks to the 3,500 new homes created by Housing First. The cost of this program is steep but worth it. Finland has spent 250 million euros to create new homes and hire 300 support workers. However, the government now saves more than 15,000 Euros per year in emergency healthcare, social services, and the justice system for every homeless person in properly supported housing. Although homelessness is not completely eradicated in Finland – there are about 5,500 people who are still officially classified as homeless – these social programs are doing their part to keep people off the streets.

Waste through the Sea

At least 14 million tons of plastic end up in the ocean every year, and plastic makes up 80% of all marine debris found from surface waters to deep-sea sediments. Marine species ingest or are entangled by plastic debris, which causes severe injuries and death. Finland uses over 2 million tonnes of packaging annually but, because of efficient recycling, only around 600 000 tonnes of packaging waste is generated. Almost 70 % (413 000 tonnes) of this packaging waste, is recycled or utilised as energy.

... AIM of The Project



COLLECTING WASTE & PRODUCING ENERGY

RAISING AWARENESS ABOUT RECYCLING & RENEWAL ENERGIES



OFFERING HOMELESS JOB OPPORTUNITIES



2) SITE ANALYSIS

500 m E:25493473.3 N:6672832.5

©Silk Mate

... Circulation and Accessibility



PORT MAP

The port on the southwestern landside of the South Harbor supports passenger and vehicular ferries to foreign destinations such as Sweden and Estonia.



HELSINKI WEST HARBOUR new incoming route January 13, 2020 →
 • Just in time arrival
 • No waiting areas

ЗАПАДНИЙ ПОРТ ХЕЛЬСИНКИ новый маршрут въезда с 13.01.2020 →
 • Прибытие точно ко времени
 • Нет зон ожидания

PORT ZACHODNI W HELSINKACH nowa droga dojazdowa 13.01.2020 →
 • Przyjazd „just in time”
 • Brak stref oczekiwania

ЗАХІДНИЙ ПОРТ ГЕЛЬСИНКИ новий вхідний маршрут 13.1.2020 →
 • Своечасне прибуття
 • Зон очікування немає

EXIT → выезд / wyjazd / виїзд

← CHECK IN регистрация / обржава / реєстрація

CARGO CHECK IN регистрация груза / обржава cargo / реєстрація вантажу

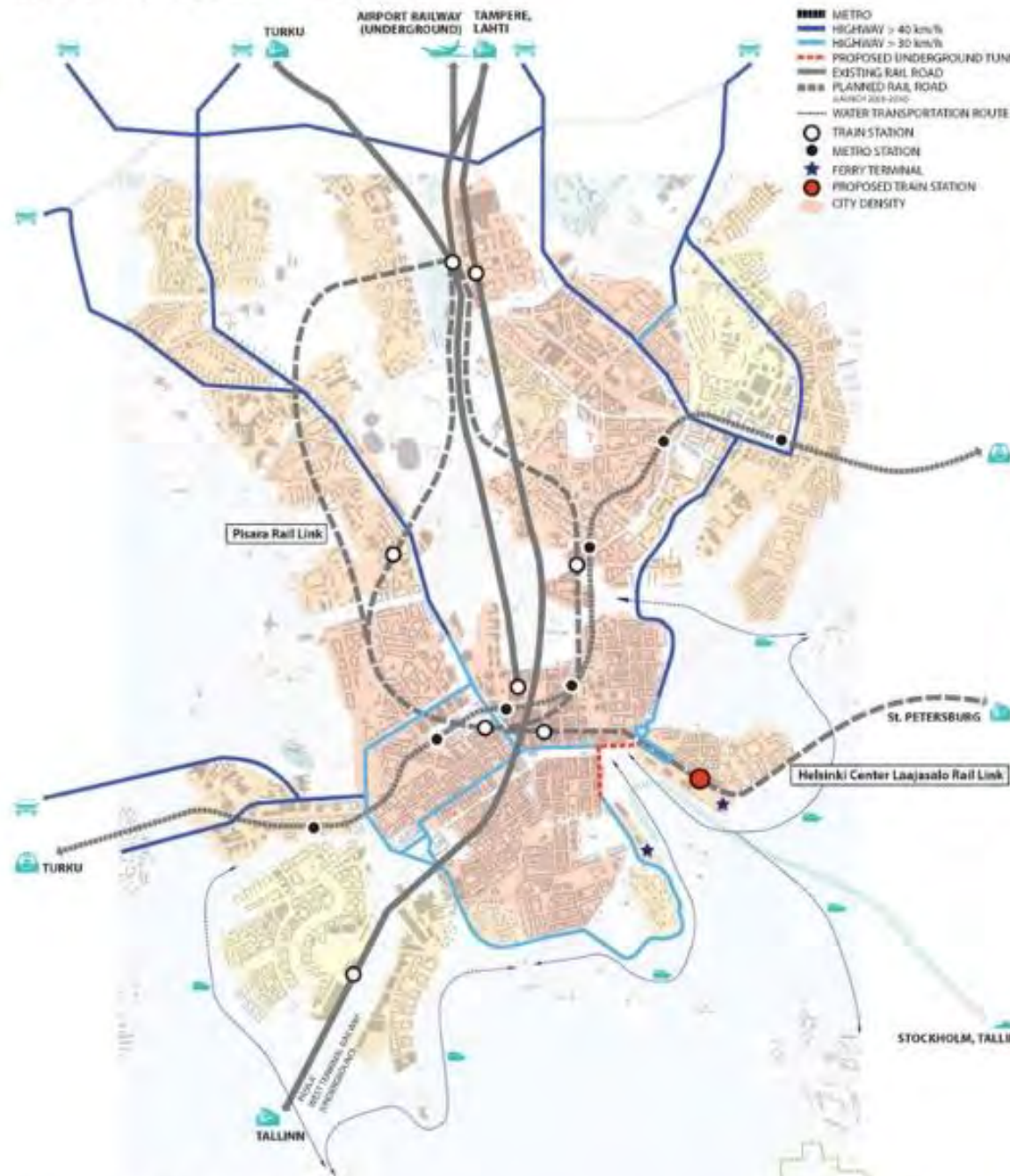
GATE A ворота A / brama A / прохідна A

NO PARKING нет зоны парковки / obszar zakazu zatrzymywania / парковки немає

INTENSIVE интенсивное движение транспорта / ruch pojazdów ciężarowych / интенсивний рух



REGIONAL TRAFFIC NETWORK



PARKING SYSTEM



TRAFFIC MAP



VEHICLE & CARGO TRAFFIC



PUBLIC TRANSIT



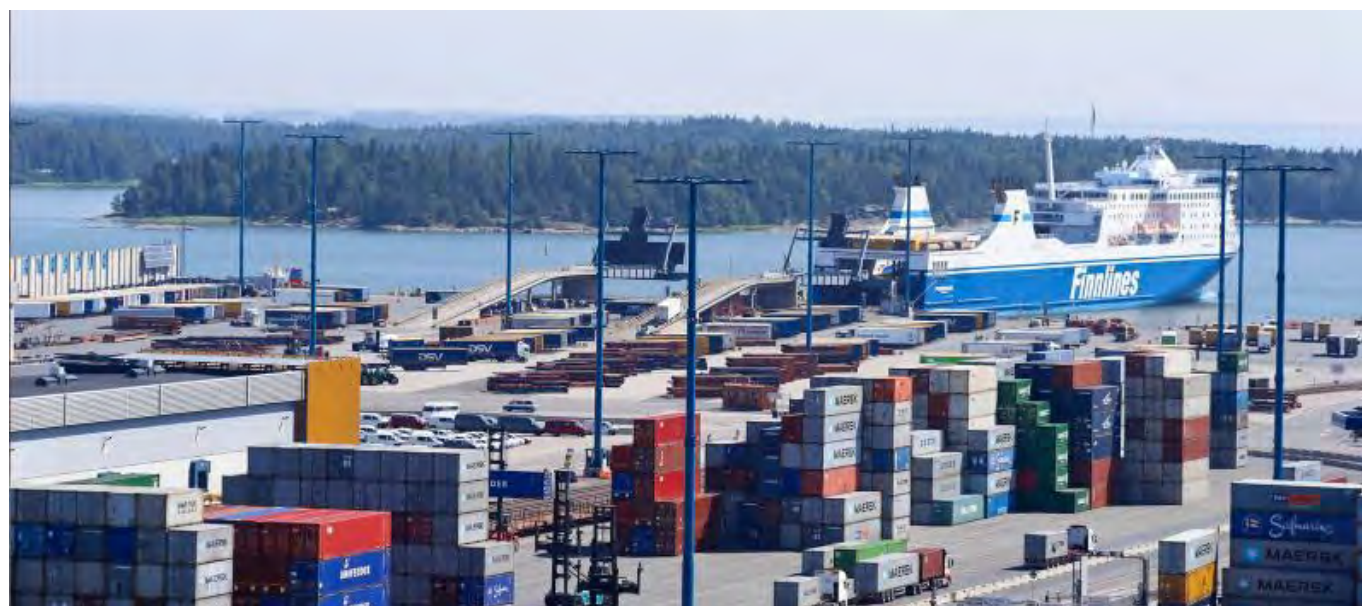
BIKEWAY



The Helsinki region plays a central role in the Finnish economy. The region produces nearly one-third of the nation's gross domestic product. The region is also home to the leading concentration of innovation activities in Finland. Services represent a large share of the Helsinki region's economy; for example, health care, social welfare and business services are the largest employers in Helsinki.

The prolonged recession of the Finnish economy was reflected on economic trends in the Helsinki region, but since 2014 economic output has grown more strongly in the region than in the rest of the nation. Unemployment growth was halted in Helsinki at the end of 2016.

The projects of the programme term 2016–2018 under the theme of the economy and competitiveness focused on three areas: competitiveness and business activities; labour market, education and training; and municipal economy.



... Activities

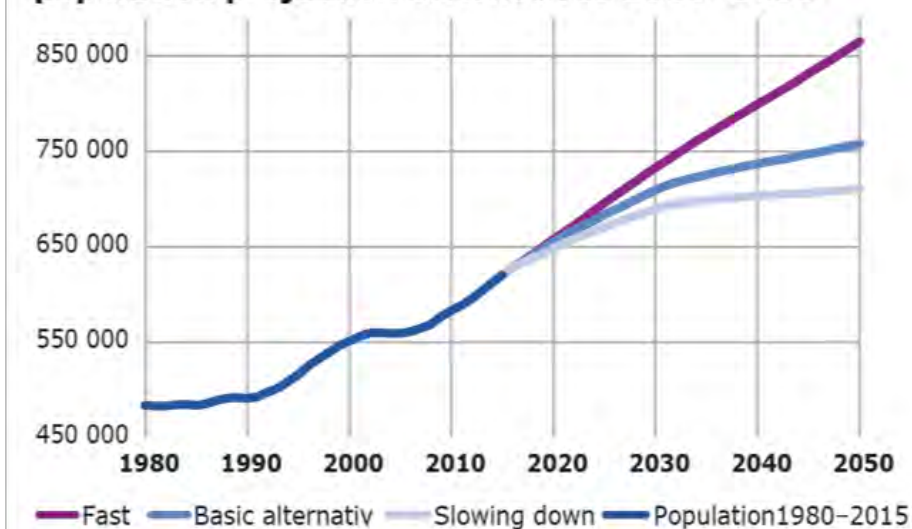
- _ free walk tours within the history and culture
- _ tasting the fish and traditional Finnish food
- _ riding the Helsinki trams
- _ relaxing at Esplanade Park
- _ visiting winter garden
- _ hiking
- _ visiting islands
- _ taking the ferry tours
- _ visiting the old Finnish architectural history and the like...



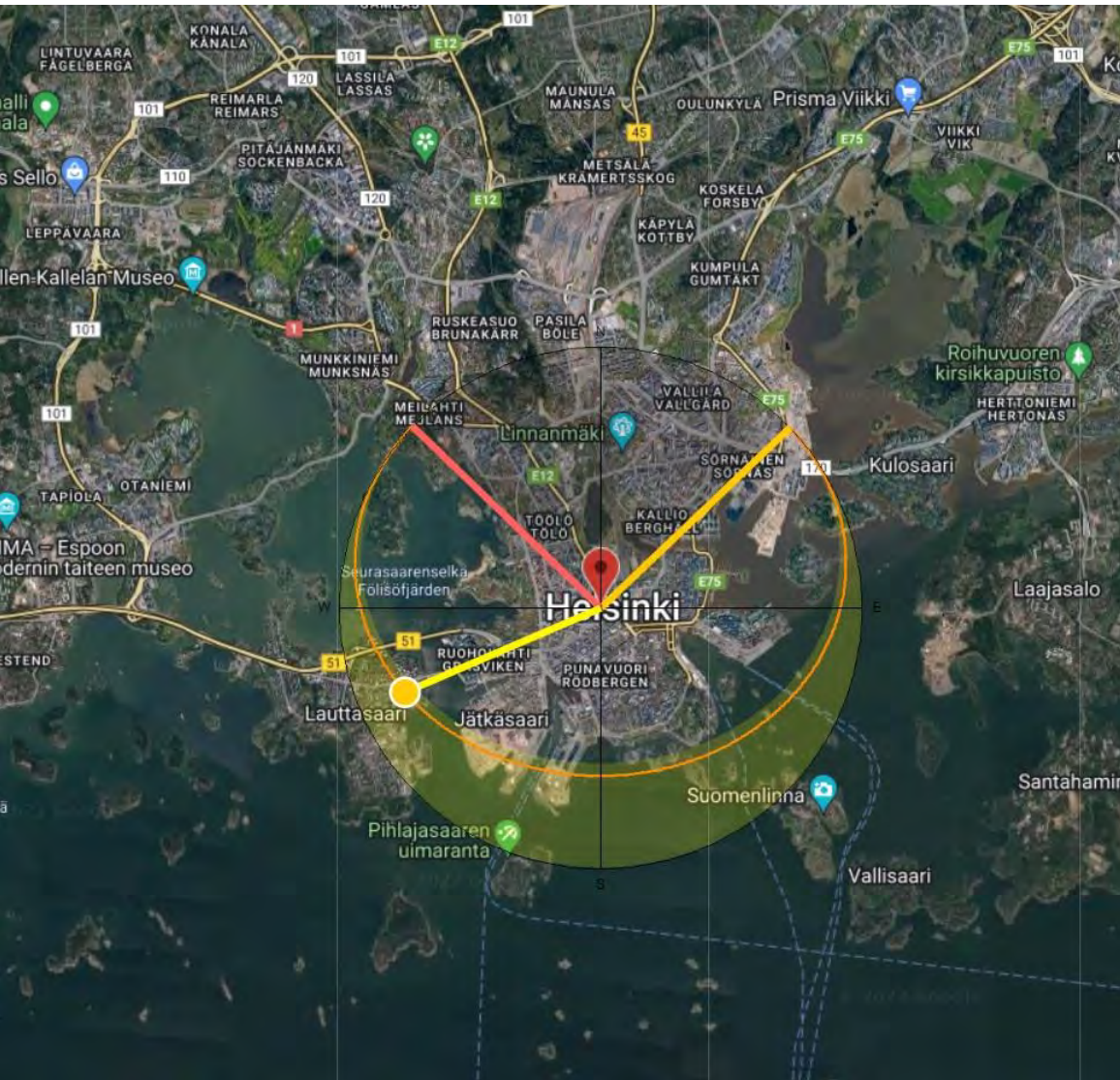
The population of Helsinki is growing rapidly, and the trend is expected to continue in the future. In addition to population growth, the most significant demographic phenomena of recent years are an increase in the city's foreign-born population, an increase in the number of families with small children, and the aging of the population.

... Population

Population of Helsinki 1980–2015 and population projection alternatives 2016–2050



... Sun

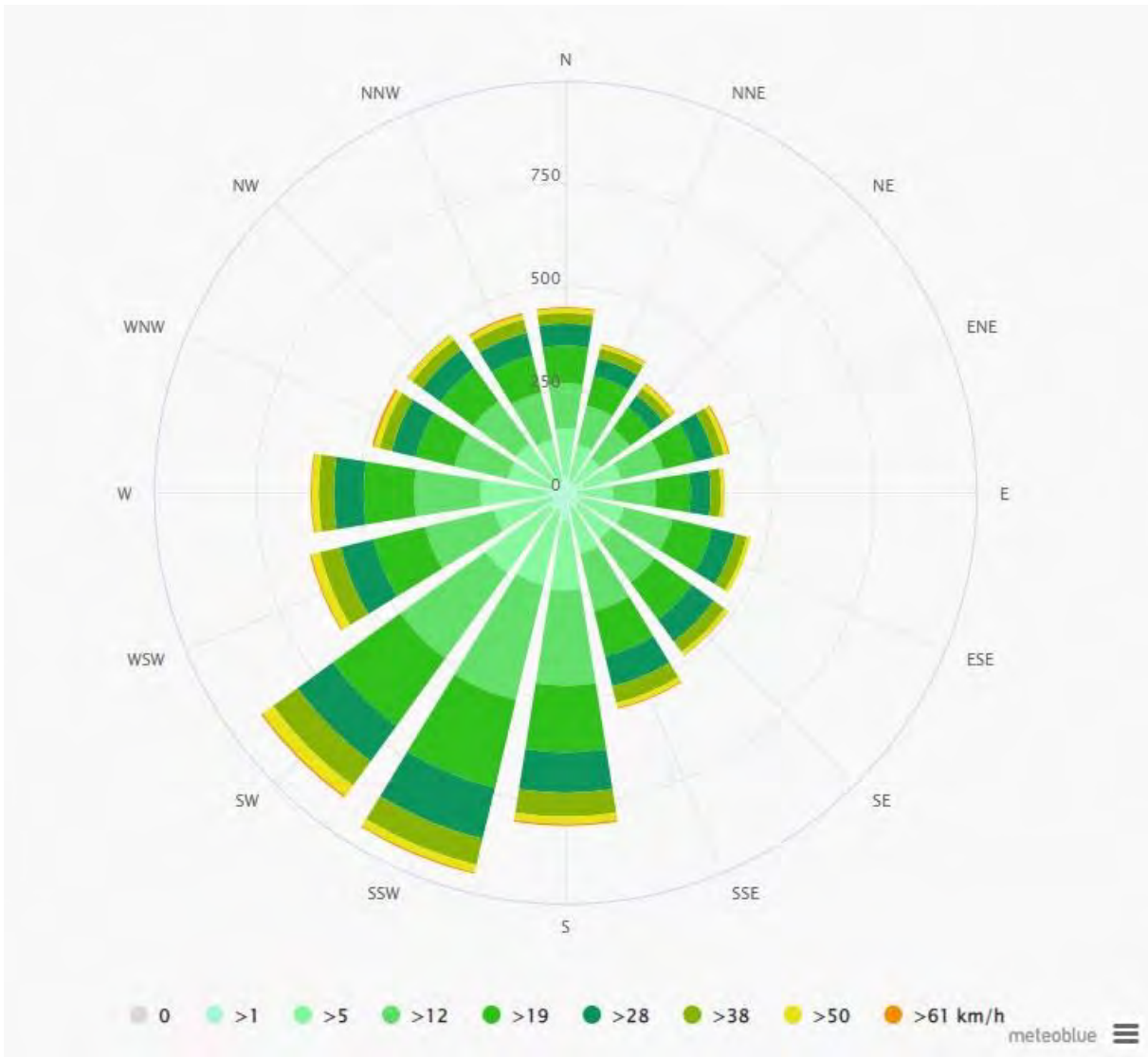


The earliest sunrise is at 3:53 AM on June 19, and the latest sunrise is 5 hours, 32 minutes later at 9:25 AM on December 27. The earliest sunset is at 3:11 PM on December 16, and the latest sunset is 7 hours, 39 minutes later at 10:50 PM on June 23.

Daylight saving time (DST) is observed in Helsinki during 2022, starting in the spring on March 27, lasting 7.1 months, and ending in the fall on October 30.

In 2022, the shortest day is December 21, with 5 hours, 49 minutes of daylight; the longest day is June 21, with 18 hours, 56 minutes of daylight.

... Wind



The windier part of the year lasts for 5.7 months, from September 17 to March 7, with average wind speeds of more than 9.2 miles per hour. The windiest month of the year in Helsinki is December, with an average hourly wind speed of 11.2 miles per hour.

The calmer time of year lasts for 6.3 months, from March 7 to September 17. The calmest month of the year in Helsinki is June, with an average hourly wind speed of 7.1 miles per hour.

The wind is most often from the south for 2.0 months, from January 27 to March 28 and for 1.3 months, from November 3 to December 11, with a peak percentage of 35% on November 25. The wind is most often from the west for 7.2 months, from March 28 to November 3 and for 1.5 months, from December 11 to January 27, with a peak percentage of 40% on June 3.

... Seasons



SUMMER



AUTUMN



SPRING

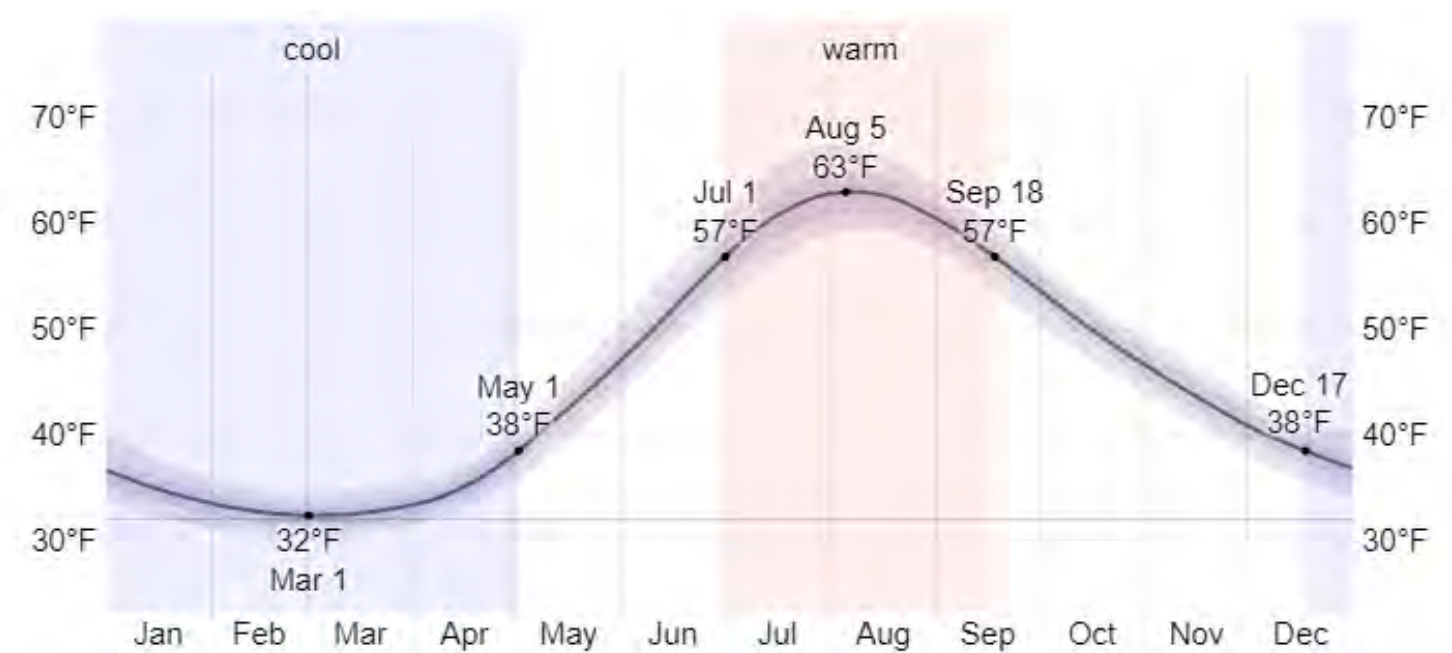


WINTER

... Snow



... Water



The snowy period of the year lasts for **5.6 months**, from **October 29** to **April 17**, with a sliding 31-day snowfall of at least **1.0 inches**. The month with the most snow in Helsinki is **January**, with an average snowfall of **5.8 inches**.

The snowless period of the year lasts for **6.4 months**, from **April 17** to **October 29**. The least snow falls around **July 30**, with an average total accumulation of **0.0 inches**.

... Rain



Rain falls throughout the year in Helsinki. The month with the most rain in Helsinki is **October**, with an average rainfall of **2.2 inches**.

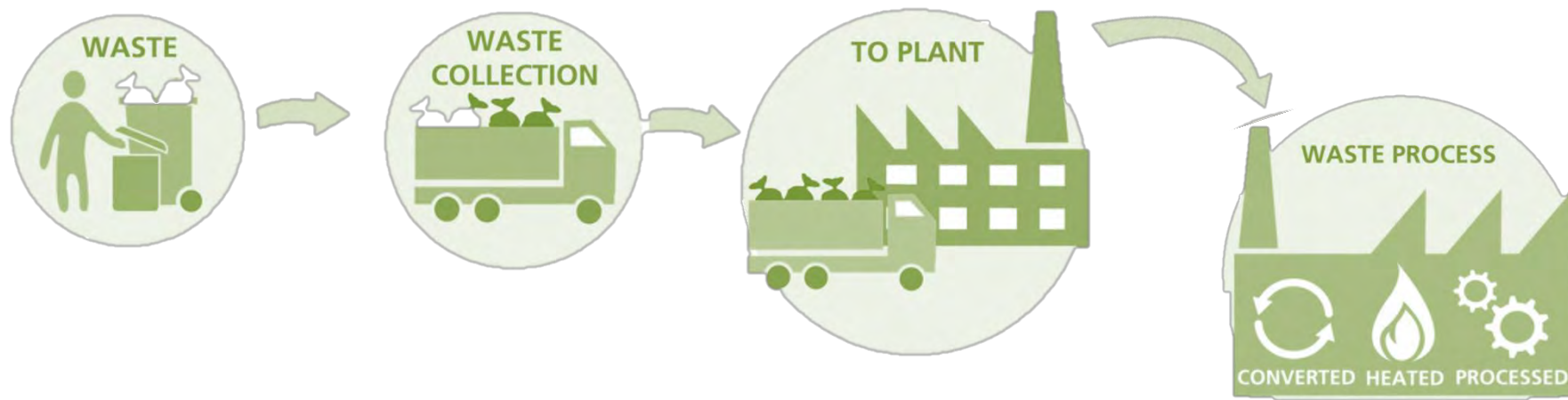
The month with the least rain in Helsinki is **February**, with an average rainfall of **0.5 inches**.

The time of year with warmer water lasts for **2.5 months**, from **July 1** to **September 18**, with an average temperature above **57°F**. The month of the year in Helsinki with the warmest water is **August**, with an average temperature of **62°F**.

The time of year with cooler water lasts for **4.5 months**, from **December 17** to **May 1**, with an average temperature below **38°F**. The month of the year in Helsinki with the coolest water is **March**, with an average temperature of **33°F**.

3) LITERATURE REVIEW



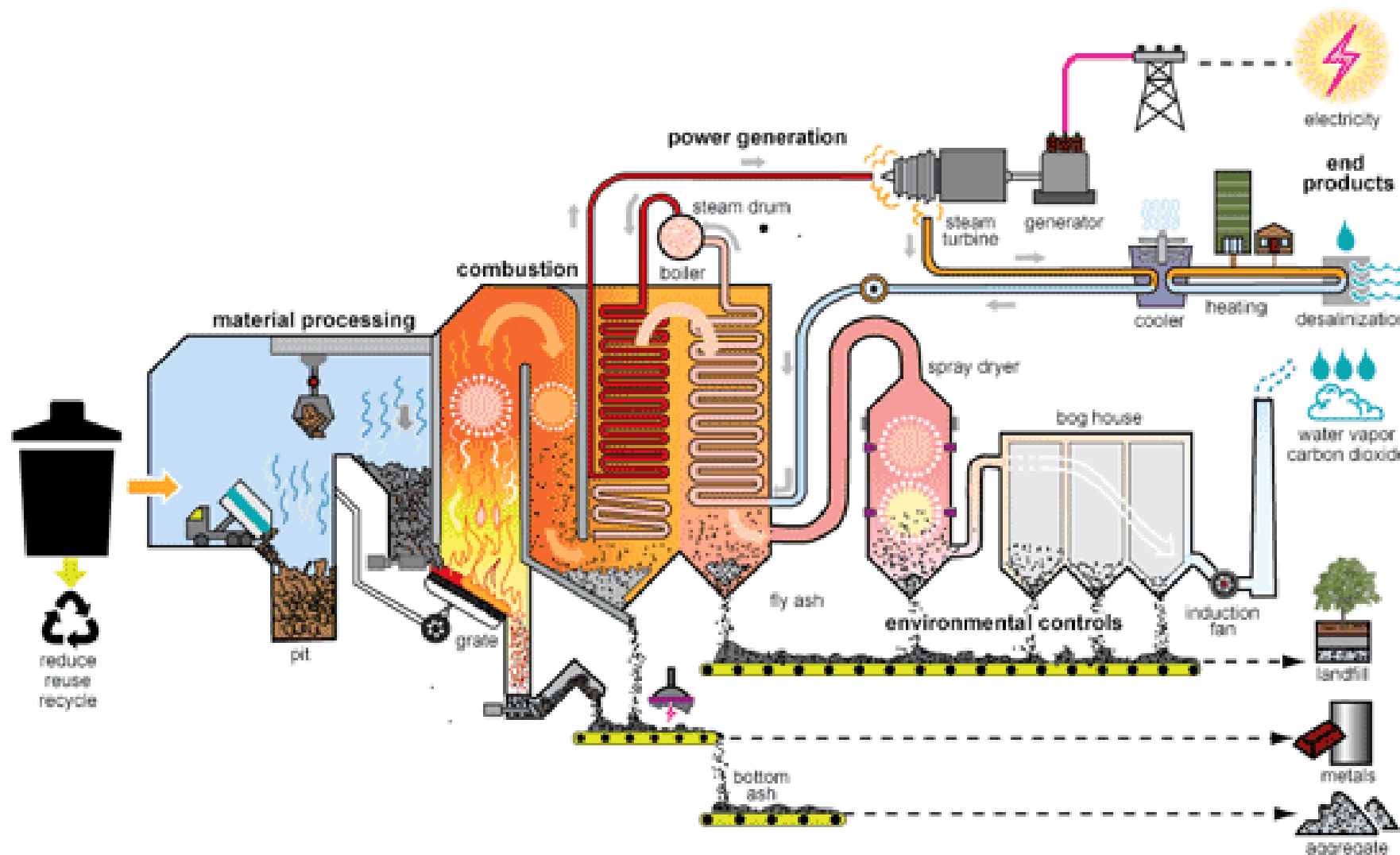


Waste to Energy Plants

... Waste-to-energy plants burn municipal solid waste (MSW), often called garbage or trash, to produce steam in a boiler that is used to generate electricity.

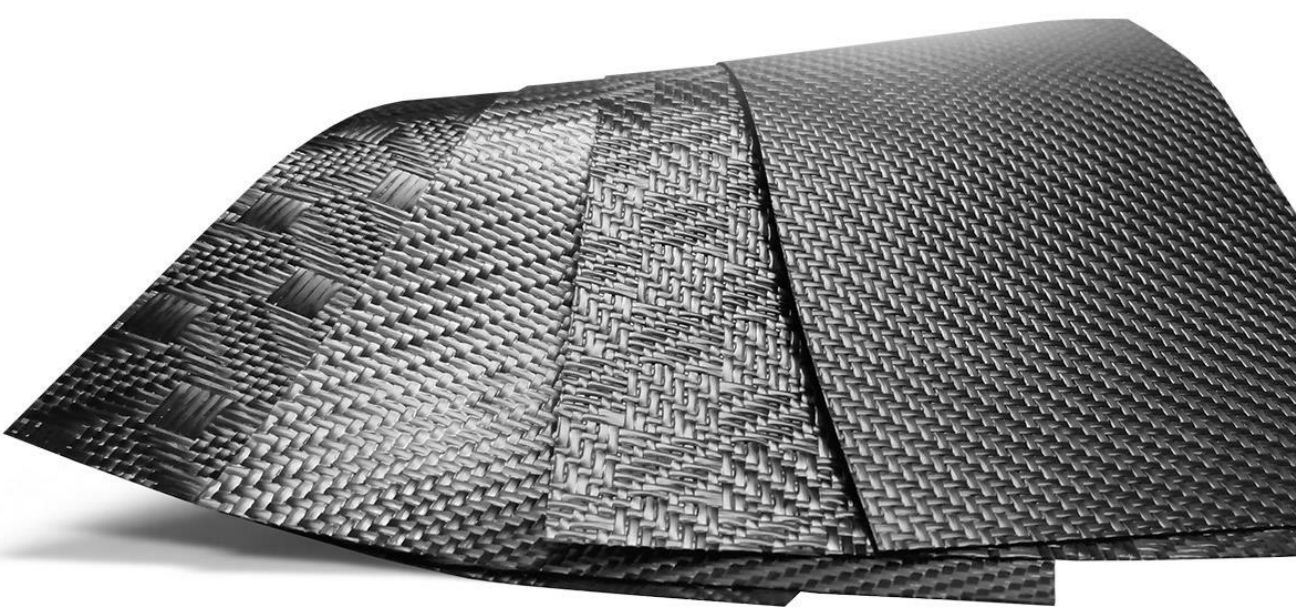
... MSW is a mixture of energy-rich materials such as paper, plastics, yard waste, and products made from wood.

... There are different types of waste-to-energy systems or technologies. The most common type used in the United States is the mass-burn system, where unprocessed MSW is burned in a large incinerator with a boiler and a generator for producing electricity. Another less common type of system processes MSW to remove most of incombustible materials to produce refuse-derived fuel (RDF).



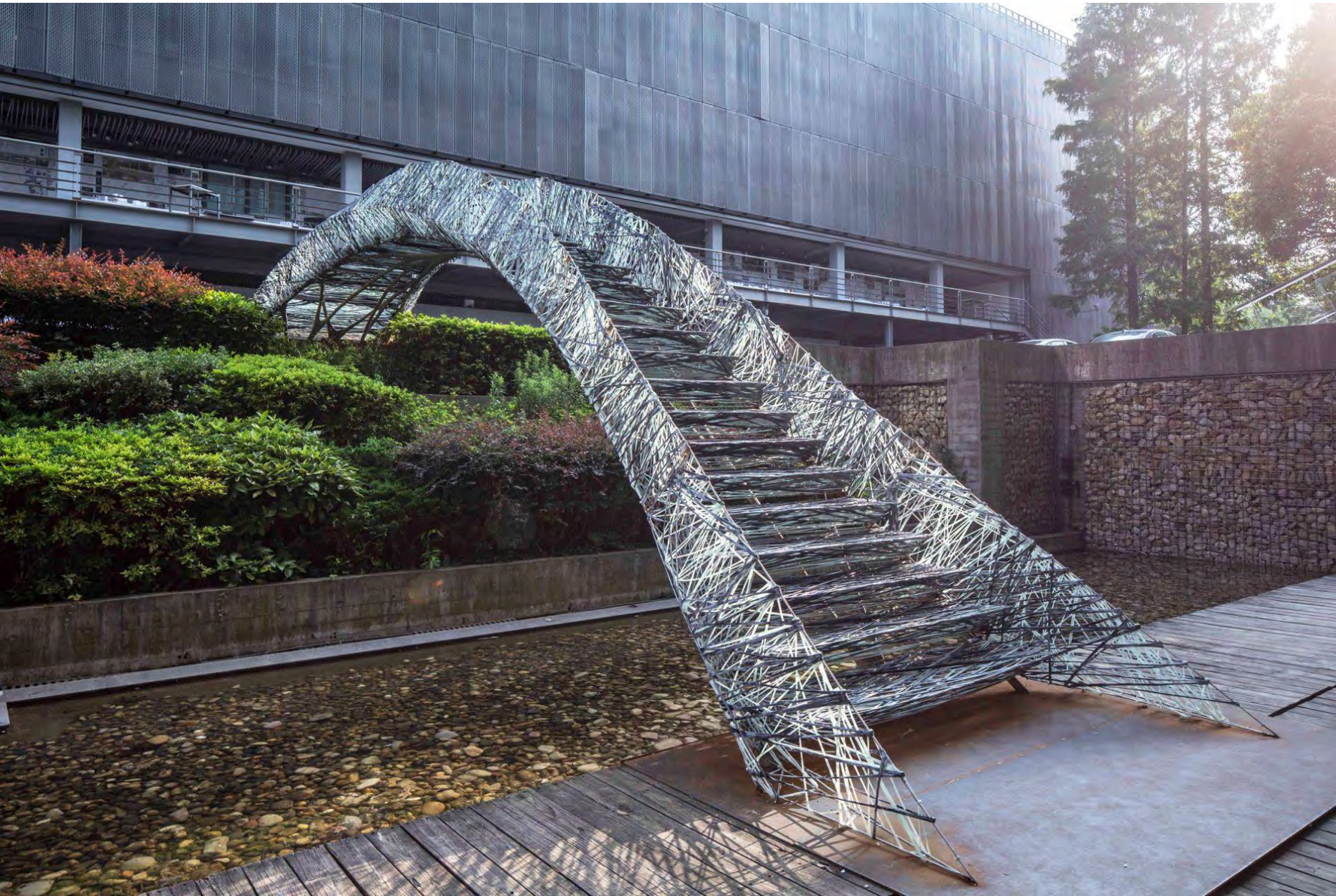
The process of generating electricity in a mass-burn waste-to-energy plant has seven stages:

- 1) Waste is dumped from garbage trucks into a large pit.
- 2) A giant claw on a crane grabs waste and dumps it in a combustion chamber.
- 3) The waste (fuel) is burned, releasing heat.
- 4) The heat turns water into steam in a boiler.
- 5) The high-pressure steam turns the blades of a turbine generator to produce electricity.
- 6) An air pollution control system removes pollutants from the combustion gas before it is released through a smoke stack.
- 7) Ash is collected from the boiler and the air pollution control system.



Carbon Fiber

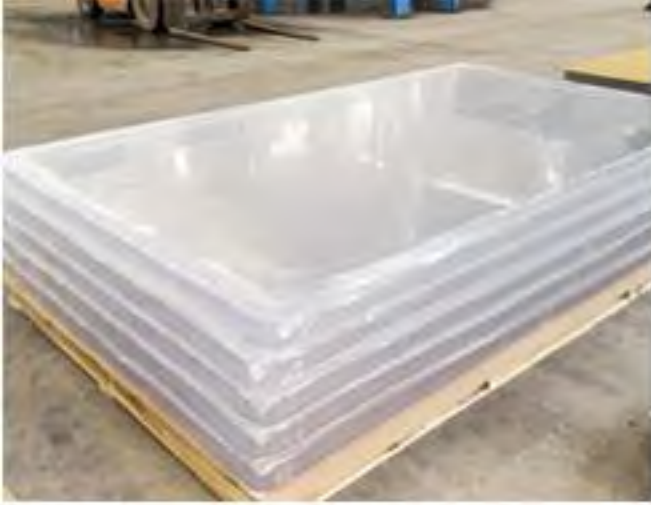
Traditionally, architectural units made of brick or concrete are small and multiple, heavy, difficult to vary, and are much better in compression than tension. Using carbon fiber filaments to create variable units allows for larger individual units that can vary in both shape and structural performance as needed.



Though steel is generally considered the standard when it comes to construction and industrial settings, in terms of strength to weight ratios, carbon fiber is actually significantly stronger than steel.

The future of carbon fiber composite materials is bright. With new advancements and applications appearing every day, the carbon fiber industry is steadily growing. As carbon fiber manufacturing techniques improve, we can expect an uptick of carbon fiber use across practically every industry.





Flat panels



Tunnels



Cylinders

Submarine Glass

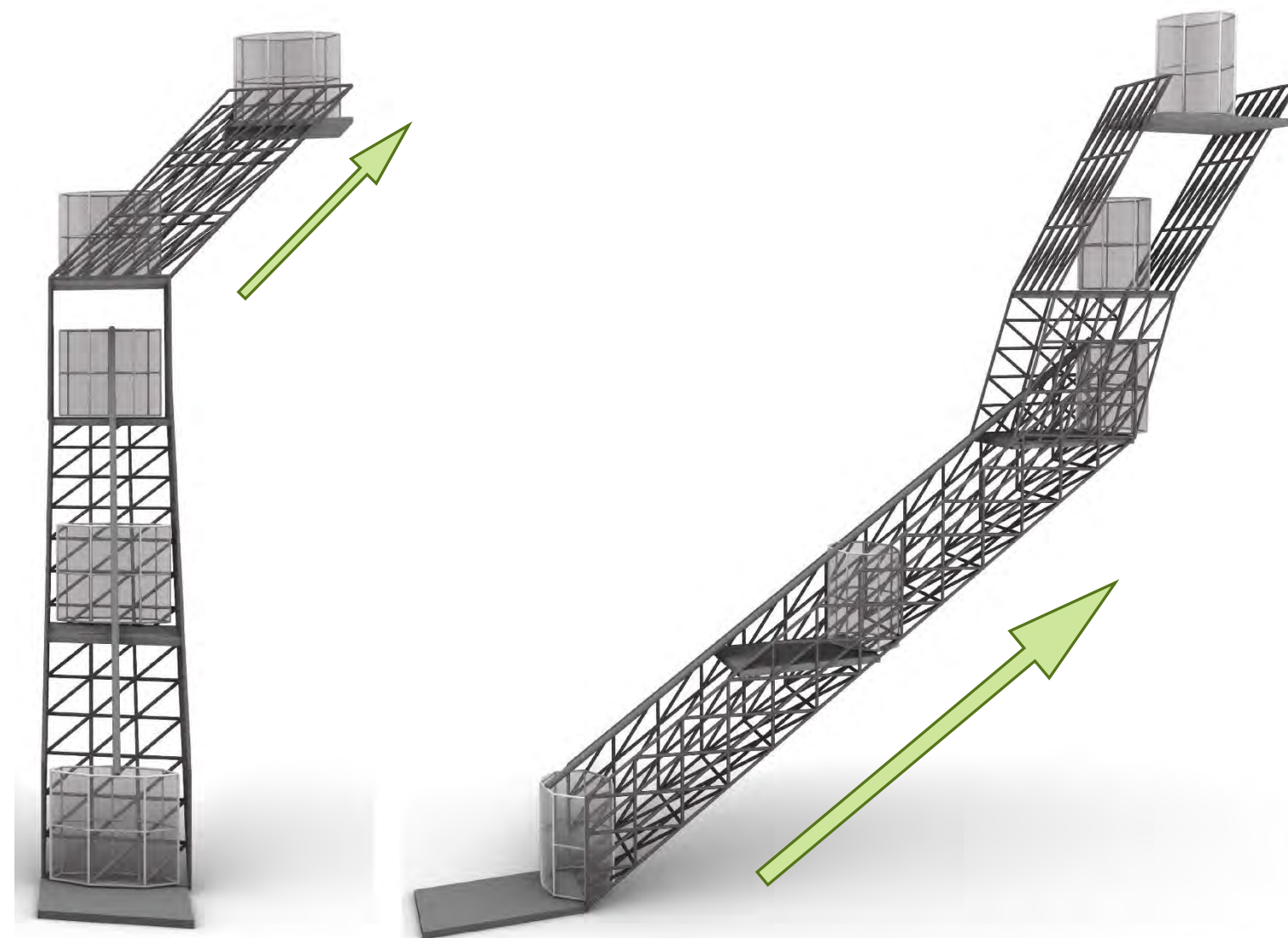
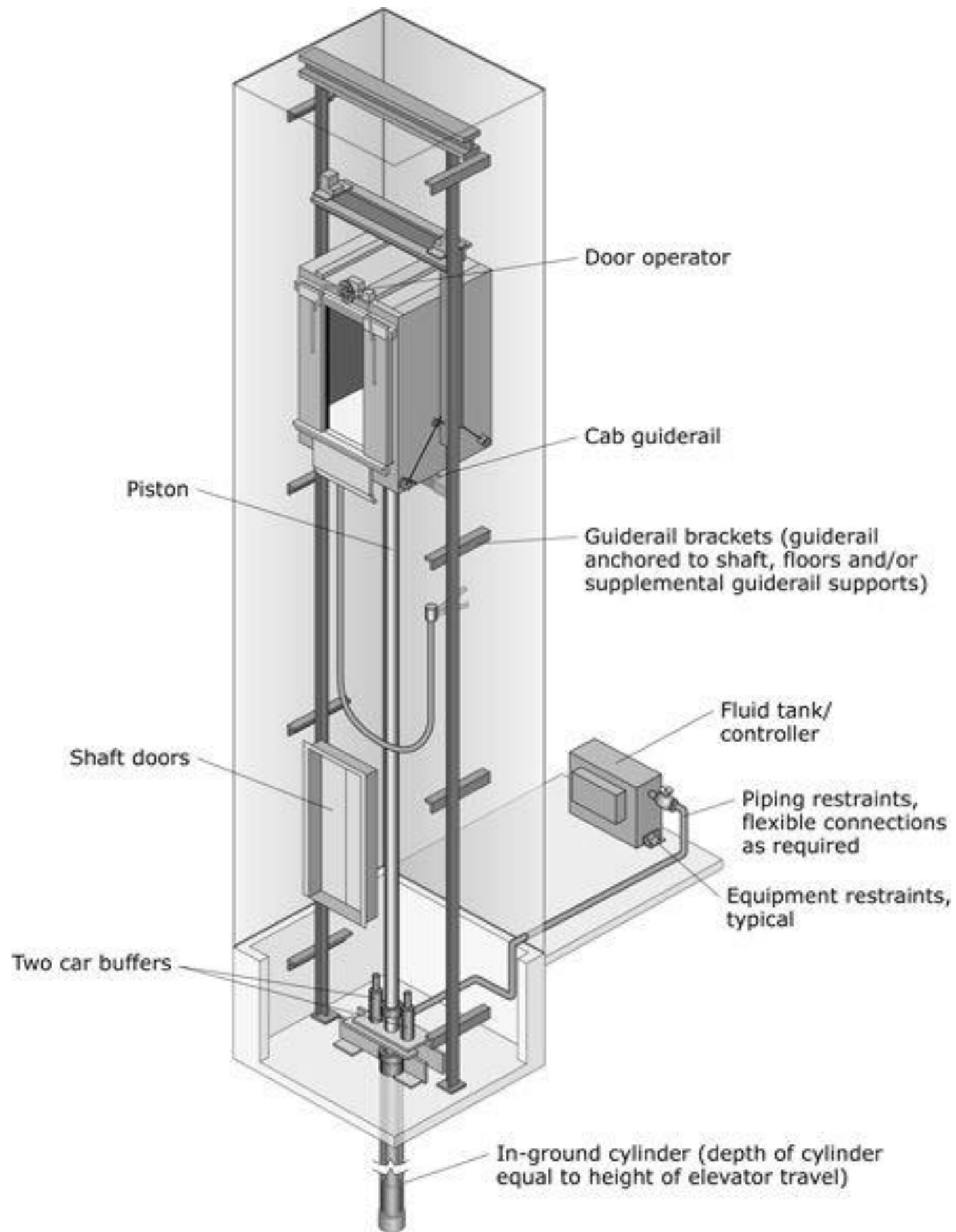
Acrylic, also known as Plexiglass, is a versatile plastic material with a variety of purposes and benefits, available in a spectrum of colors and opacities. Acrylic plastic was first produced in 1928 and brought to the market by Rohm and Hass Company around 1933. It was initially used during World War II for products such as airplane windows, canopies, and turrets.

The advantage of acrylic compared to glass is considerably. One of them is the weight. Acrylic underwater windows weighs half as much as normal glass and is much more stronger. Besides that acrylic will not break or crack like glass.



Hydraulic Elevators

Hydraulic elevators are considered the safest option because the cab is never suspended inside the hoist way. Elevators that use a cable-driven system hold the cab suspended in the air when they are above the ground floor. Pneumatic elevators hold the cab at higher floors by using a brake system.



Notes: Provide lateral restraints for guiderails to resist design forces and accommodate anticipated interstory drift.

Elevators should be installed, maintained, inspected and repaired by qualified elevator technicians. Inappropriate seismic restraints may compromise the safe operation of these systems.

4) CASE STUDIES

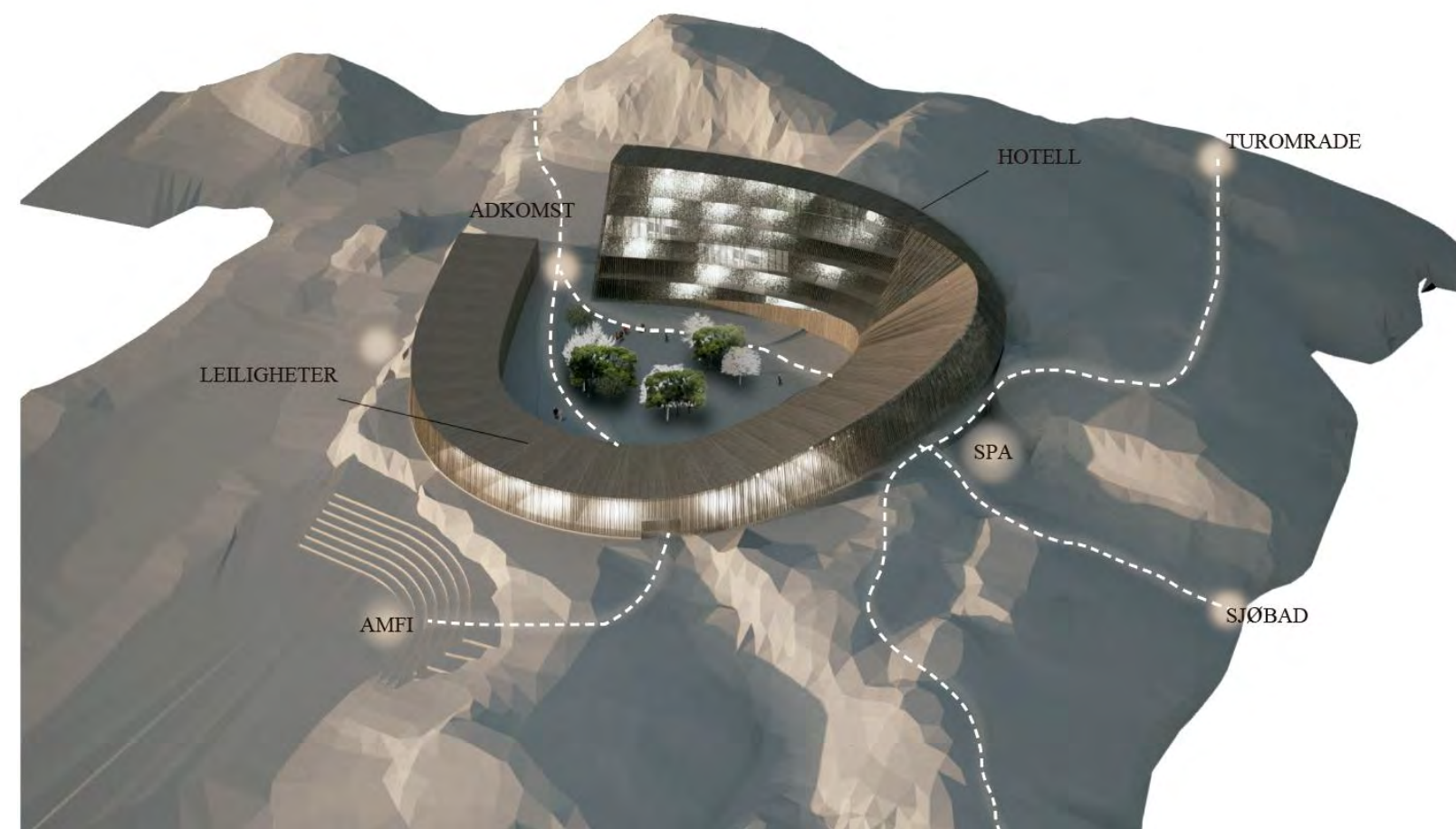




Lofoten Opera Hotel _ Snohetta

Furthest west of Lofoten, in Moskenes municipality close to the town Sørvangen, is area Glåpen. The site stretches out towards the sea both to the south and the west. It creates a link between the ocean and the tall mountains to the north and north-west.

The form creates an inner and outer space, and enhances the site's inherent potential of an architectural expression. Concept and program are balanced in a mix of hotels, apartments, amphitheater, spa, hiking and sea water basins within a total size of 11,000 m². The organic form protects and opens at the same time.



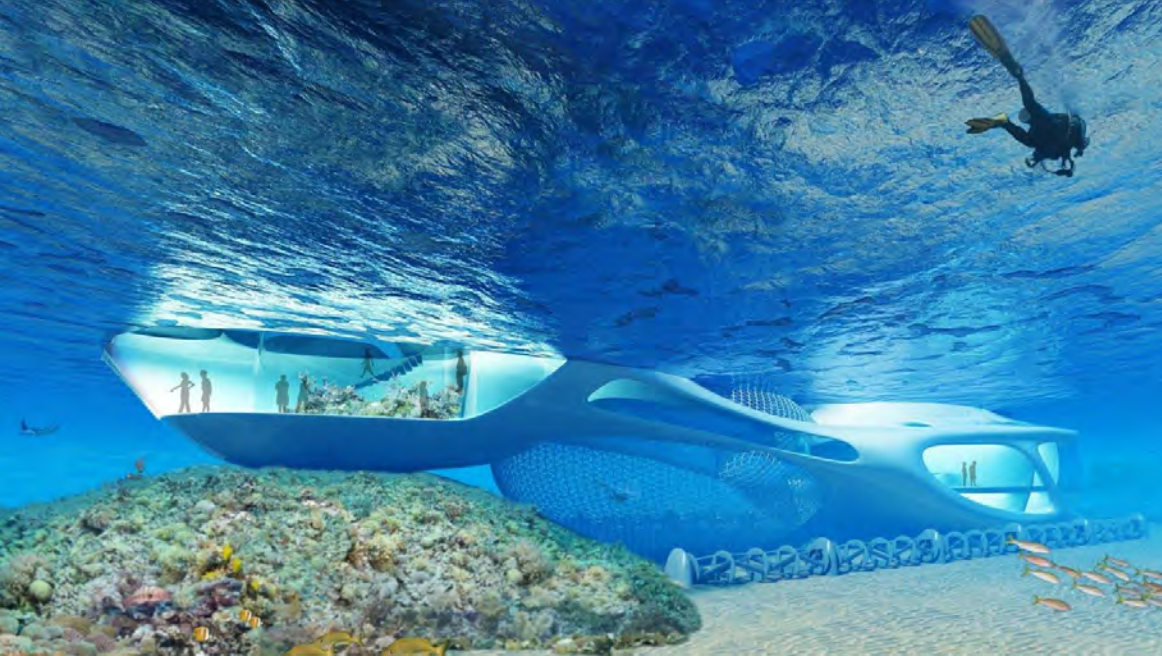


Underwater Restaurant_ Snøhetta

Located at the southernmost point of the Norwegian coastline, where the sea storms from the north and south meet, the project is situated at a unique confluence. Marine species flourish here in both briny and brackish waters to produce a natural abundance in biodiversity at the site. The Snøhetta-designed restaurant also functions as a research center for marine life, providing a tribute to the wild fauna of the sea and to the rocky coastline of Norway's southern tip.

Under was built on a barge as a concrete tube shell twenty meters from the site. The windows were installed prior to the submersion. During submersion, the structure floated on its own and was delicately moved to its final location by a separate crane and tugboats. Following the submersion, structural work was completed, and the building was bolted to a concrete slab anchored to the bedrock beneath the seabed. In order to ensure a proper connection to the bolts on the concrete slab, the construction team filled the structure with water to make it sink. After ensuring that all bolts were fully tightened, the water was drained away, allowing the interior work to begin.

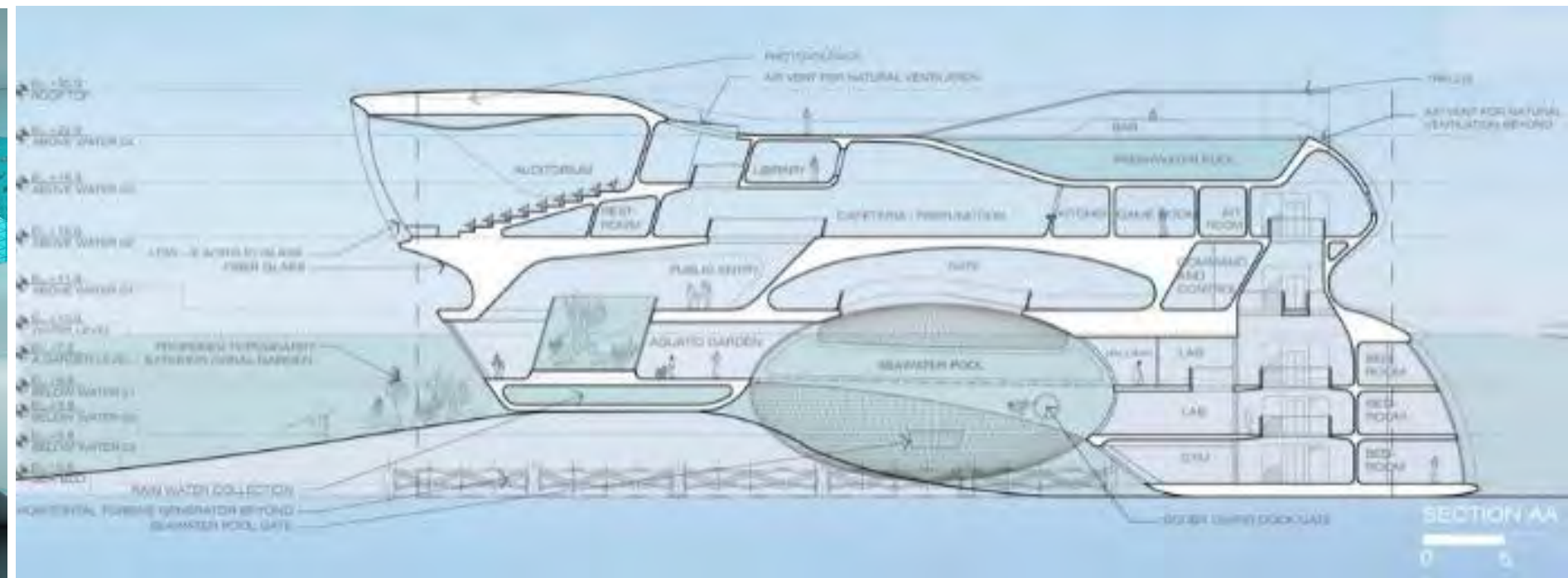
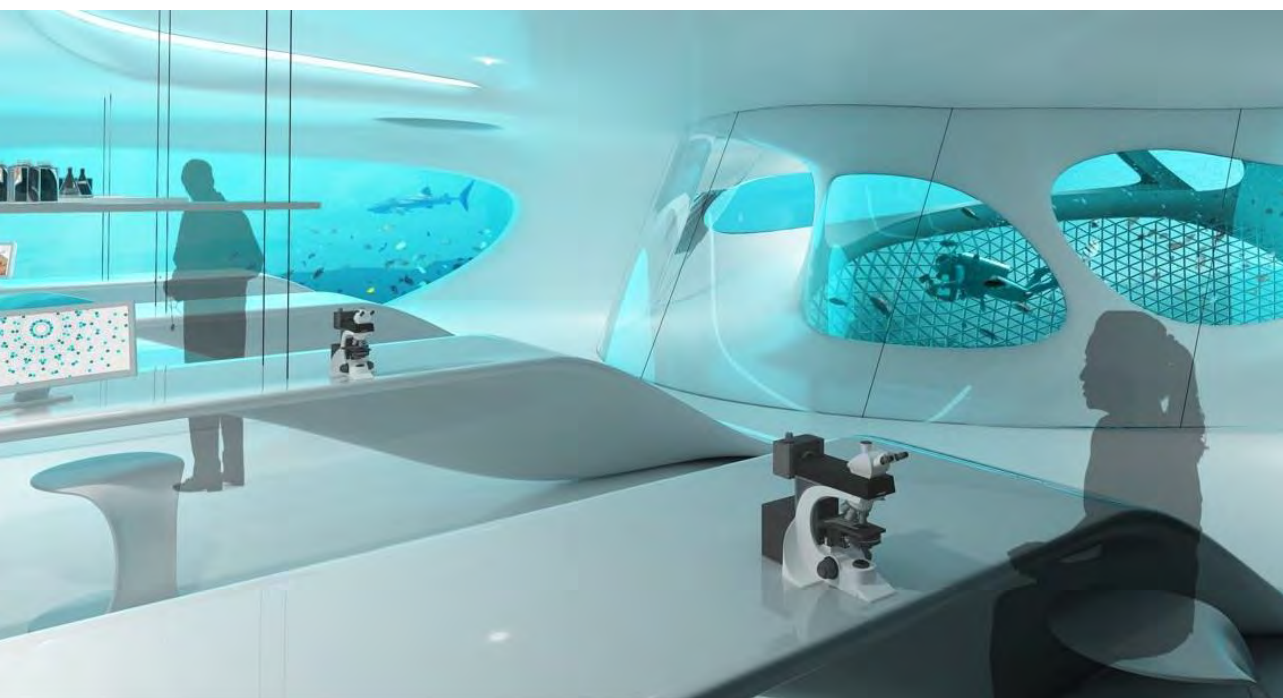




Marine Research Center in Bali_Solus 4

The 2500 square meter Marine Research Center would be located 150 meters off shore from the of Kuta beach. It is an imposing fluid structure that seamlessly adapts to its natural aquatic environment and allows visitors and scientist to have a direct visual connection to the exterior. The program which consists of research labs, bedrooms for scientist, seawater pool, aquatic garden library and an auditorium would be distributed under and over the surface of the sea.

In keeping with the nature of the universal ocean, the project is intended to be wholly energy efficient. Large glass-based panels form the skin – both transparent and opaque as well as embedded PV cells. The close in to shore location allows for tidal/current generators to serve the power requirements. Rainwater collection and seawater conversion systems take care of the domestic water requirements. Deeper source seawater is circulated through the skin for radiant cooling and temperature control of the overall anthropomorphic shape.

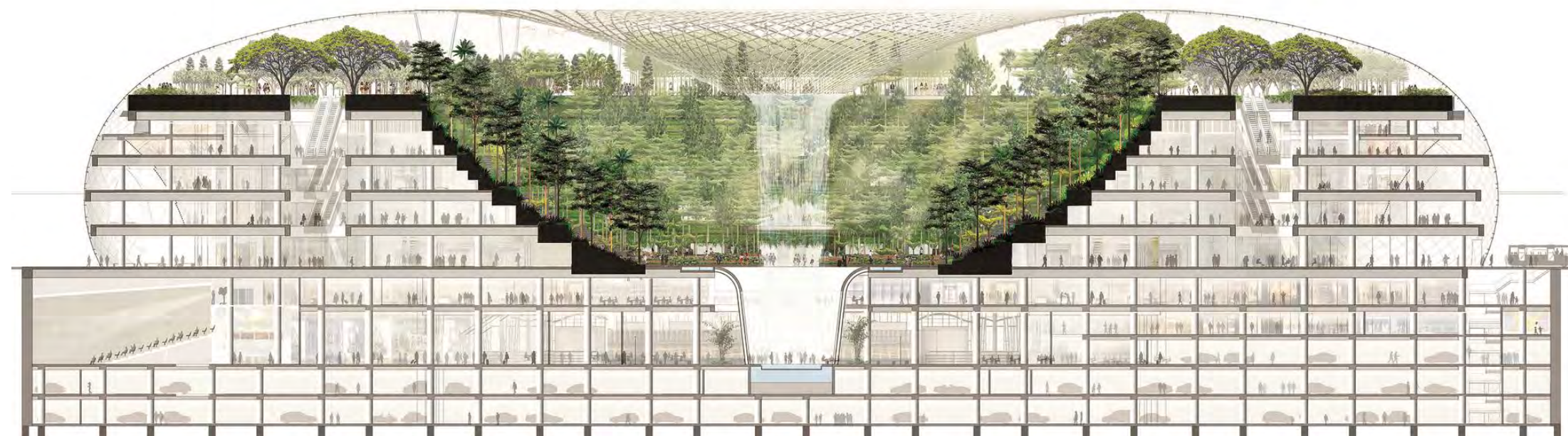


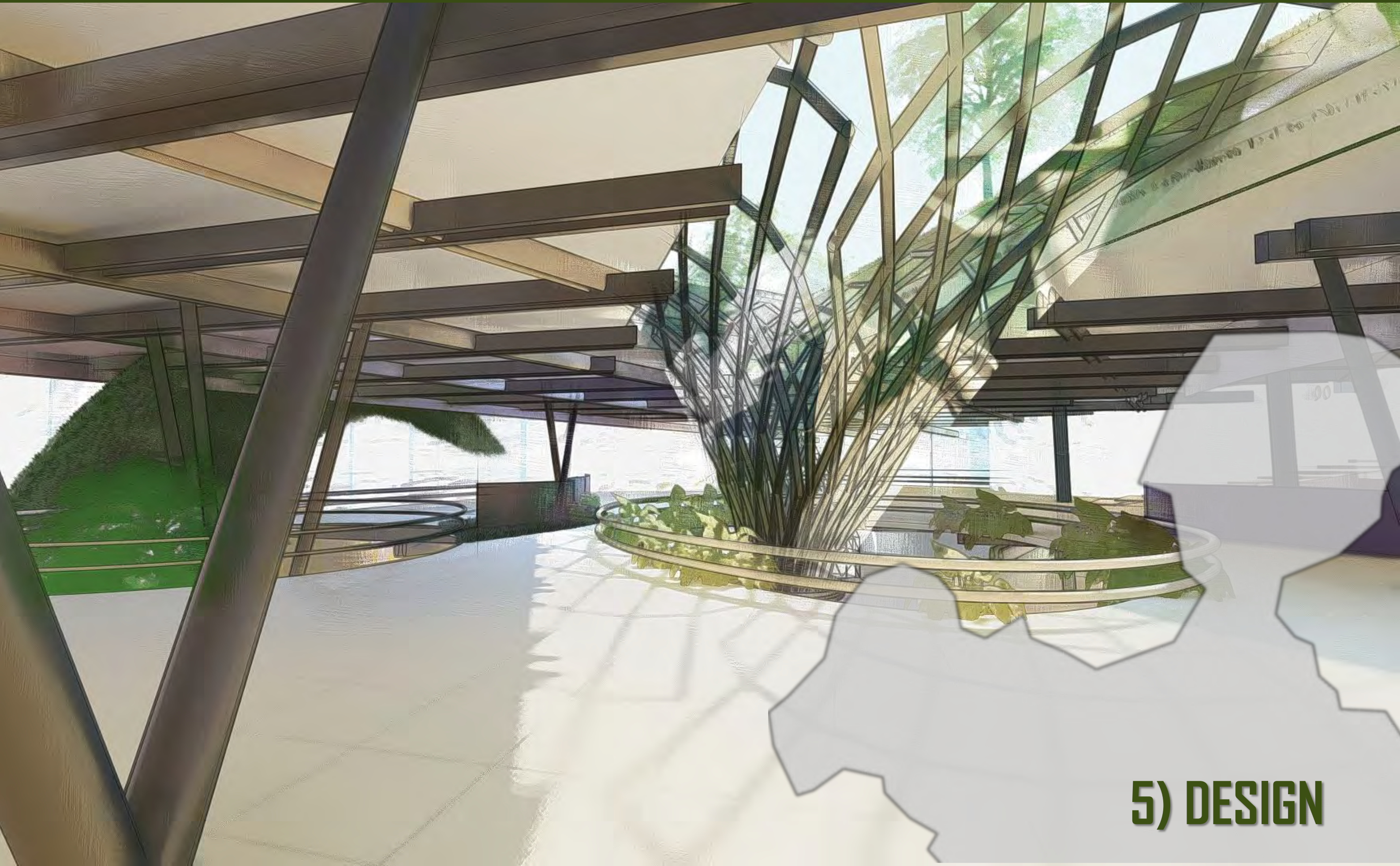


Jewel Changi Airport_Safdie Architects

The publicly accessible 135,700 sqm center includes facilities for landside airport operations, indoor gardens and leisure attractions, retail offerings, restaurants and cafes, and hotel facilities, all under one roof. Directly connected to Terminal 1 and to Terminals 2 and 3 via pedestrian bridges, Jewel engages both in-transit passengers as well as the public at large. Each of the cardinal axes—north, south, east, and west—are reinforced by gateway gardens that orient the visitors and offer visual connections between the internal program elements of Jewel and the other airport terminals.

At the heart of Jewel is the Forest Valley, a terraced indoor garden that offers many spatial and interactive experiences featuring walking trails, cascading waterfalls, and quiet seating areas. Amid the more than 200 different species of trees and flora, is the world's tallest indoor waterfall—a 'rain vortex'—showering down from an oculus in the domed roof to the Forest Valley garden seven stories below. The waterfall—at peak conditions flowing at more than 10,000 gallons per minute—aids in the cooling of the landscape environment and collects significant rainwater to be re-used in an around the building. Surrounding the gardens is a multi-level retail marketplace on five levels that access the garden via a series of vertical canyons.





5) DESIGN



Master Plan

... Helsinki is currently going through a fascinating process of **renewal** as former industrial and harbor areas.

... Helsinki is facing the greatest urban change in its history, and it is a fast-growing metropolitan area in Europe.

... Helsinki is in a uniquely privileged situation within European cities.

... It is believed and visioned that Helsinki will become the notion of a city on a **human scale with the backbone of a sustainable public transport system** and the city is growing around the abundant **natural features like green fingers, sea and green spaces.**

... Helsinki has a **developed economic and political** features.

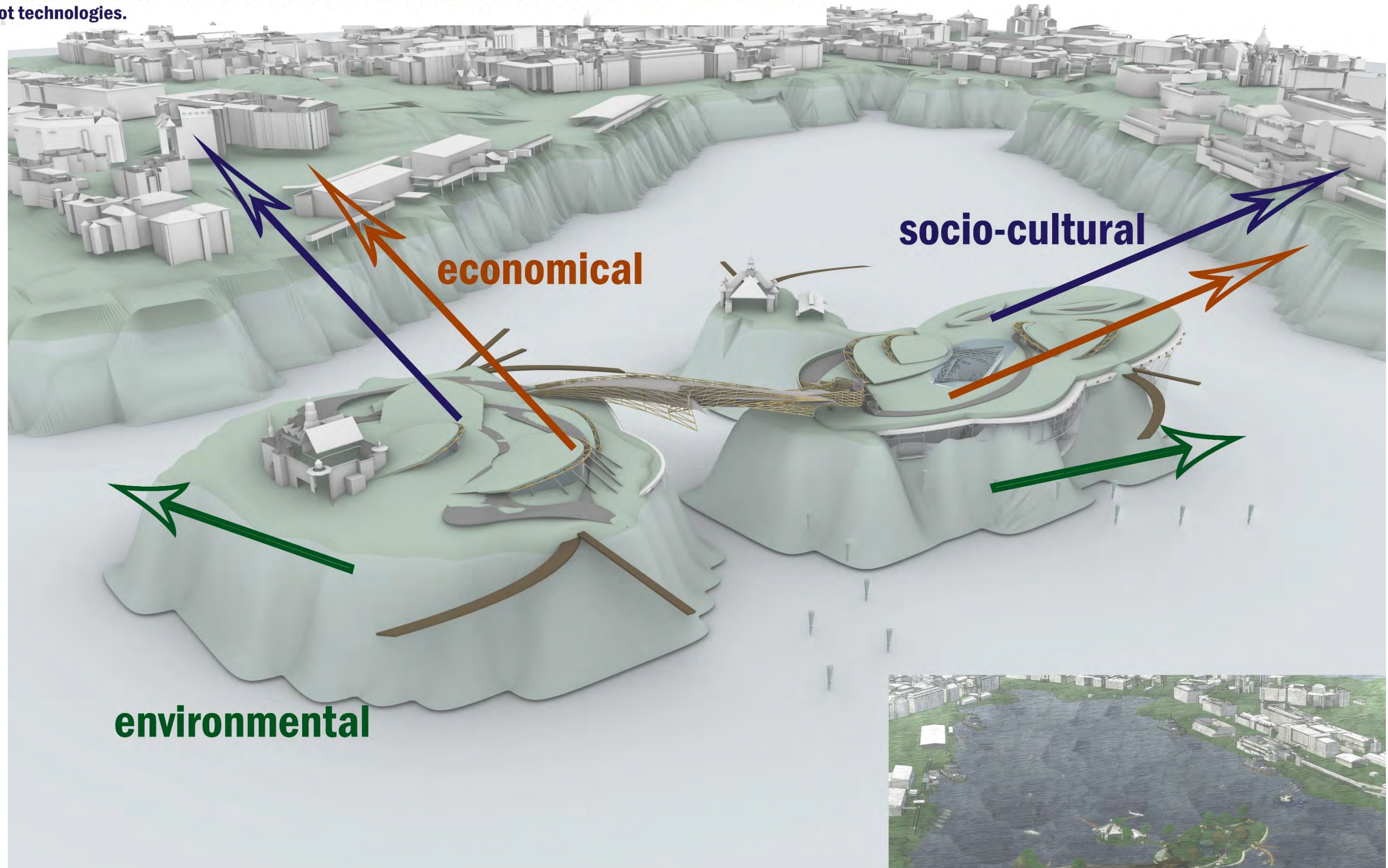
... Industrialization advanced Helsinki and South Harbor and the port benefited from a great rise in both cargo and passenger traffic.

... Helsinki is currently undertaking a **process of renewal and regeneration.**

... Helsinki has currently a high rate of homeless citizens. They are given home but not job.

... Helsinki is in close proximity to more than three hundred islands, many of which can be reached by a short ferry journey.

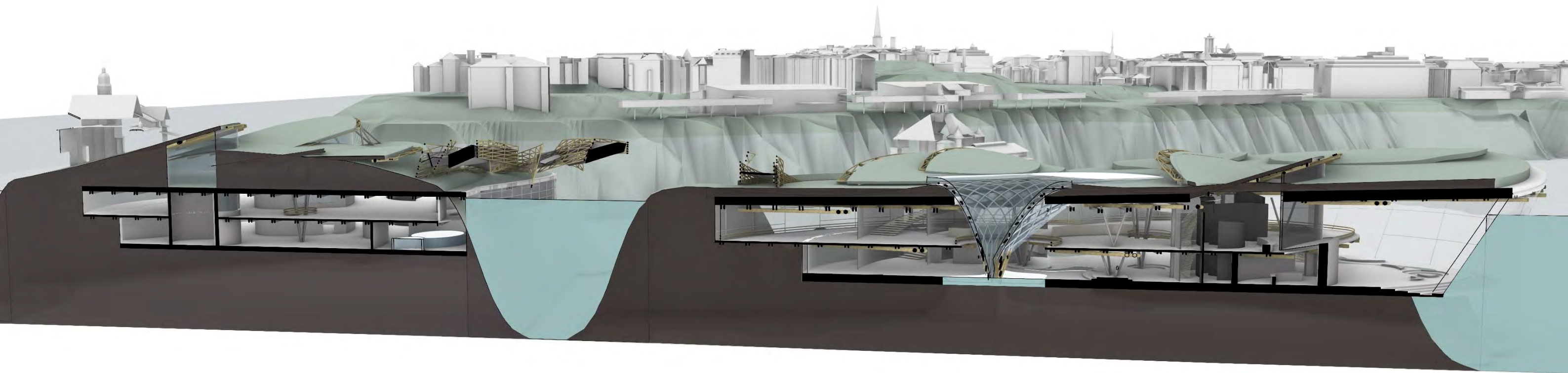
- ... job opportunities for homeless people
- ... cultural landmark
- ... introducing the new renewable energy systems and materials to citizens
- ... experiencing the new technologies which supports the usage of new sustainable systems
- ... introducing and teaching the new systems to citizens by making them experience and observe these models of new or pilot technologies.



- ... producing electricity for the city
- ... job opportunities for homeless people

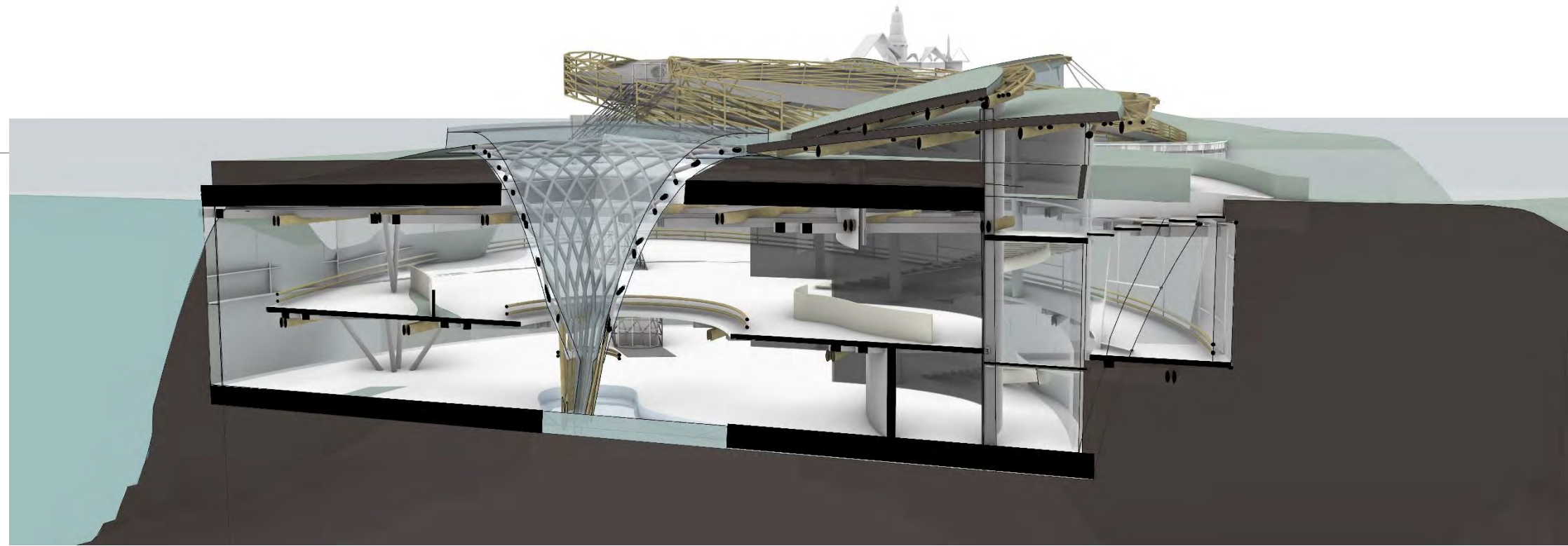
- ... producing electricity while decreasing the dependency of coal and natural gas based electricity production

Longitudinal Section



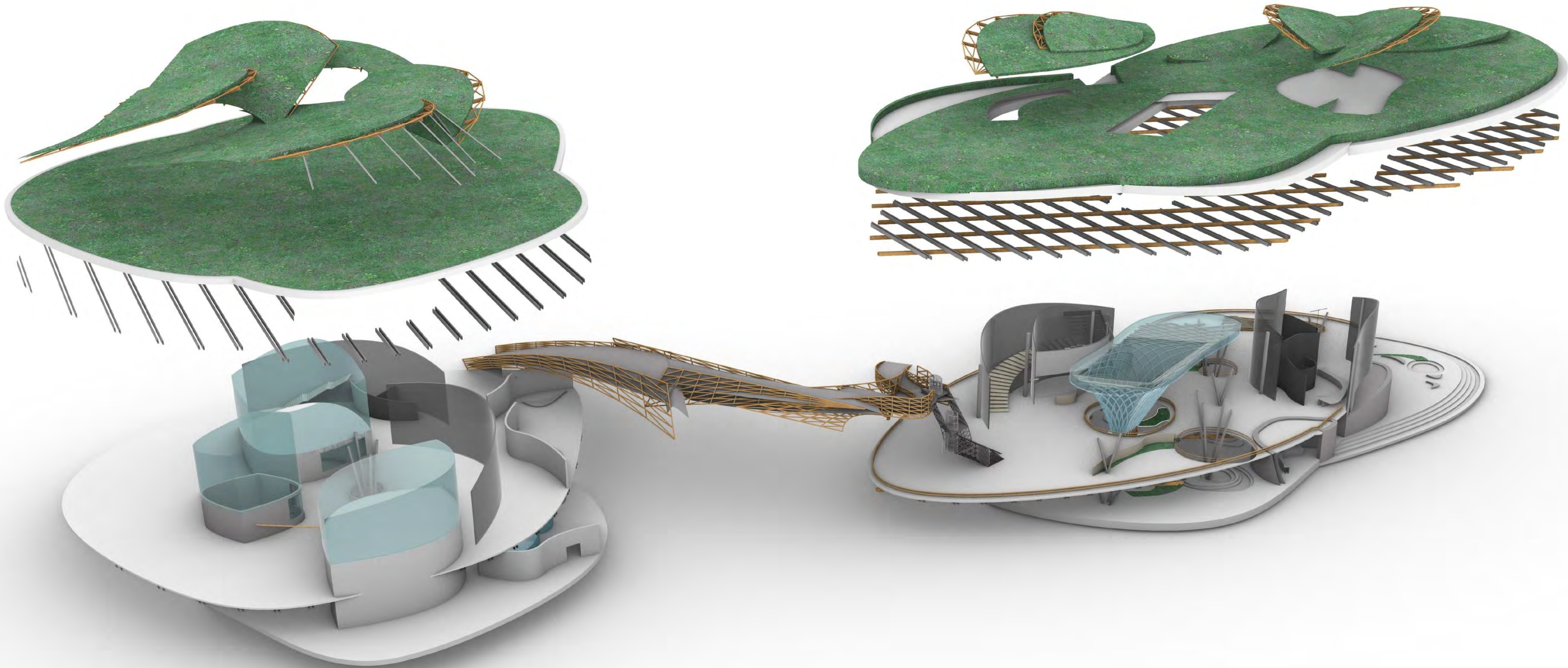
Partial Sections

Research Center



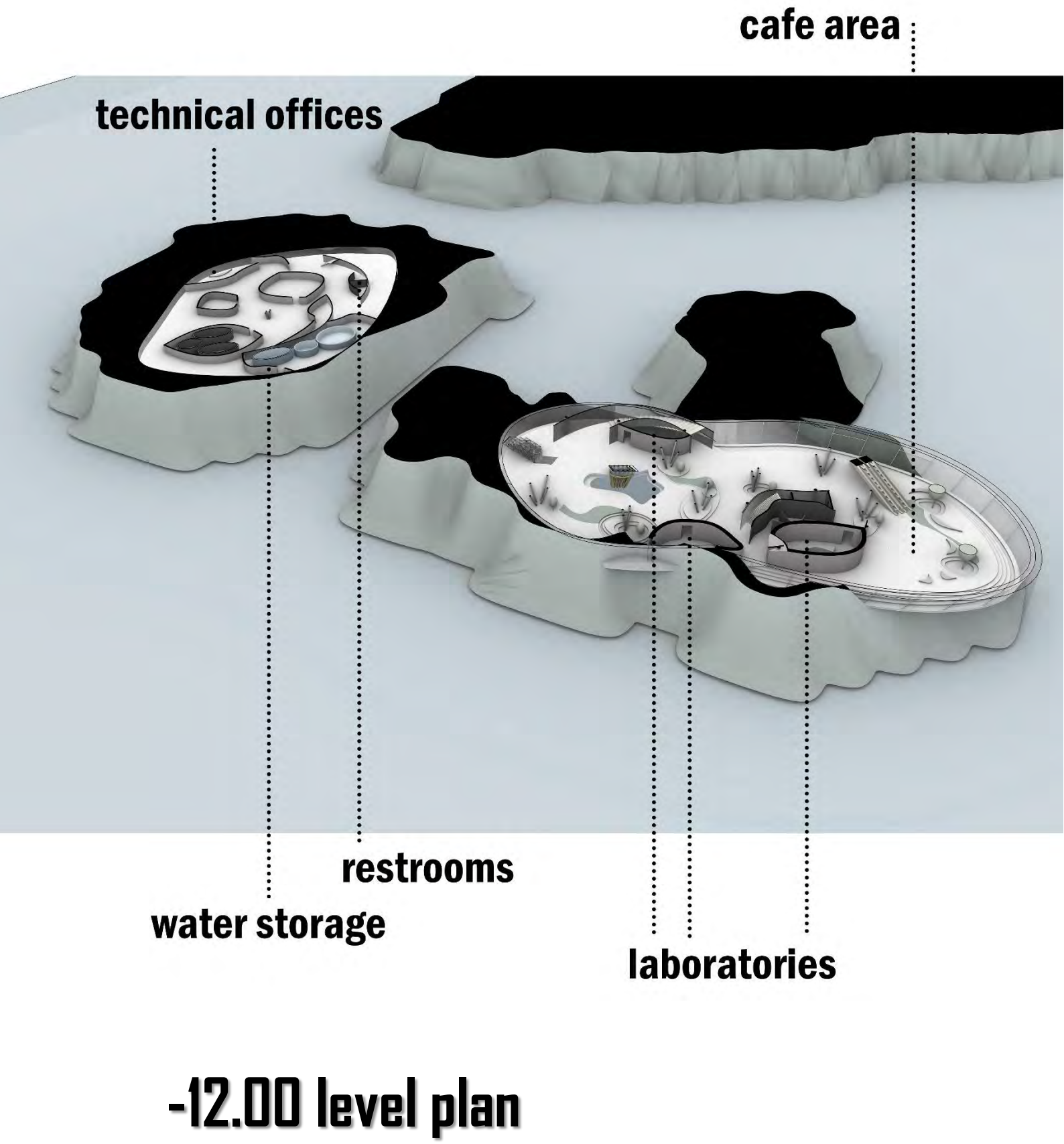
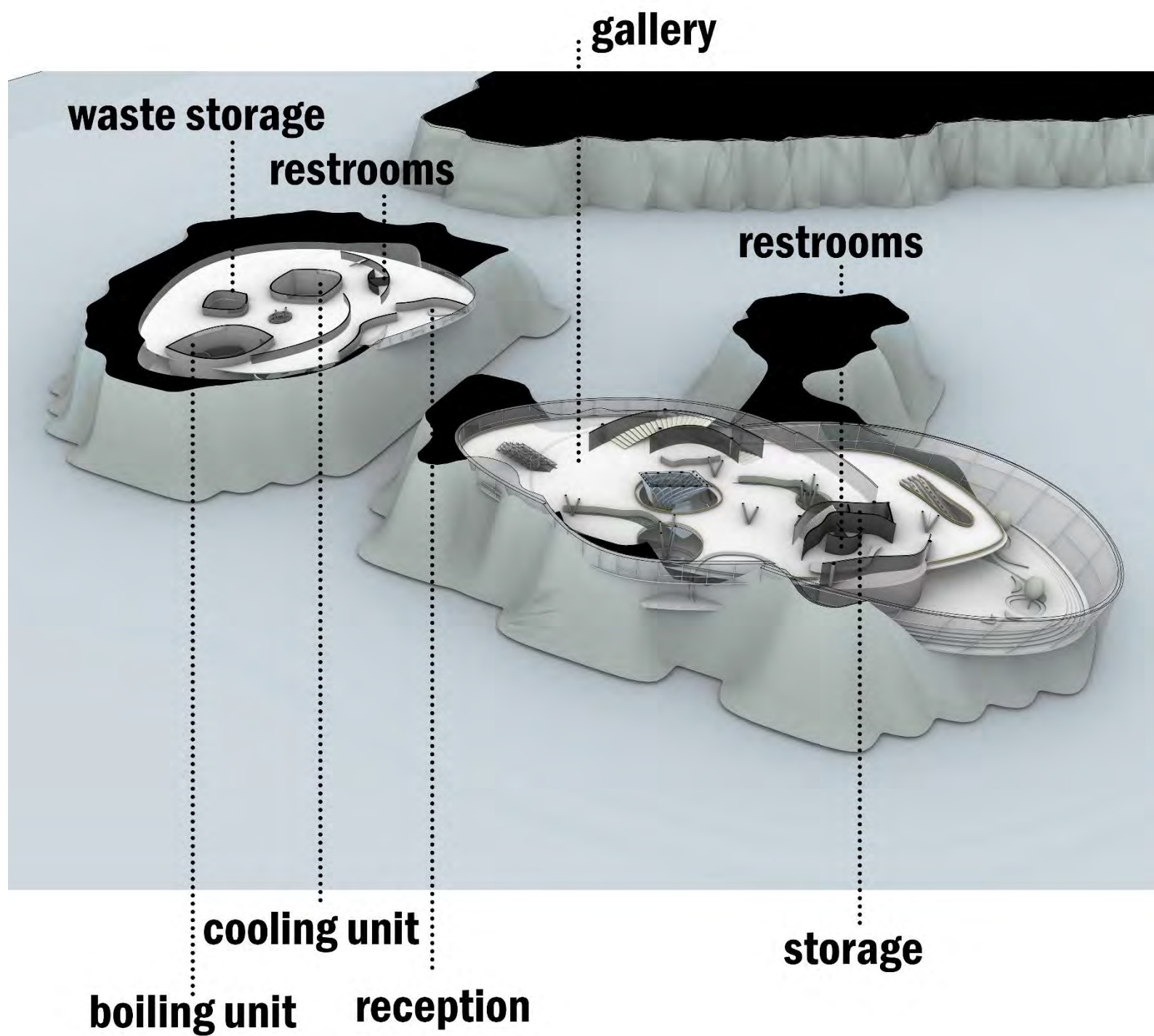
Waste to Energy Center

Exploded Diagram for Plans



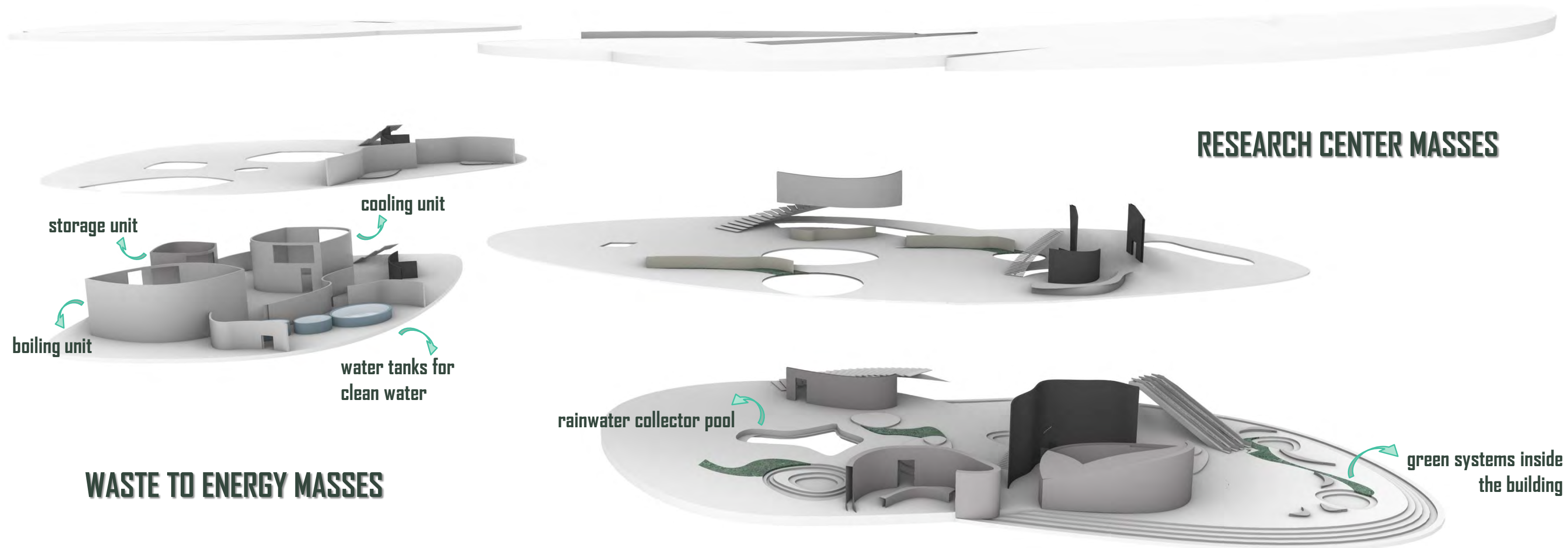
PLANS

-6.00 level plan

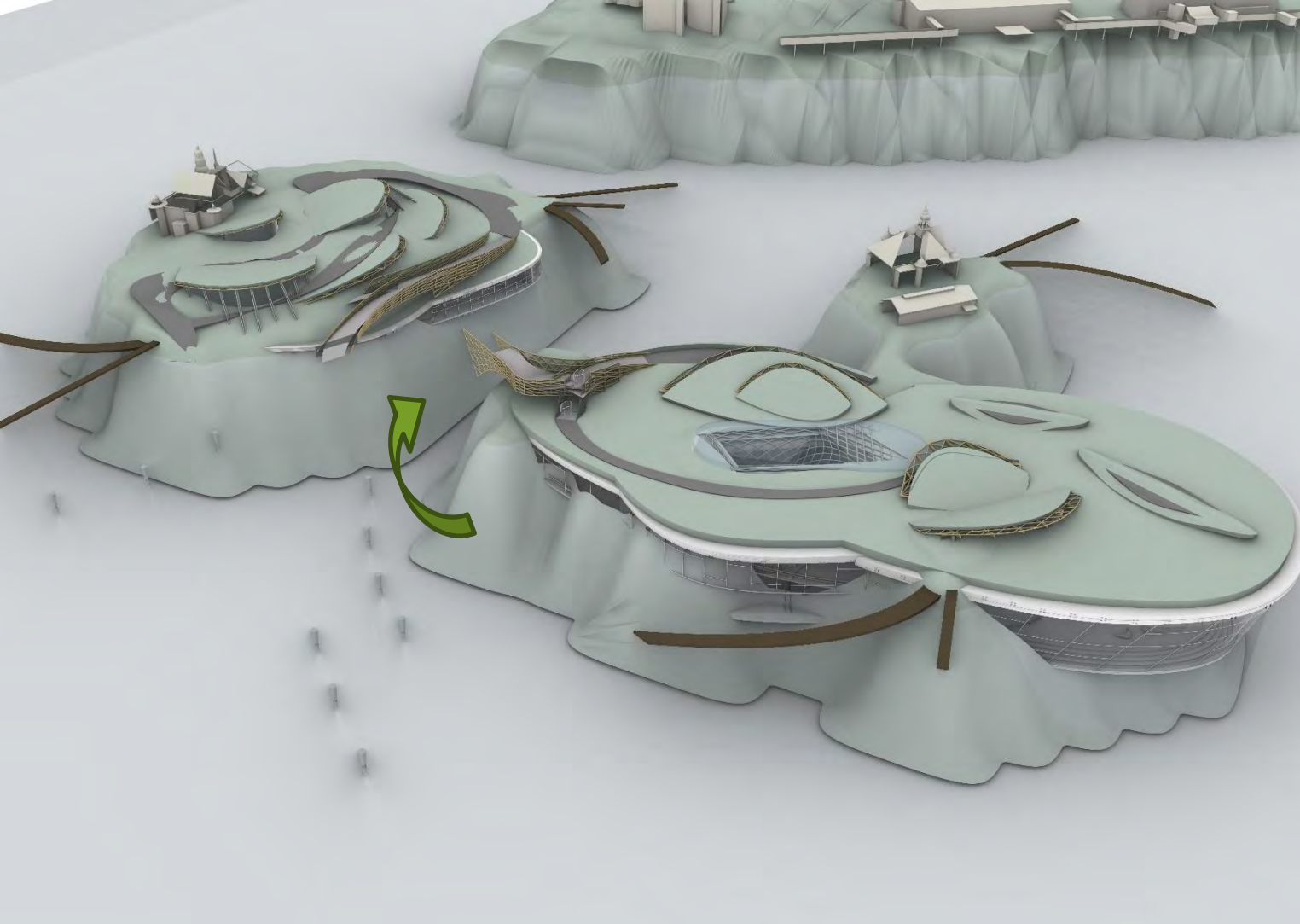


-12.00 level plan

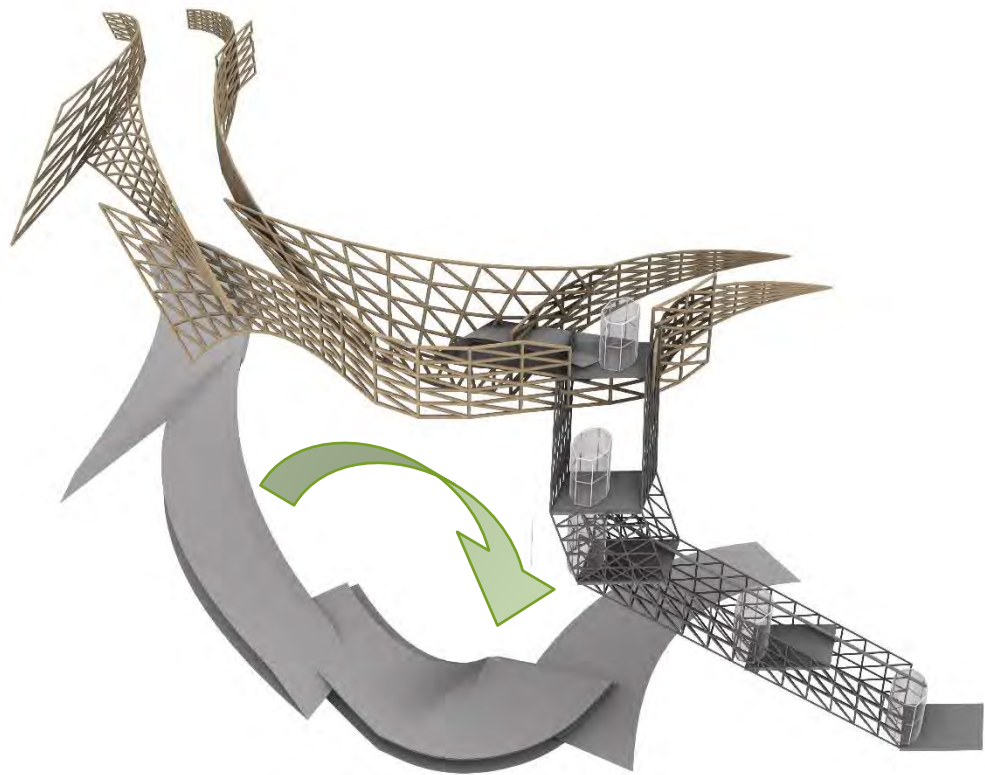
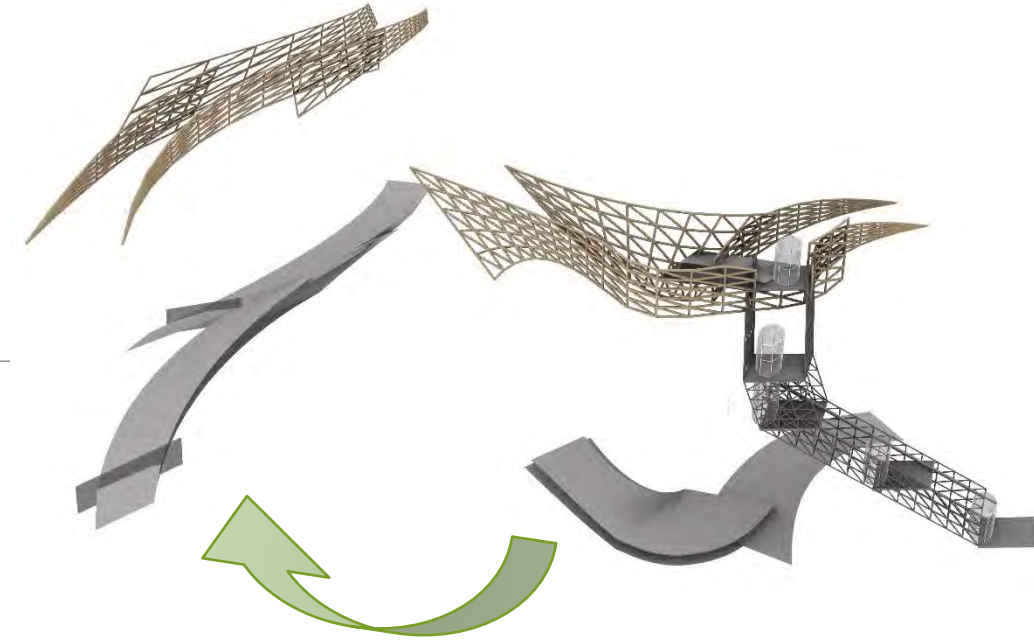
There are so many sustainable and energy systems that are integrated through the building:



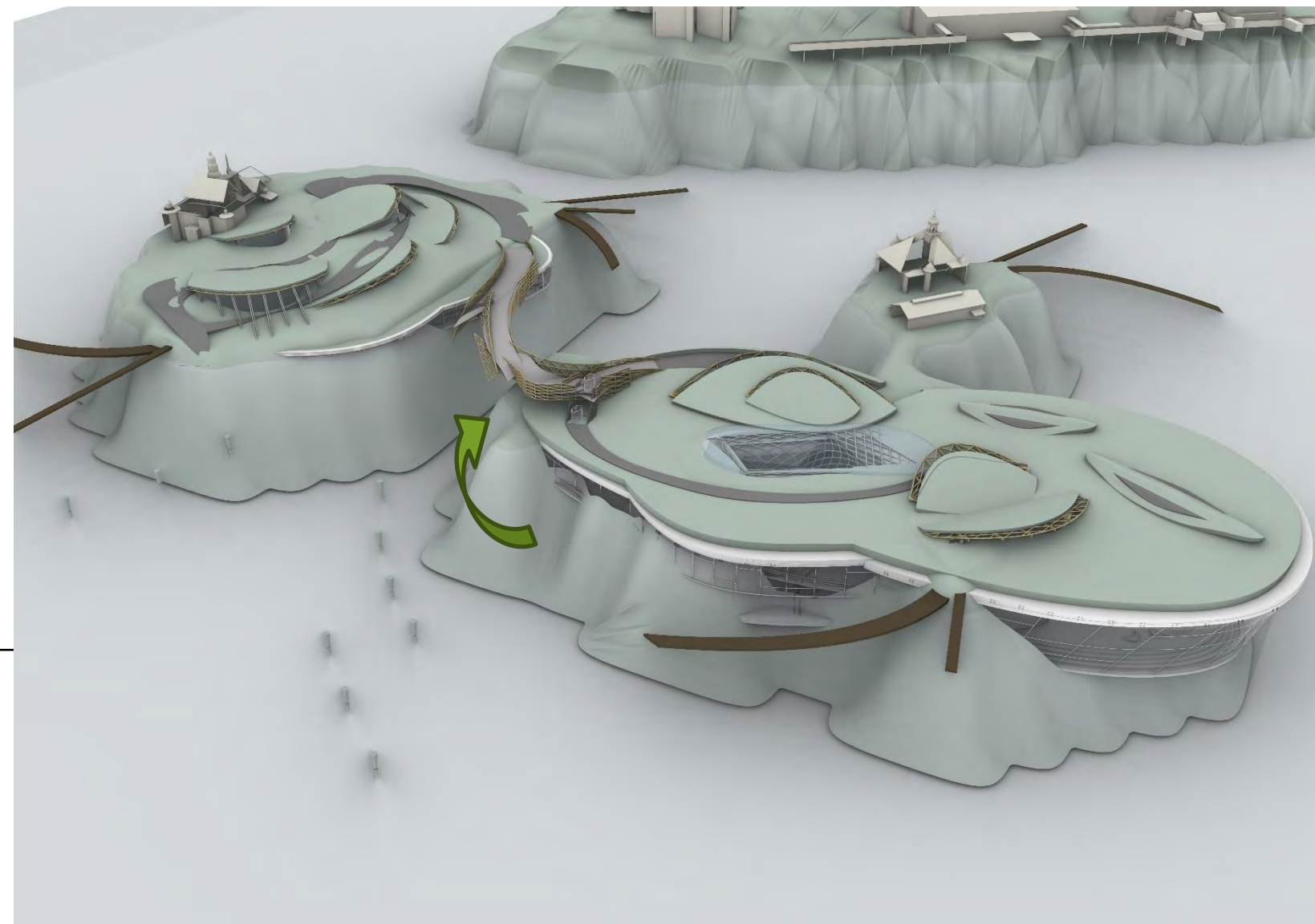
STRATEGIES

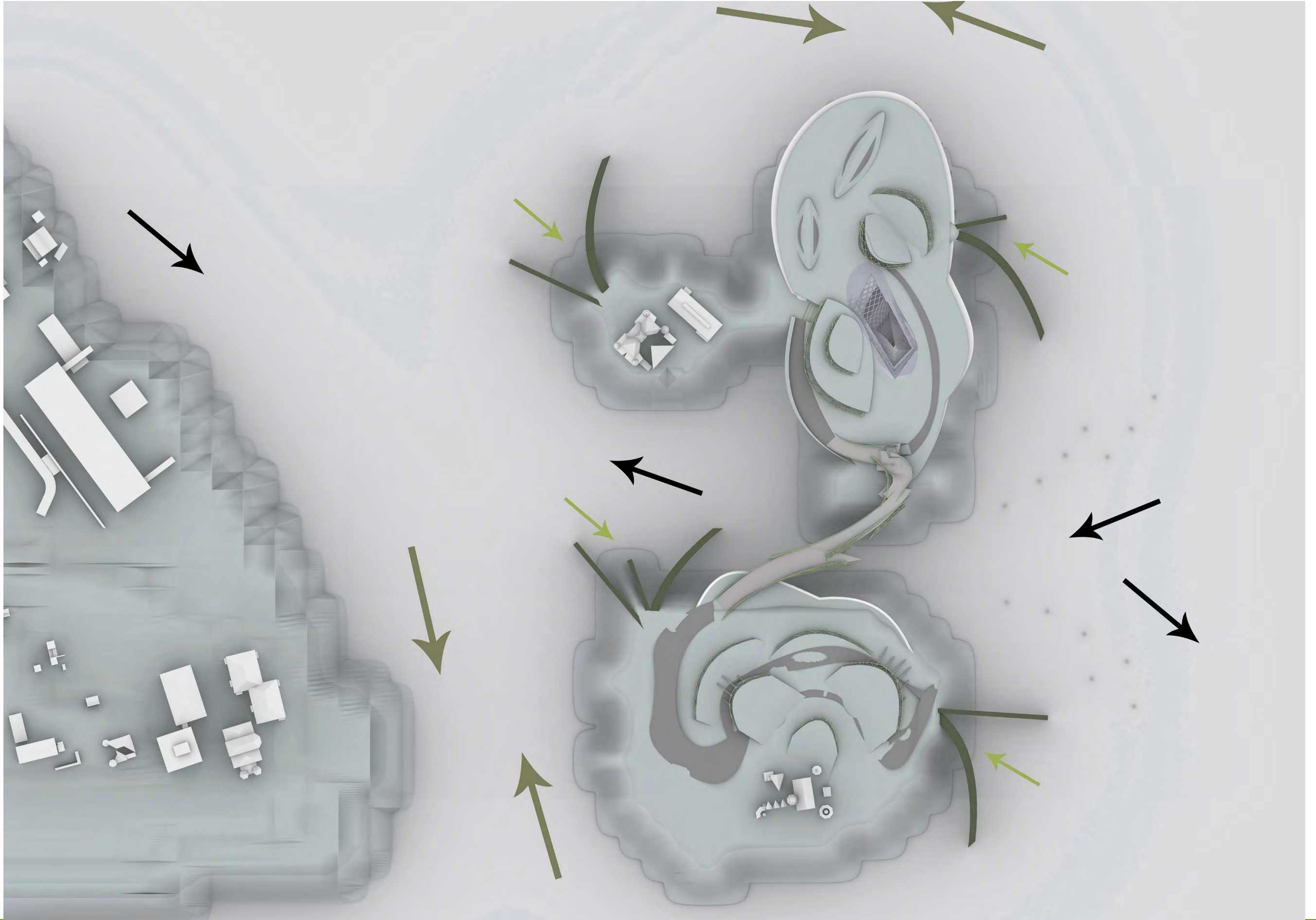


Bridge is opened.

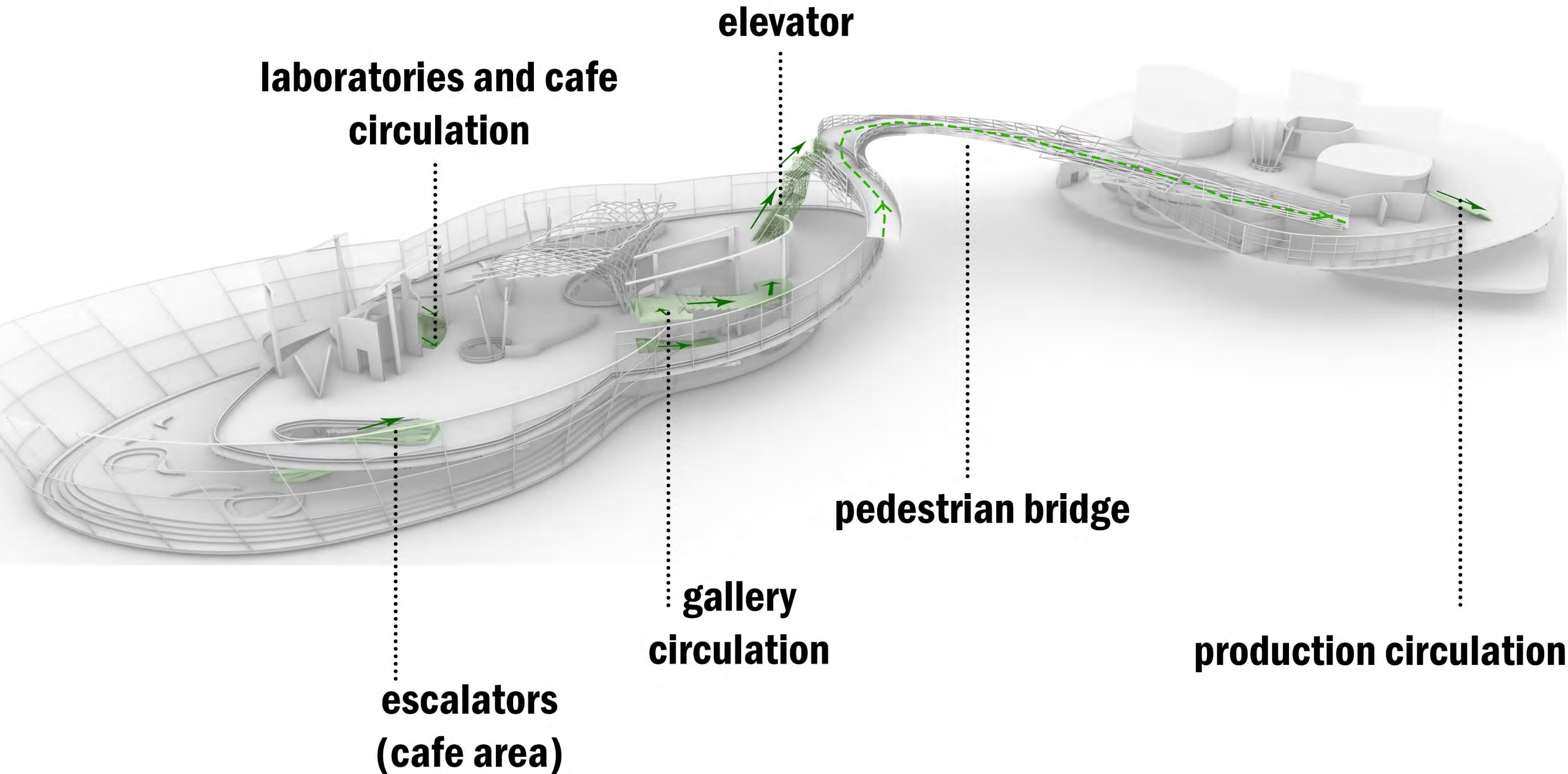


Bridge is closed.

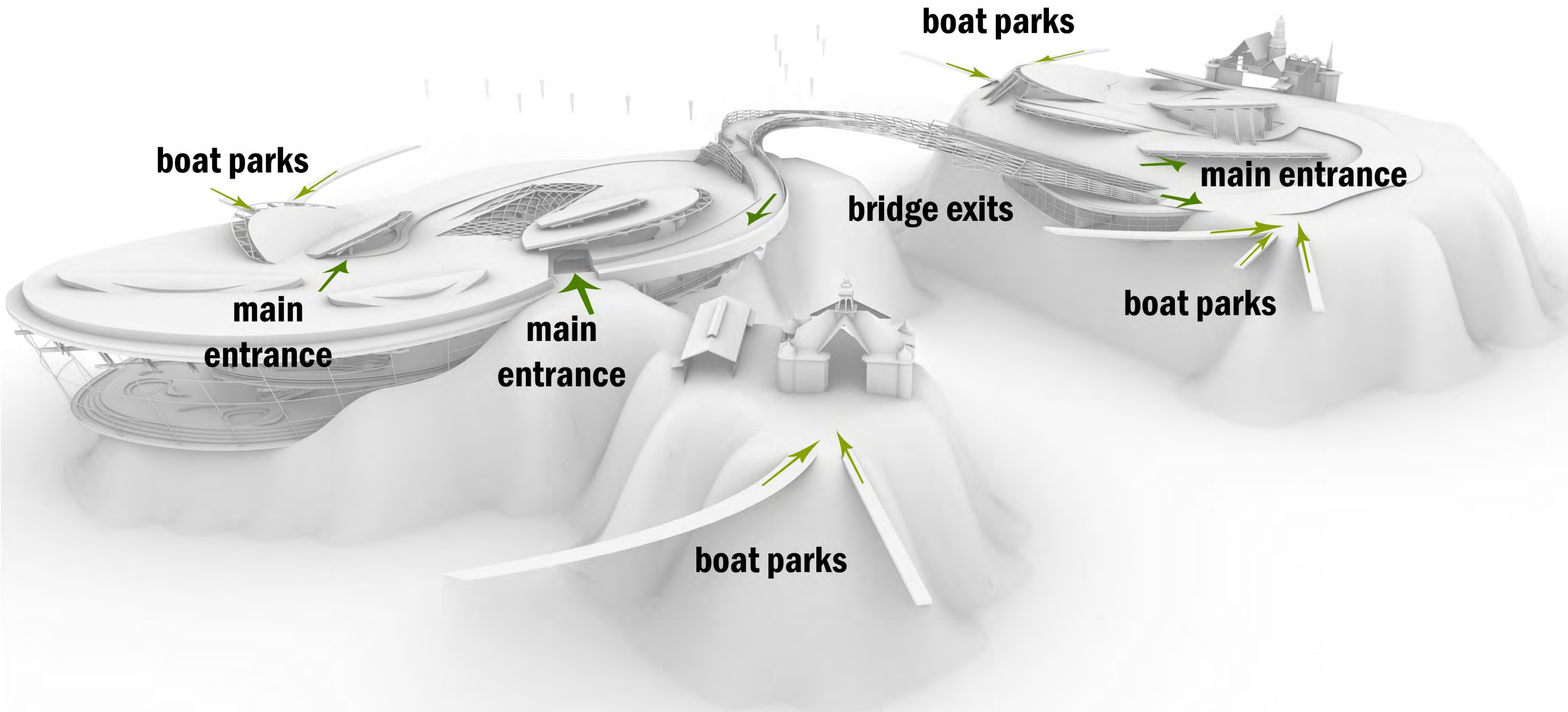




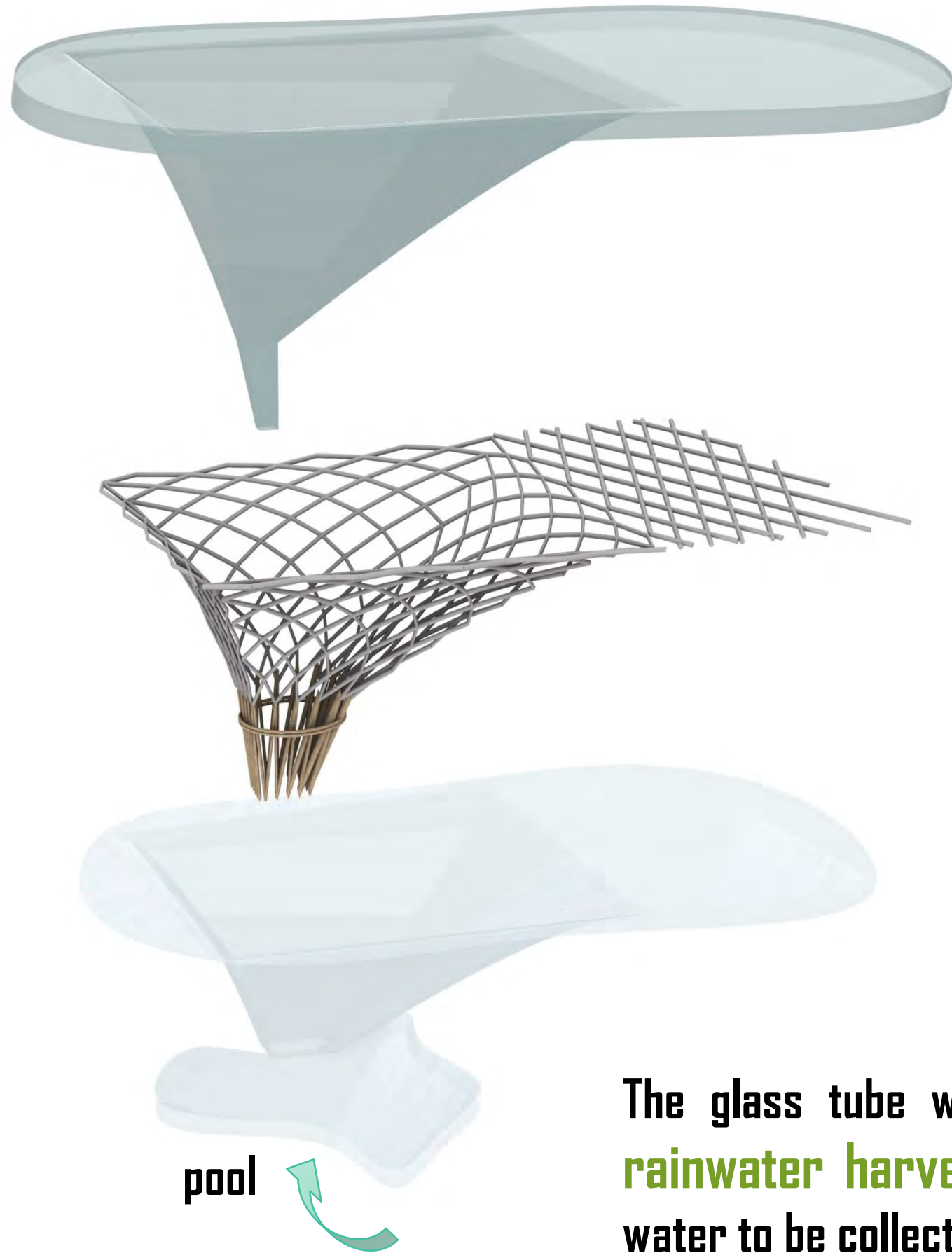
interior circulation



entrances



interior glass tube



tempered glass

steel hollow & glulam hollow diagrid

tempered glass

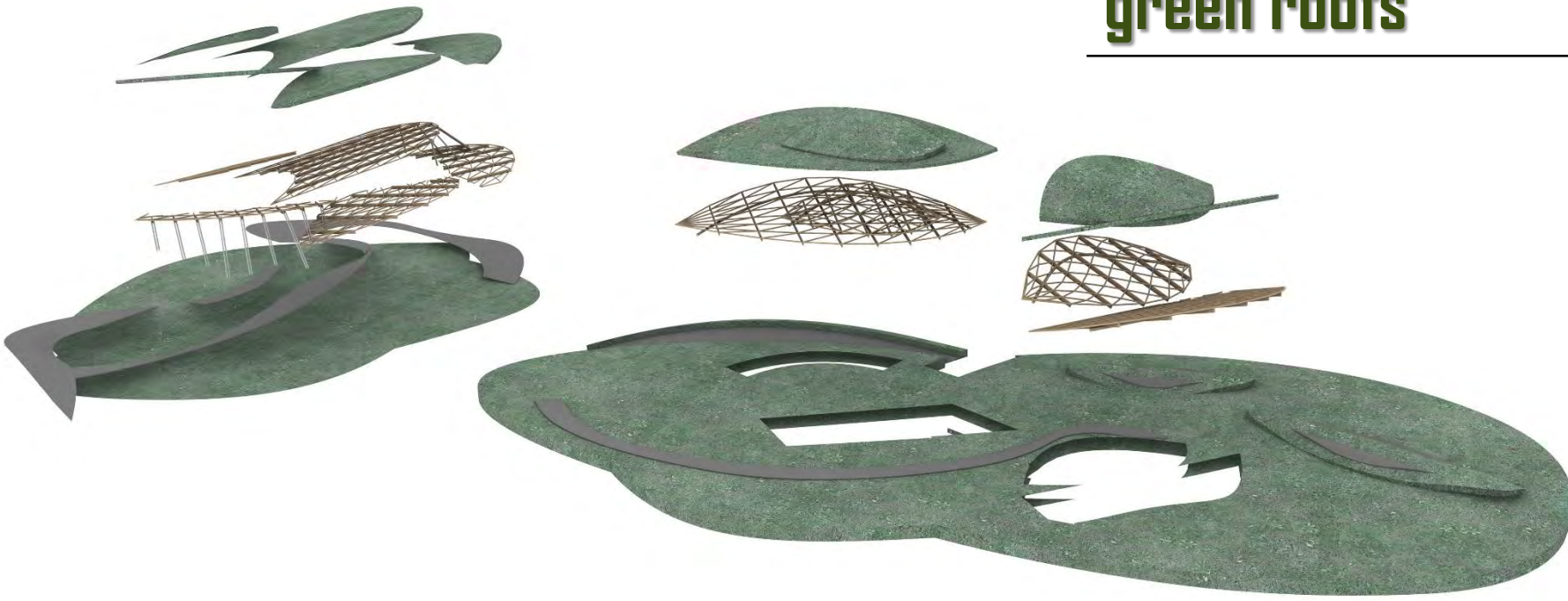
The glass tube which has both exterior and interior connections is using as a **rainwater harvesting system**. There is a pool under the tube which enables the water to be collected.

green roofs

green roof

glued laminated timber

green roof



... Finland is one of the best countries producing wood.
... Metal is the other material that is produced in the country.

structures

steel with glulam beams

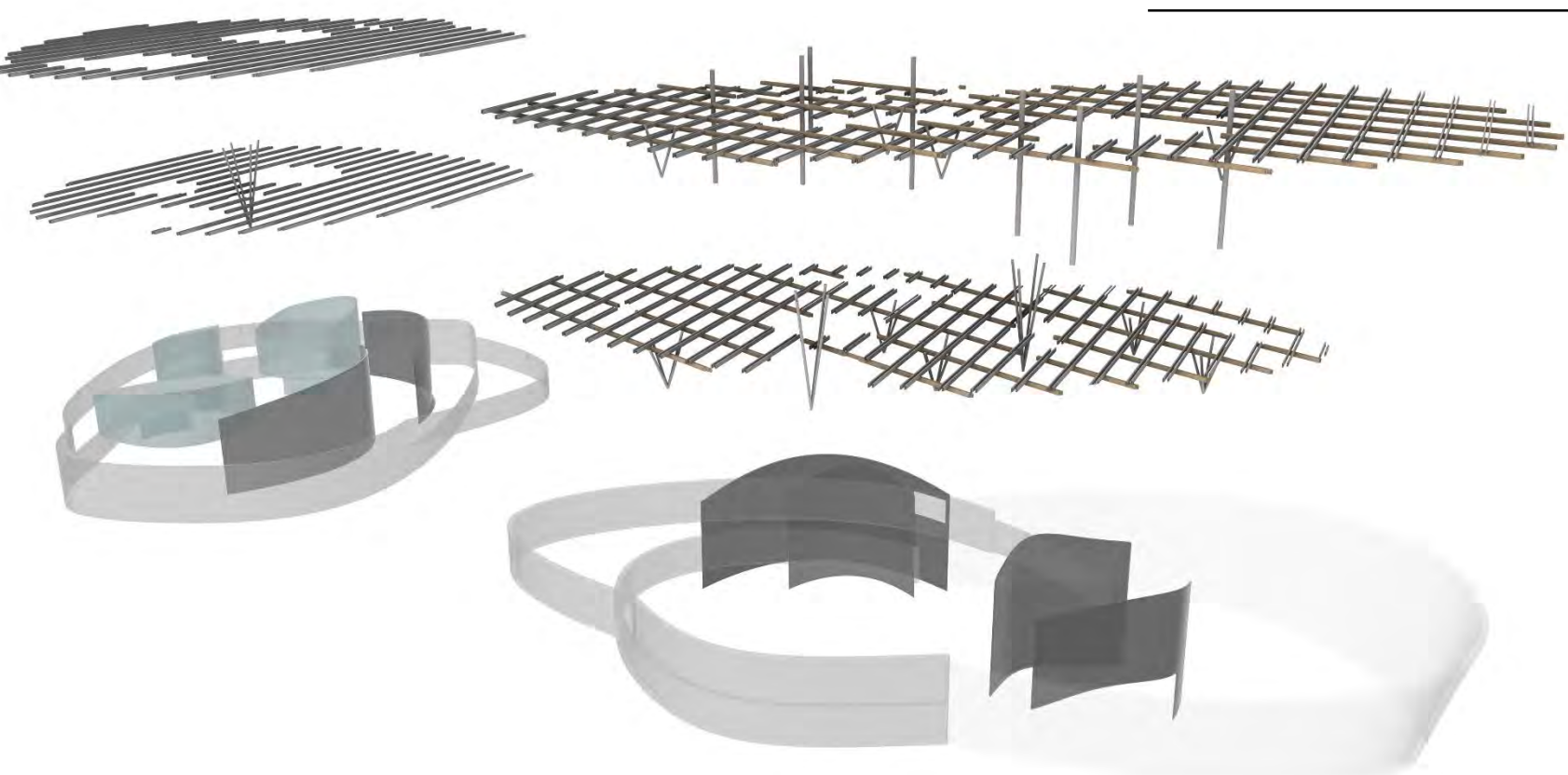
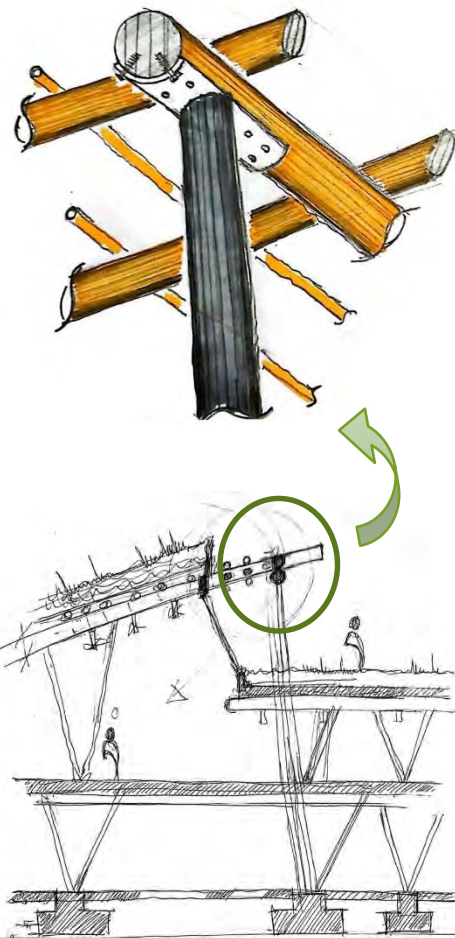
steel rounded columns

steel with glulam beams

steel rounded columns

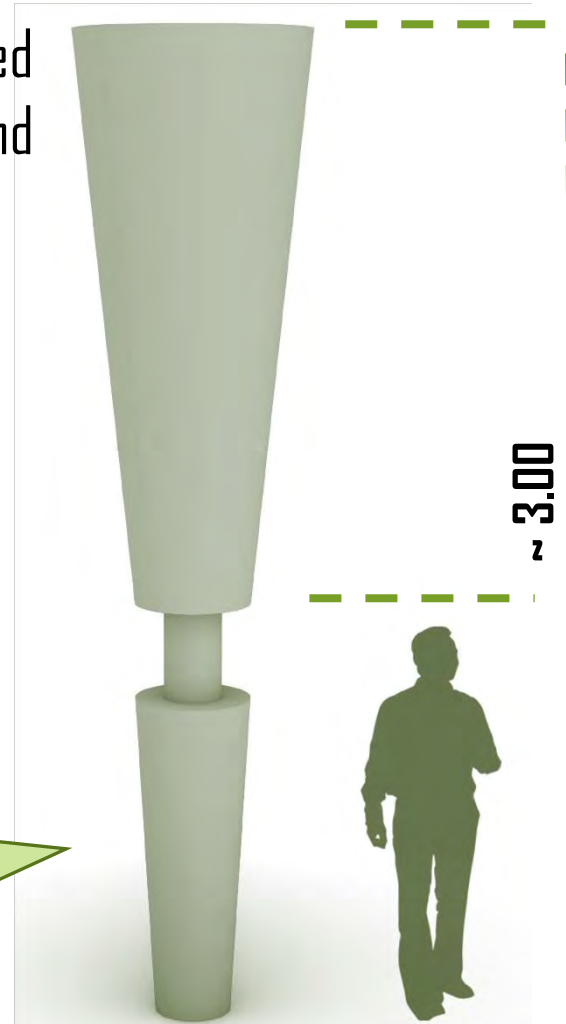
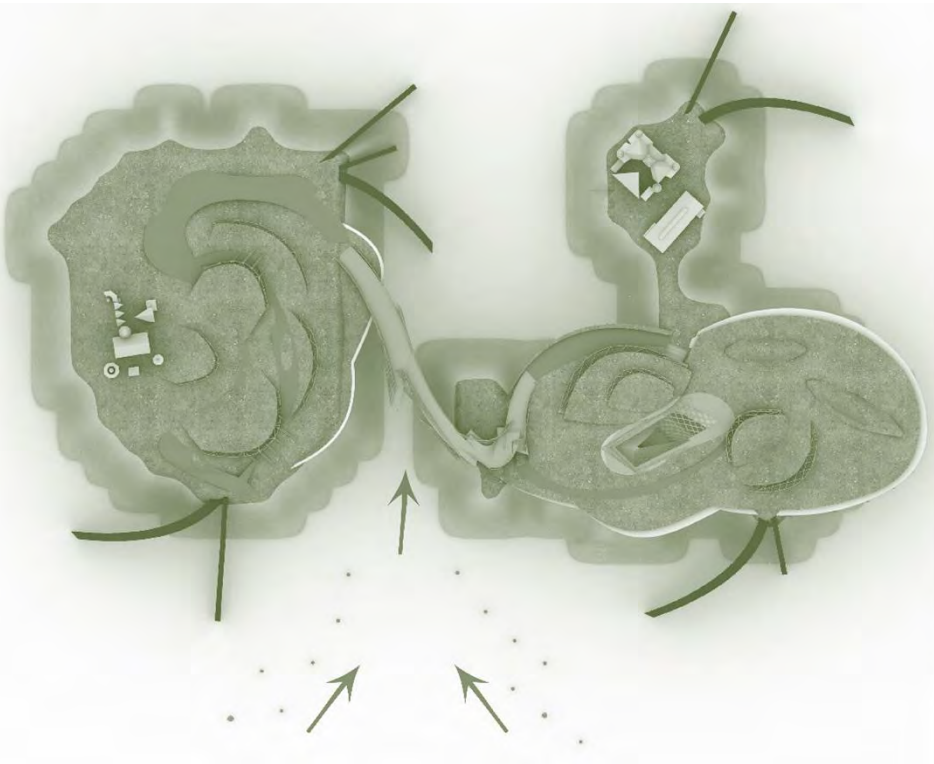
double skin

(acrylic glass & tempered glass)

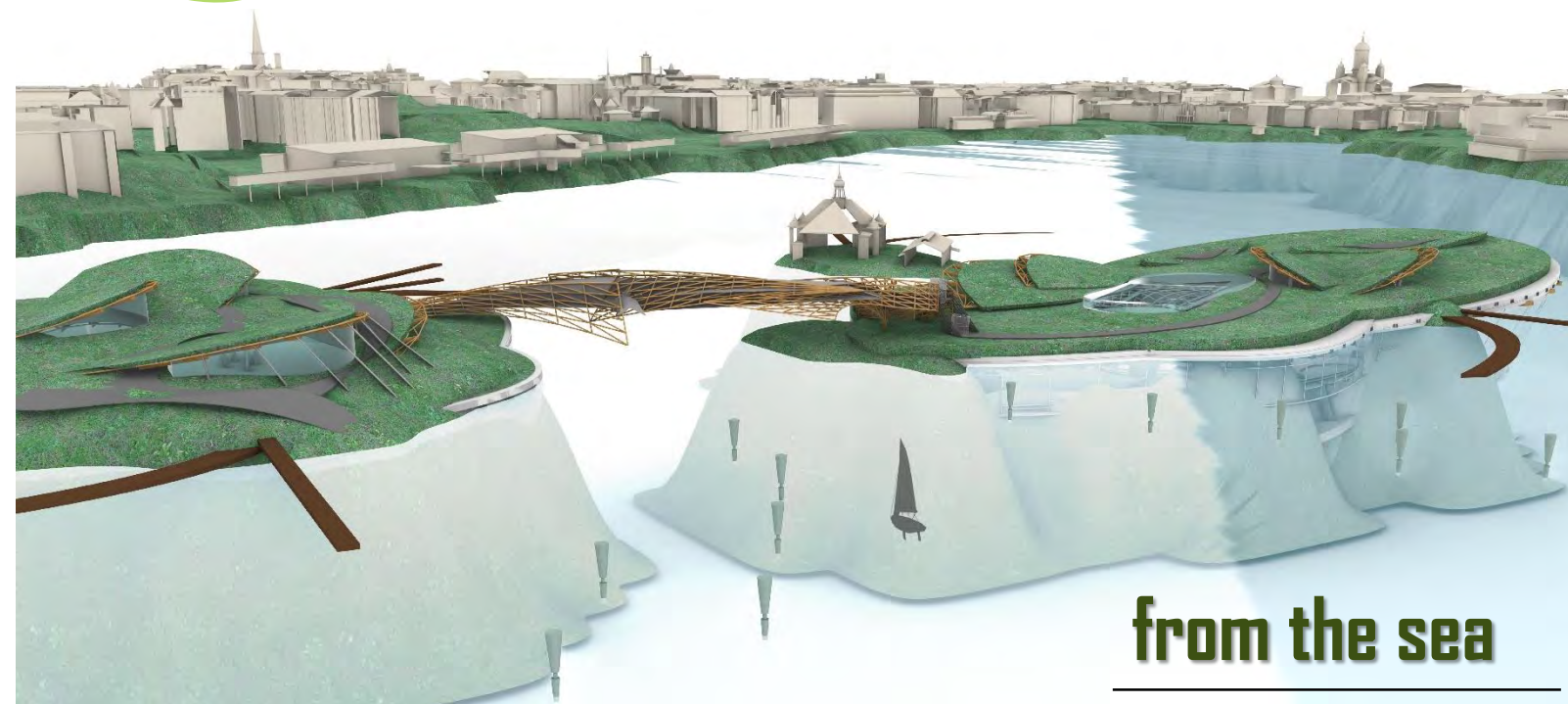
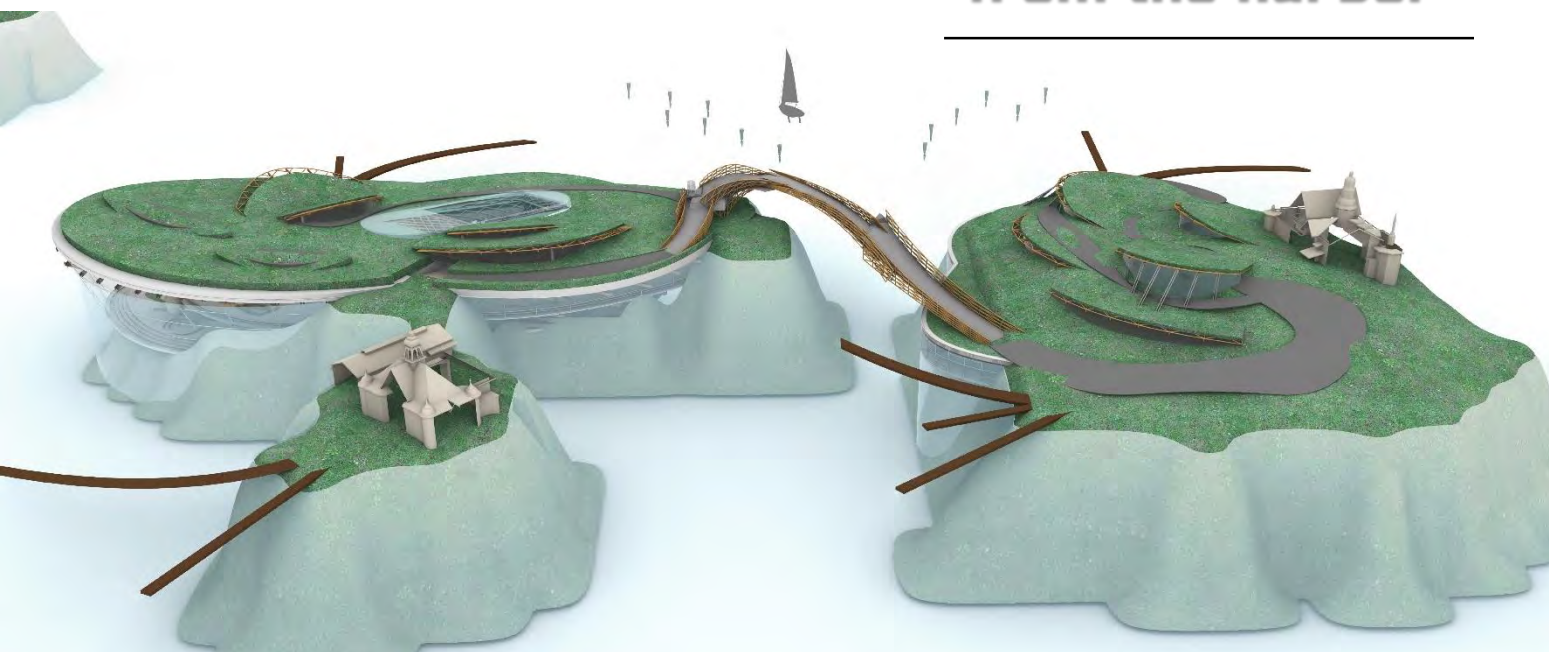


bladeless wind turbines

The bladeless turbines stand at 3 metres high, a curve-topped cylinder fixed vertically with an elastic rod. To the untrained eye it appears to waggle back and forth, not unlike a car dashboard toy. In reality, it is designed to oscillate within the wind range and generate electricity from the vibration.



from the harbor



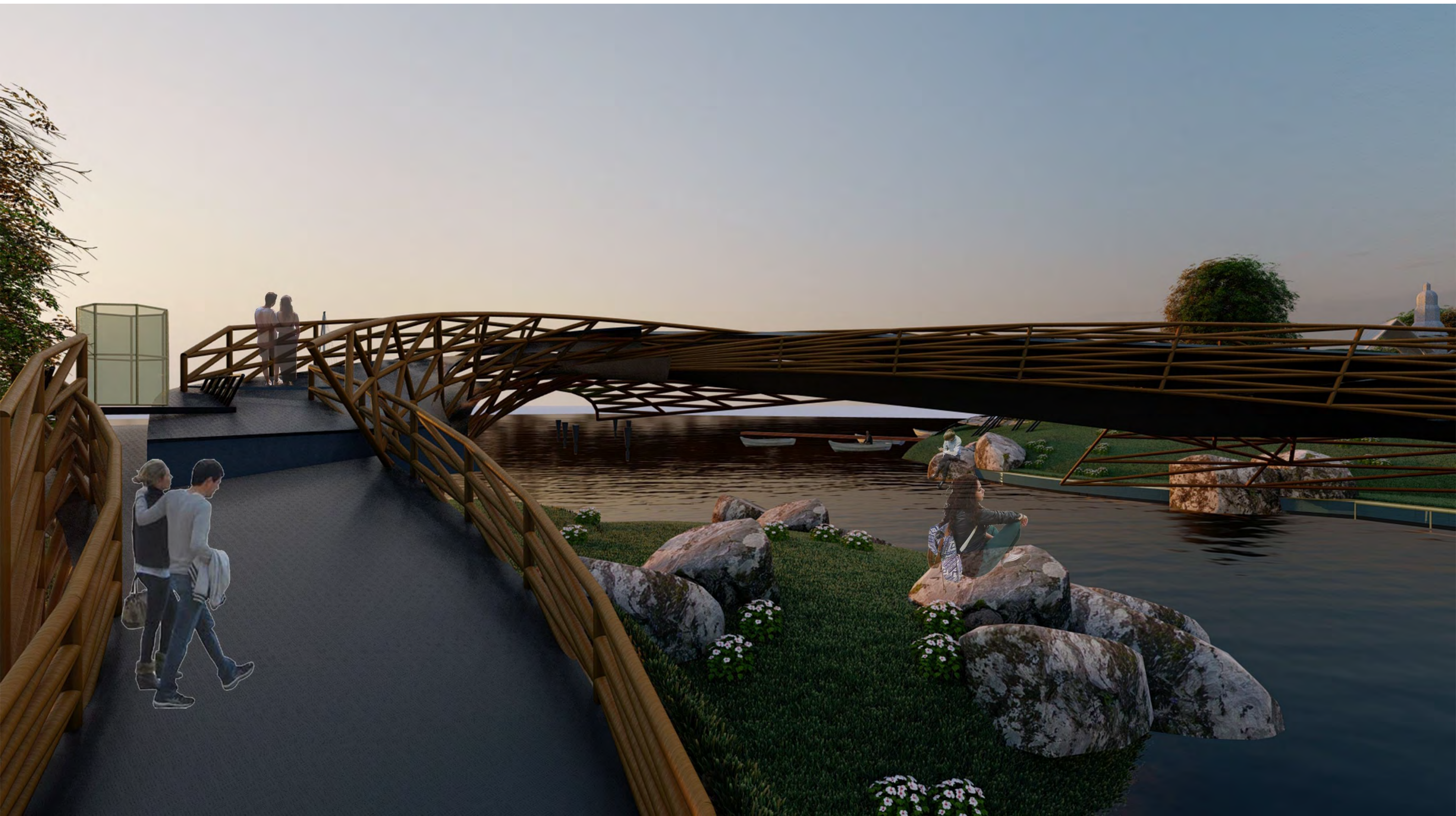
from the sea



6) VIEWS

... through the bridge

(when it is closed)



... from the bridge

(when it is opened)



... through the W. To E. Center



... from the W. to E. Center



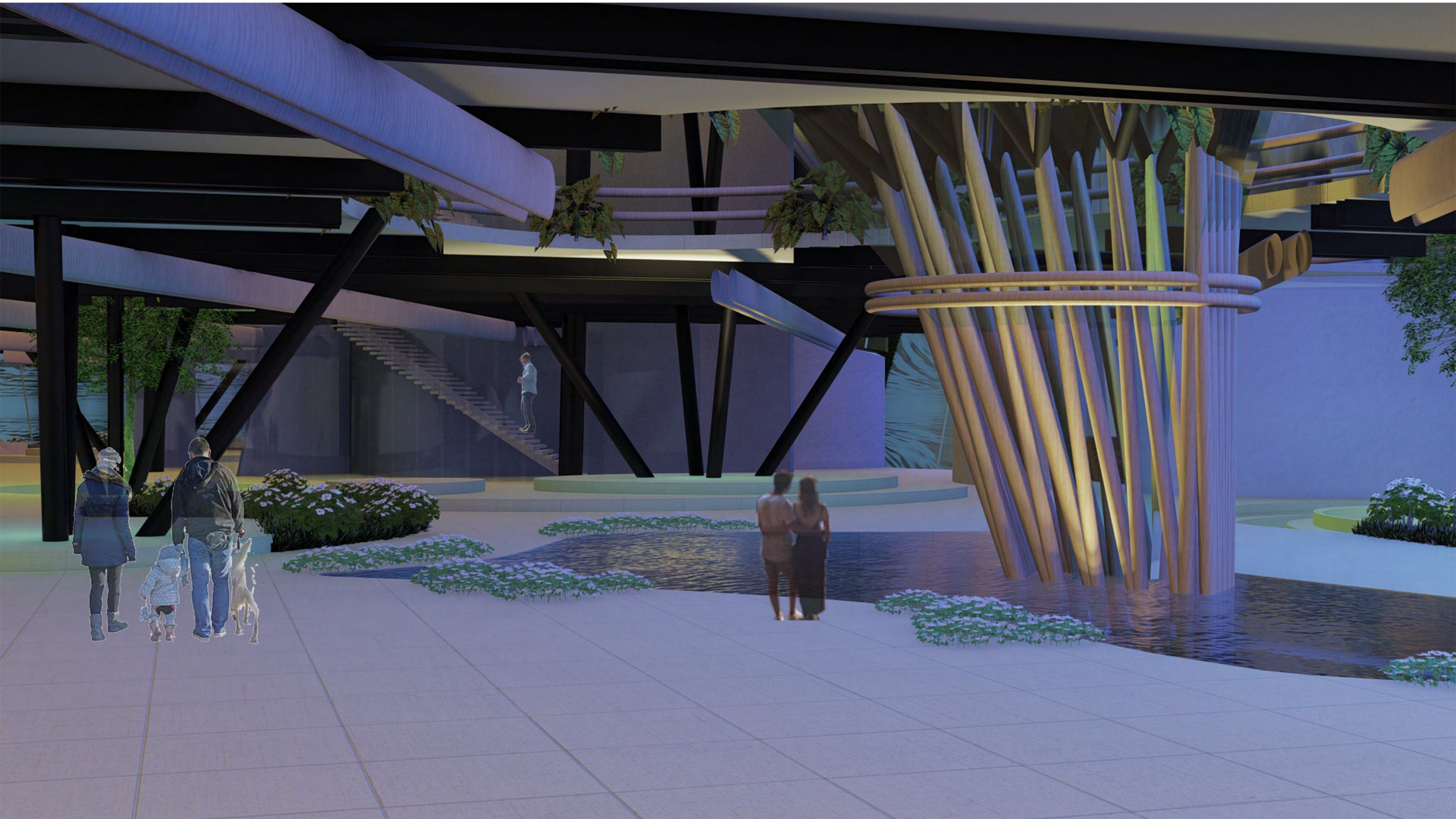
... through the entrance



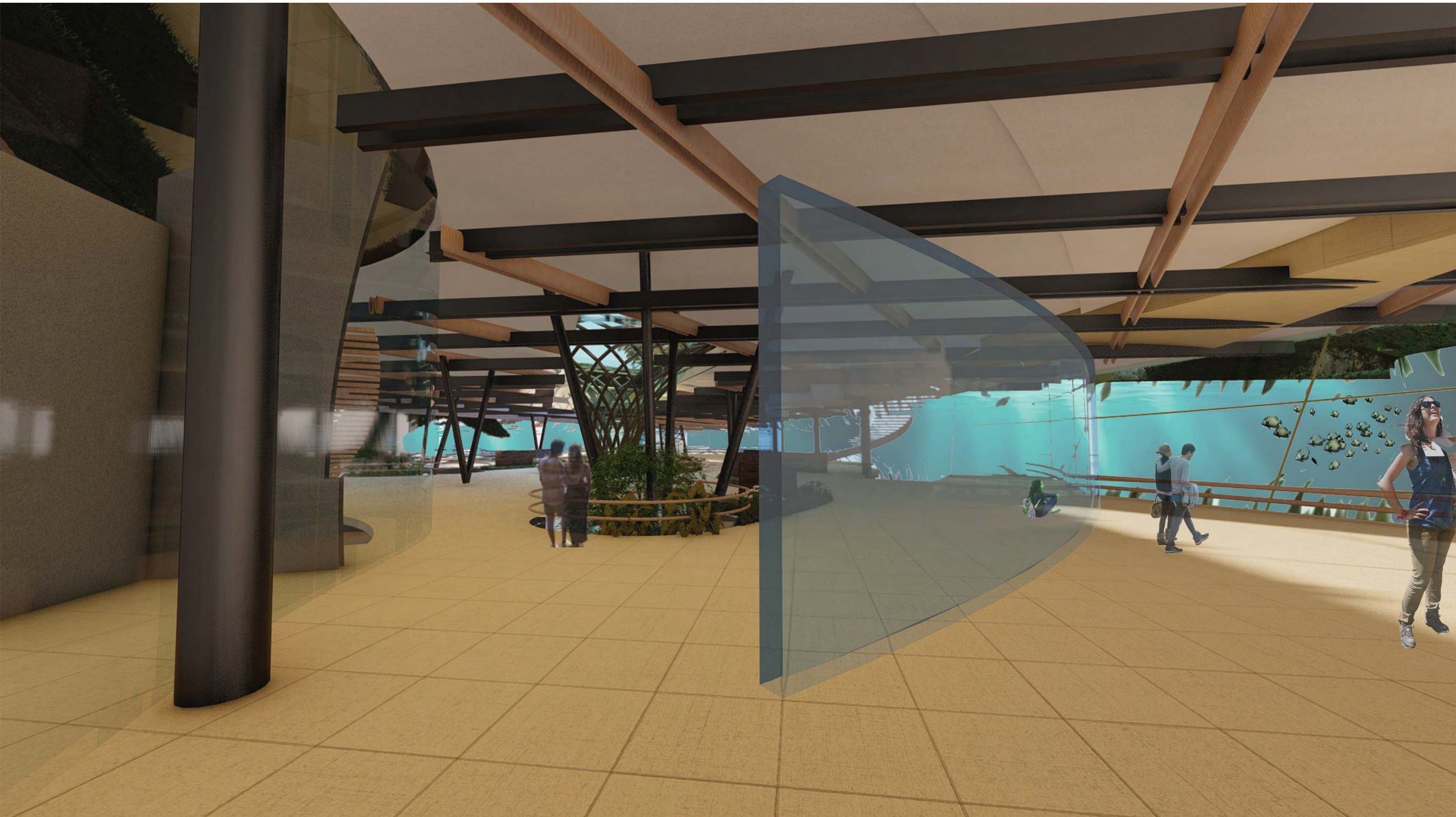
... through the South Harbor



... through the interior pool



... through the galleries



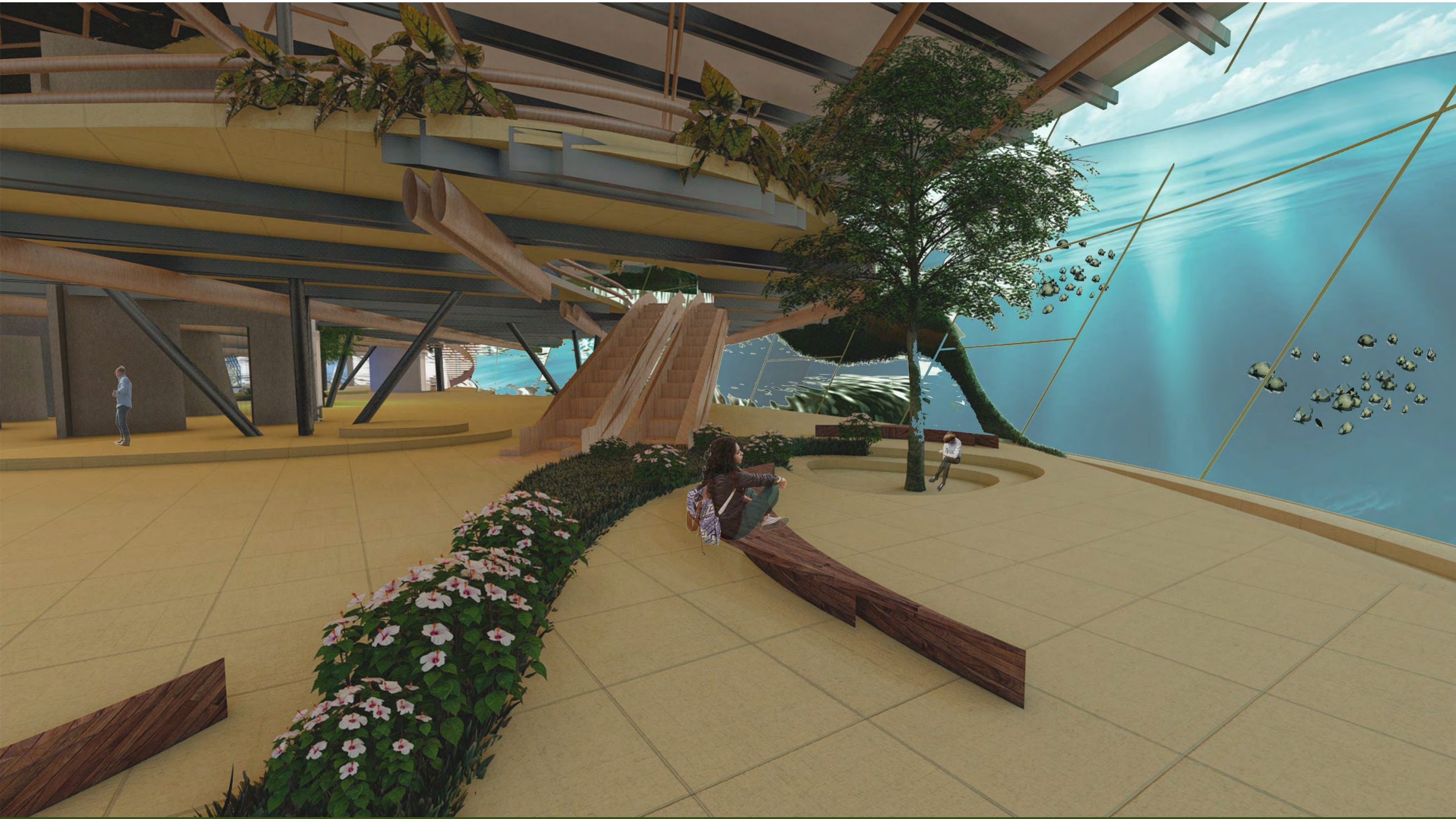
... from the galleries



... through the cafe/restaurant



... through the escalators



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