Sustainable Design: What Are the Designers Dreaming Up?

TIM PECK
CHAIRMAN, OBMI

- It's a pleasure to be here today to talk with you about the favorite subject of designers: THE FUTURE
- "What's next?" That's the question on everyone's mind when they think about the future of hospitality — especially when it comes to sustainability.
- I'm sure everyone in this room is aware of at least some of the impacts of climate change on our planet and on our industry, - as well as the climate concerns of hospitality guests.
- It really impacts some guest's appreciation of a vacation experience.

- Sustainable design presents wonderful opportunities for a concept I'm partial to: CIRCULARITY.
- Circularity relates to the interconnectedness of the natural environment, people, and the spaces they inhabit – Places that they work, rest and play in —
  - and Circularity influences the approach to that interconnectedness resulting in enhanced environmental preservation and wellness.
- Circularity also expands into an approach to design that encompasses functional aspects such as flexibility, adaptability, longevity and re-use.
- The concept of Circularity is a key principle in some very exciting new projects in this region, and around the world.
- This afternoon we are going to look at some examples and drill down into some project specifics

PROJECT SPOTLIGHT

THE LINE

NEOM, SAUDI ARABIA

Designed by
NEOM Company

- I am sure that you all are aware of THE LINE - a fascinating new urban living experience in the planned smart city of NEOM, in Saudi Arabia.
- THE LINE will house 9 million inhabitants on a footprint of just 34 square kilometers. It's 500 meters high at its high point, 200 meters wide, and 170 kilometers long.
- As a comparison London has a population of approximately 9.3m and a footprint of 1,600 square kilometers. That gives Neom a multiple of 47 on the population density – as a result leaving much of the surrounding environment untouched.
- Housed in an elegant mirror glass facade, THE LINE's infrastructure will enable people to travel end to end in just 20 minutes, with no need for cars, - resulting in zero carbon emissions for transportation.

PROJECT SPOTLIGHT

THE LINE

NEOM, SAUDI ARABIA

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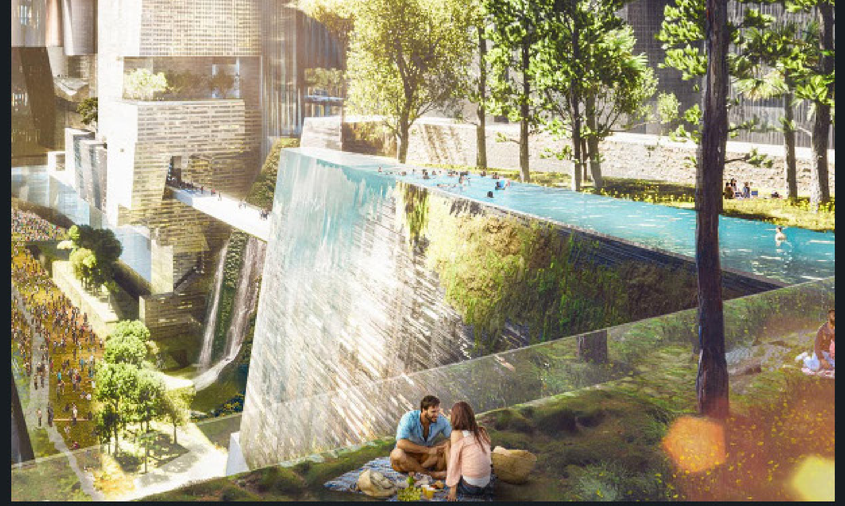
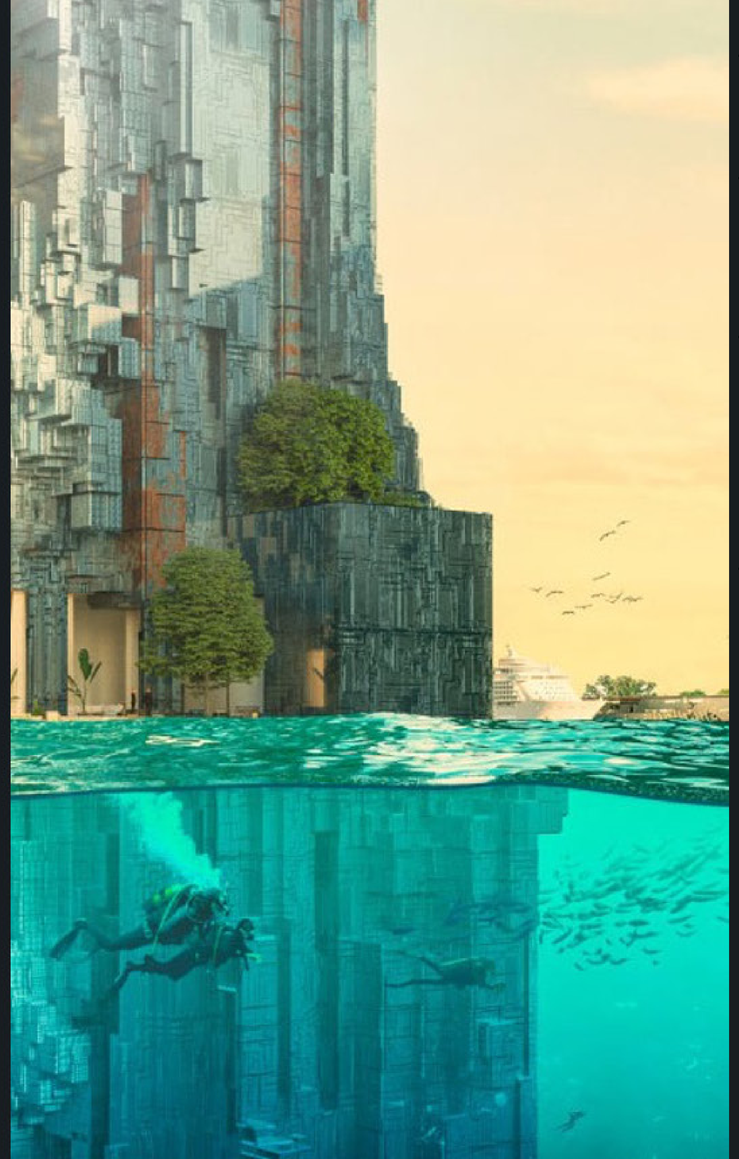




- Its designed around the concept of Zero Gravity Urbanism.
- Residents will have access to all of their daily needs within 5-minute walk neighborhoods.
- Energy and water supplies are 100% renewable, and the design will create a year-round temperate micro-climate through natural ventilation.
- In this vertical garden environment, people are always just a 2-minute walk to that preserved surrounding natural environment.

PROJECT SPOTLIGHT

CORAL BLOOM

SHURAYRAH ISLAND, SAUDI ARABIA

Designed by Foster + Partners

- Coral Bloom, in the Red Sea, is another fascinating Saudi project, designed by Foster + Partners.
- Coral Bloom is made up of 11 hotels on the island of Shurayrah — one of 22 islands being developed as part of Saudi's Vision 2030 Red Sea project.
- The Red Sea Development has committed to a 30 percent net conservation benefit by 2040.

PROJECT SPOTLIGHT

CORAL BLOOM

SHURAYRAH ISLAND, SAUDI ARABIA

Designed by Foster + Partners

- The buildings are manufactured offsite using lightweight wood with a low thermal mass, as well as sustainable building materials, - and the resort will be powered exclusively by wind and solar.
- The complex will rely on the world's largest battery storage system, at 1000 megawatt hours.
- And innovative sewage treatment will enable environmentally friendly waste management, which will in turn create new wetlands, and supplement water for the vegetation.

SEAPOD

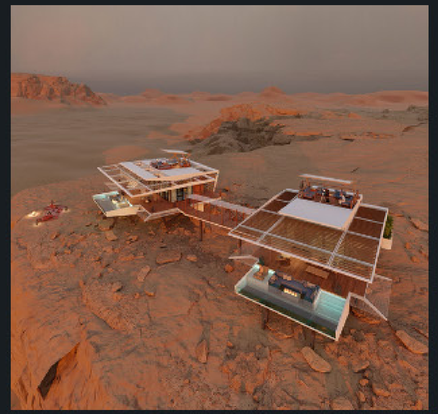
Designed by Ocean Builders

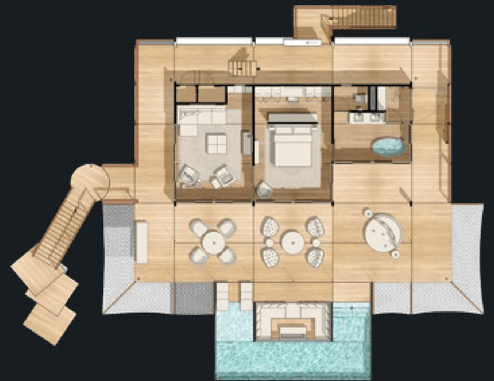
- For those looking for a resort experience directly on the water, there are a number of examples, one of which is the eco-friendly pods from Ocean Builders.
- Designed to tackle the issue of lack of space in popular seaside destinations, SeaPods will exist as what marine biologists call “fish aggregation devices,” with the shade they provide attracting sealife and fostering the growth of new coral reefs.
- Situated 2.5m above the water, SeaPods provide 80 sqm of living space equipped with self contained sustainable technology.

PROJECT SPOTLIGHT

HABITARE

Designed by OBMI





- Then we have a Moveable Hotel Experience –
  - Habitare allows hoteliers to develop in previously inaccessible locations.
- By dramatically reducing typical costs, approvals and timelines, - Habitāre makes high-profit seasonal destinations instantly viable.
- Assembled in 25% of the typical construction time frame at less than 1/3 of the cost per key of luxury resorts, Habitāre is self contained, sustainably crafted and designed to be extremely light on the land.
- With a range of models to suit resort development - Habitare will shift and move to honor the earth first - providing a rapid installation that is both economical and environmentally conscious.

TSUNAMI PARK SKYSCRAPER

Designed by
Wang Jue, Zhang Qian, Zhang Changsheng, Li Muchun & Xu Jing

- An entirely different approach to sustainable design comes in the form of the Tsunami Park Skyscraper.
- This remarkable project, from a handful of Chinese designers, is intended for Tonga, to protect against — as you might have surmised — tsunamis, while providing a truly unique accommodation experience.
- Based on the complex root structure of mangroves, which are very efficient for tsunami mitigation, the skyscraper will be situated offshore along Tonga's long and narrow coastline.

TSUNAMI PARK SKYSCRAPER

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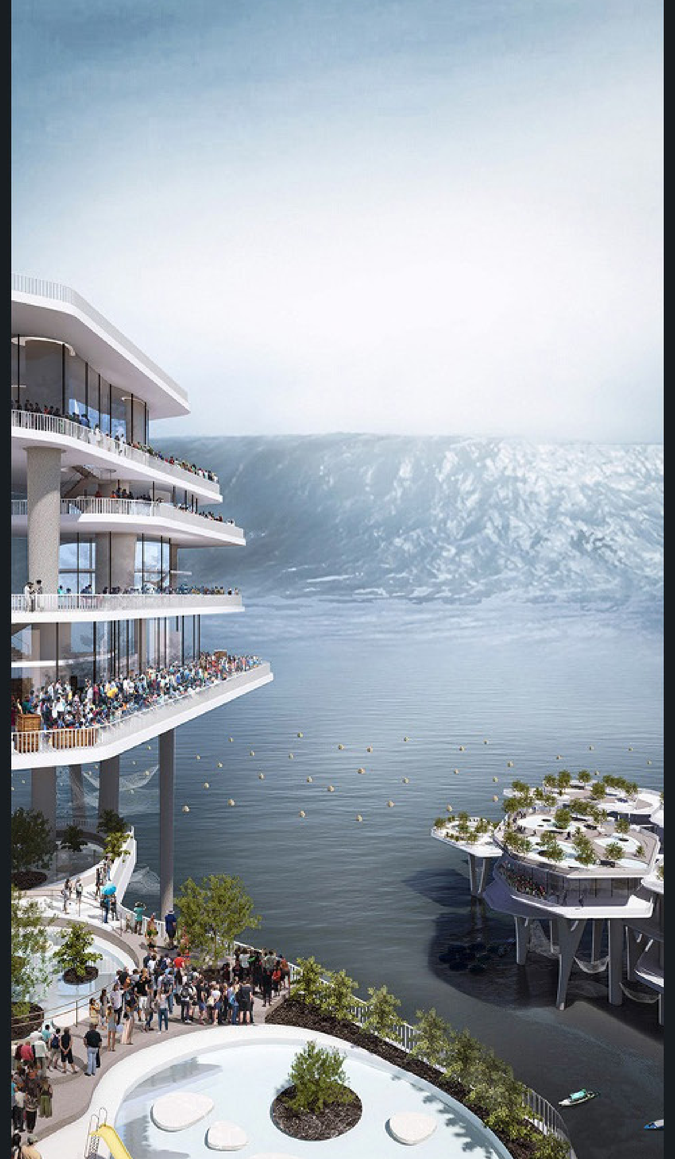


- The strong lower pillars will dissipate the force of future tsunamis, protecting the island and its inhabitants.
- During normal conditions, the structure creates another, massive “fish aggregation device”, improving the health of local sealife.
- The design also includes an extensive system for collecting, storing, desalinating, and transporting seawater.

PROJECT SPOTLIGHT

SWEEDISH TREEHOUSE HOTEL

Designed by Tham & Videgård

- Sustainability comes in all shapes and sizes
- Located in Harrads, in the north of Sweden, - 6 assorted tree rooms and a sauna perched in the treetops.
- Not for the faint of heart – and not recommended for those who sleep walk.

SWEEDISH TREEHOUSE HOTEL

Designed by Tham & Videgård

- No foundations, - and I am sure you will agree - no footprint
- Minimal visual impact, and eco friendly with under floor heating supplied by hydro-electric power and a combustion toilet that incinerates waste at 1,112F. I guess vertical toilet drain pipes would spoil the image.

PROJECT SPOTLIGHT

AERA VERTICAL RESORT

Designed by OBMI

- At OBMI, one of our sustainable design ideas is a project I presented at this conference last year — Aera, a vertical luxury resort.
- Aera reimagines the traditional horizontal resort model into an urban context,- stacking the resort amenities and the accommodation vertically.

PROJECT SPOTLIGHT

AERA VERTICAL RESORT

Designed by OBMI

- Aera is designed to use significantly less land within the city, and to promote local tourism, - reducing the need for air travel.
- Since cultural attractions are literally blocks away, Aera also reduces the environmental impact of car and bus travel for vacationers.
- Will touch more on aera later.

- Speaking of vacation travel, many of us here flew into the conference today
- And I'm guessing that quite a few of you gave at least "a bit of thought" to the climate impact of your flight.
- That same concern is echoed in the minds of many would-be vacationers: -
  - There are all of these wonderful places to visit, but is the climate cost of travel worth it?

GREENHOUSE GAS EMISSIONS FROM AVIATION

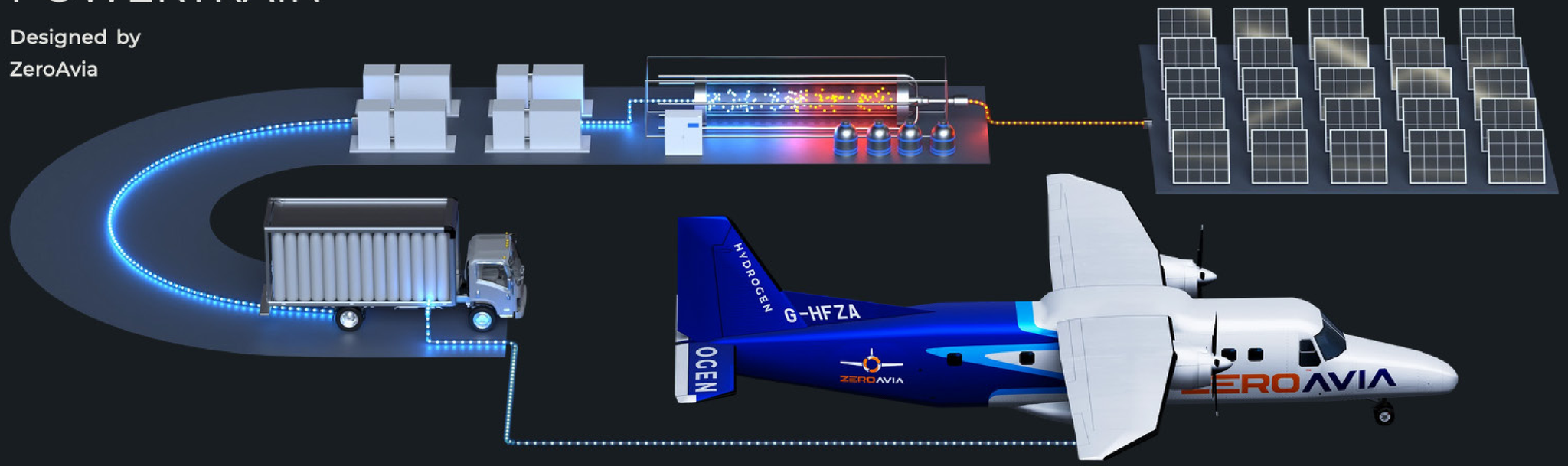
2022	5–10%
2050	**25–50%***

*Estimated

- Aviation today accounts for 5-10% of greenhouse gas emissions.
- By 2050, if we continue on our current path - its share is estimated to become 25-50%.
- Wouldn't it be nice to offer our guests the ability to travel to your resorts with a clear conscience.
- We are fortunate - creative sustainable design is looking to address this issue as well.

ZERO-EMISSION AVIATION POWERTRAIN

Designed by ZeroAvia



- ZeroAvia is designing a hydrogen-electric powertrain system for airplanes.
- Renewable hydrogen, stored in tanks, is converted into electricity in flight using a fuel cell, - which then powers the electric motors.
- Hydrogen is lighter, cheaper, and less flammable than conventional fuel, and, - most importantly, hydrogen-electric powertrains offer zero emissions.

450,000 FLIGHTS HAVE USED A MIX OF **SUSTAINABLE AVIATION FUEL**

- Another potential solution for climate-friendly vacationing is Sustainable Aviation Fuel.
- This fuel is manufactured, either directly or indirectly, from CO2 — ideally from CO2 emissions already in the air.
- And this isn't a pipe dream: 450,000 airline flights have already been undertaken using sustainable aviation fuel as part of the fuel mix.
- The world's largest producer of sustainable aviation fuel, the Finnish firm, Neste, aims to produce 1.9 billion liters next year — 15 times last year's total world production.

F1 DEVELOPING **100% SUSTAINABLE FUEL** FOR 2026 SEASON

- On an interesting side note, Formula 1 racing is also exploring sustainable fuels, - supported by Aramco, to maintain the viability of the sport into the future.
- Saudi Arabia's petroleum giant, Saudi Aramco, and CEMEX, a Mexican cement company, are just two examples of companies that have teamed up with sustainable aviation fuel partners to extract the CO_2 needed for sustainable fuel from their refineries.
  - Fuel refineries and cement production are major sources of CO_2 so this is a perfect marriage.

- So, that's all intriguing, macro-level stuff in terms of the future of sustainable design.
- But designers also have to think about sustainability on much more practical levels in terms of systems and materials within resorts —
  - Design that considers the circularity of those systems interacting with both the natural environment and humans.
- And in turning our thinking to sustainability on that micro level, we designers are faced with the question that confounds and torments us constantly...

HOW?

- How do you actually make it work?
- How do we create built environments with sustainable foundations? And truly sustainable operating systems?

CENTER FOR ARCHITECTURE SCIENCE AND ECOLOGY

Rensselaer Polytechnic Institute

CASE Center for Architecture, Science and Ecology at Rensselaer

Rensselaer

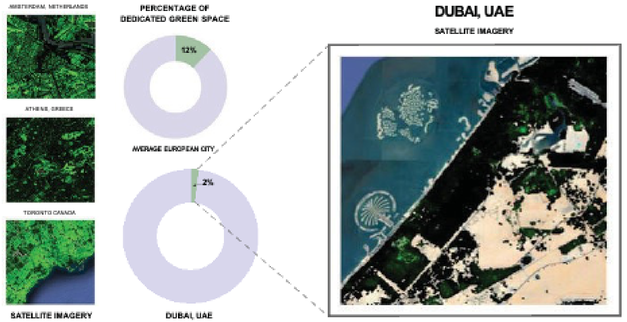
The Architecture of Plants and Wellbeing

Simulating Relationships Between Plants, Environments, and Humans to Inform Design Decisions

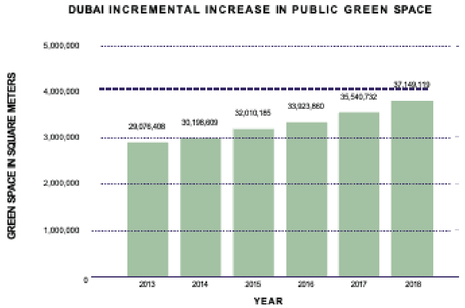
INTRODUCTION

Due to large-scale industrialization, urbanization continues to grow at an accelerated pace. As populations grow and cities expand, the overall depletion and high level of fragmentation of green spaces have had consequences on the mental and physical health of surrounding communities (Ritchie & Roser, 2018). Several studies have outlined the influences of greenery in terms of types, conditions, levels of exposure, and proximity in a city setting, which could inform design decisions on a larger scale to improve residents' mental and physical health.

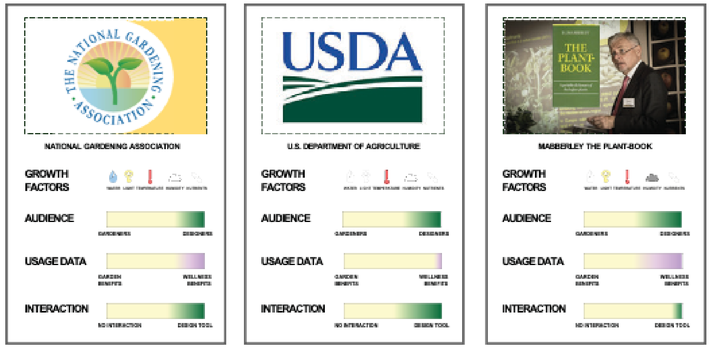
An average European city has 12% of its land designated for public space while countries such as Dubai have only designated 2% (The National, 2020). Therefore, a recent proposal by OMBI in Dubai has become to central model for this research analysis and the creation of a tool design to address this issue. OMBI's AERA project proposes an amount of indoor greenery that has yet to be achieved indoors. By conducting an environmental analysis on this project, there are controllable conditions that allow for the production of an architectural design tool.



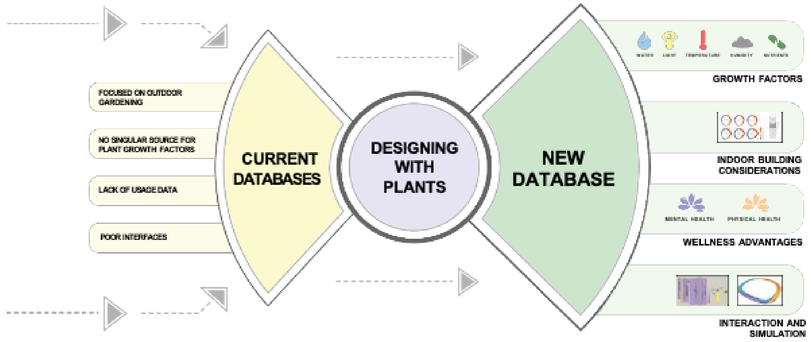
DUBAI AND URBAN GREEN SPACE



UAE UPWARD TREND TO INCREASE GREEN SPACE



PROMINENT EXISTING PLANT DATABASES



DATABASE COMPARISON DIAGRAM

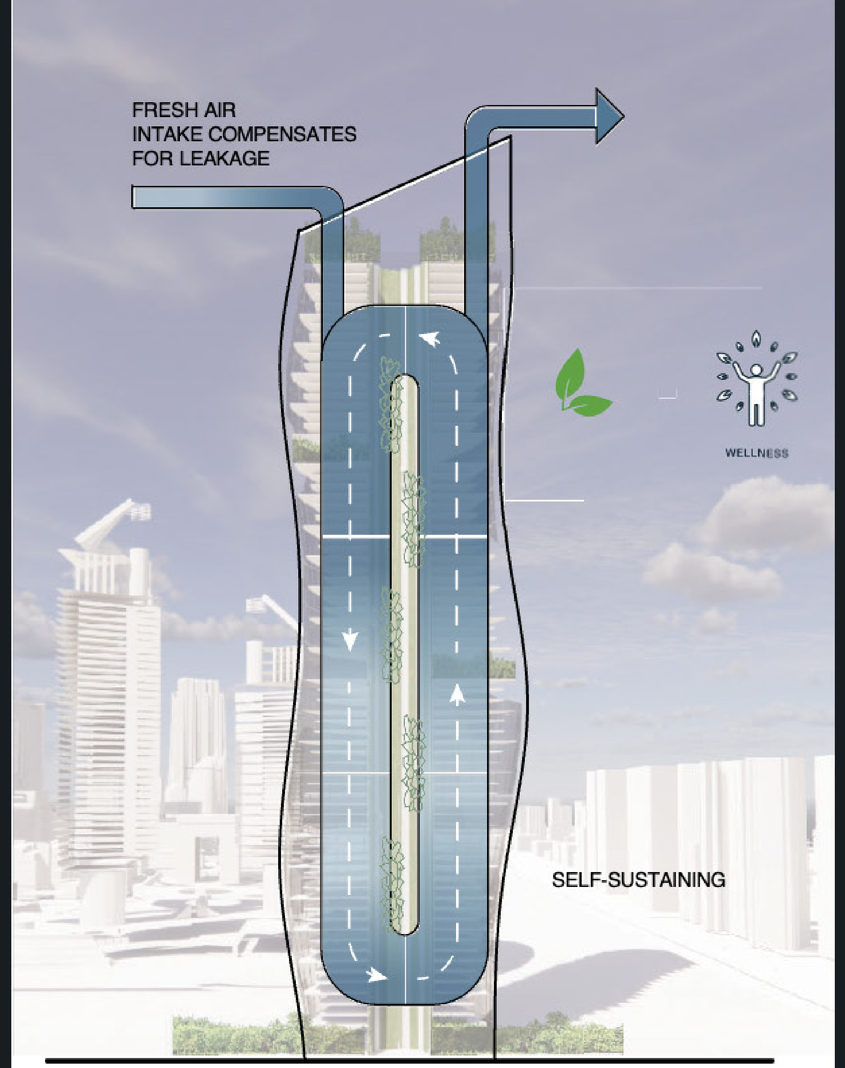
- Circling back to Aera and use it as an example of how we have found solutions to some of these issues.
- To assist us with our vertical resort concept, we partnered with CASE — the Center for Architecture Science and Ecology in Brooklyn, New York.
- CASE is an academic and professional collaboration advancing the built environment through education, research, and built projects.

PHYTOREMEDIATION

Using Plants to Condition the Elements of a Space

- The first great idea we seized upon was sustainable operating systems for the resort based on phytoremediation —
  - Which in simple terms means using plants to condition air, water, and soil in an environment.
- This has the potential to impact resort systems in several ways.

SCALABLE AIR PURIFICATION

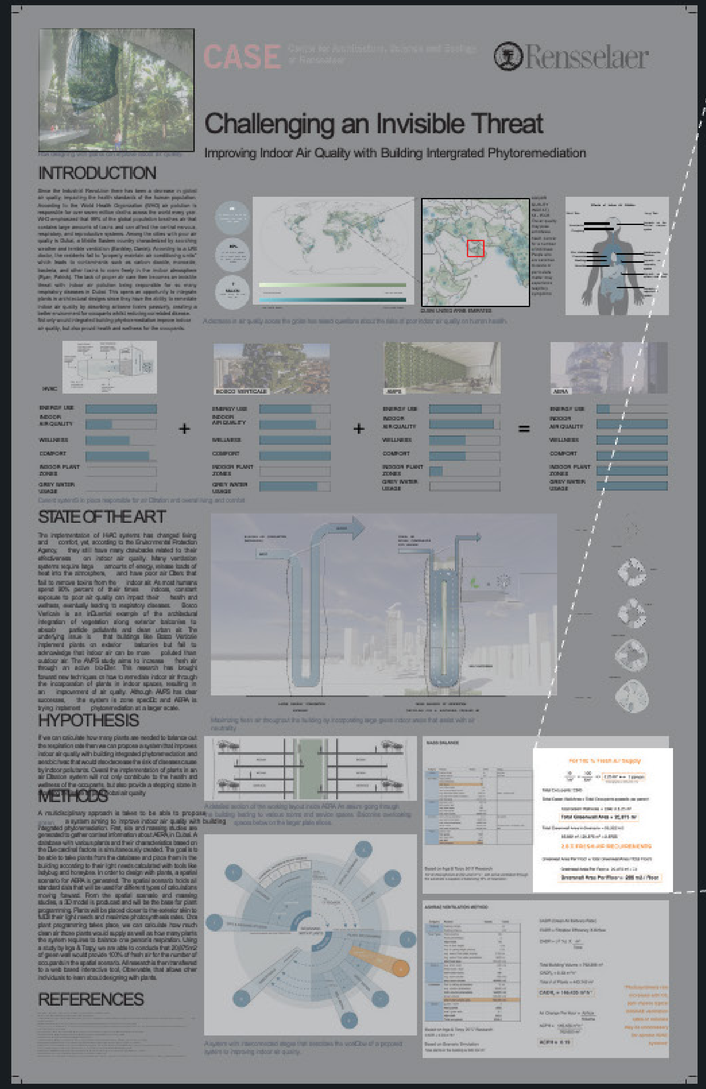


MASS BALANCE OF RESPIRATION

RECYCLING CO2 & SUSTAINING FRESHER AIR

- The first is air purification.
  - This is obviously done via photosynthesis, as plants convert CO2 into breathable oxygen —
    - As an aside scientists have recently announced that they have learnt how to genetically modify plants in the future to increase their ability to photosynthesize
  - To truly evaluate this concept we needed to establish a baseline and make this concept quantifiable at scale with existing plant species - to become a truly impactful sustainability solution for hospitality design.
- So that's exactly what the folks at CASE did, using Aera as a model.

CREATING FRESH AIR



For 100 % Fresh Air Supply

$$\frac{16}{1m^2} = \frac{100}{Xm^2} \Rightarrow \boxed{6.25\ m^2 \leftrightarrow 1\ \text{person}}$$

Chlorophytum at 250 µmol m⁻² s⁻¹

Total Occupants: 3340

Total Green Wall Area = Total Occupants x needs per person

Total Green Wall Area = 3340 X 6.25 m²

Total Greenwall Area = 20,875 m²

Total Greenwall Area in Scenario = 59,922 m2

59,922 m² / 20,875 m² = 2.8705

2.8 X FRESH AIR REQUIREMENTS

Greenwall Area Per Floor = Total Greenwall Area / Total Floors

Greenwall Area Per Floor = 20,875 m² / 73

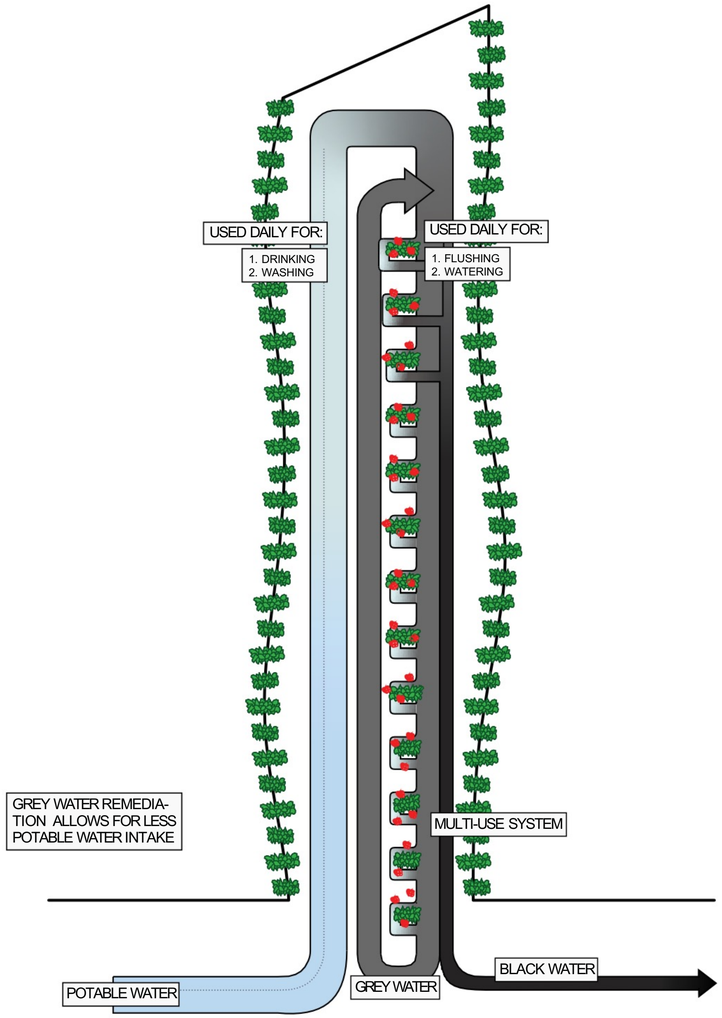
Greenwall Area Per Floor = 286 m2 / Floor

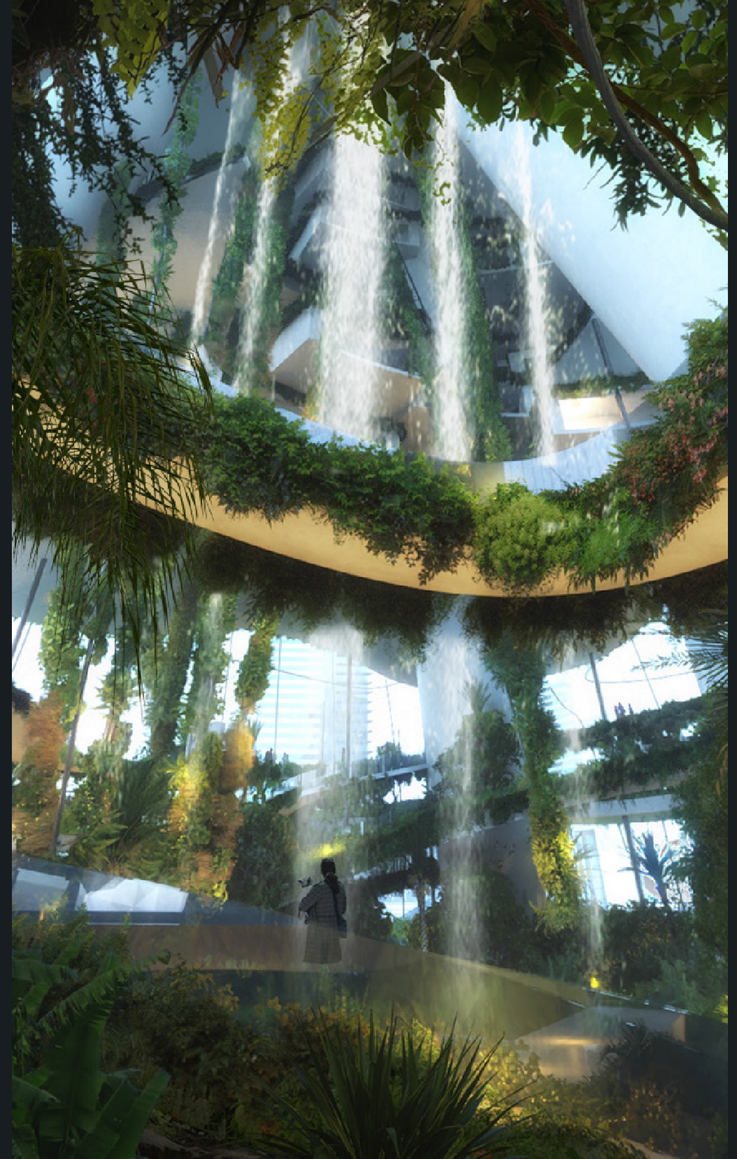
- They calculated respiratory CO2 emissions from the average human, as well as how much plant material it would take to absorb the CO2 from the 3,340 occupants at Aera and recycle it into 100% fresh air supply.
- The required greenwall area was calculated to be almost 21,000 square meters.
- We designed Aera to have almost 60,000 square meters of greenwall space, generating 2.8 times as much fresh air needed for a 100% fresh air supply.
- This saves on energy usage by not having to introduce and cool external air, especially in hot climates — air that might well arrive polluted by the external context and further polluted by HVAC systems, many of which fail to remove toxins as their filters become dirtied.

PLANT ROOTS AS BIO-FILTERS

- As for air-borne toxins other than CO2, - CASE is exploring research initially pioneered by NASA for Mars expeditions - on the ability of plant roots to act as bio-filters.
- Formaldehyde, for example, is a common toxin found in the air inside buildings, off-gassed by furniture, printers, and wood stains.
  - NASA's research demonstrates that plant roots eat toxins like these, further improving air quality and, subsequently, human health.

GREYWATER AS AN AMENITY



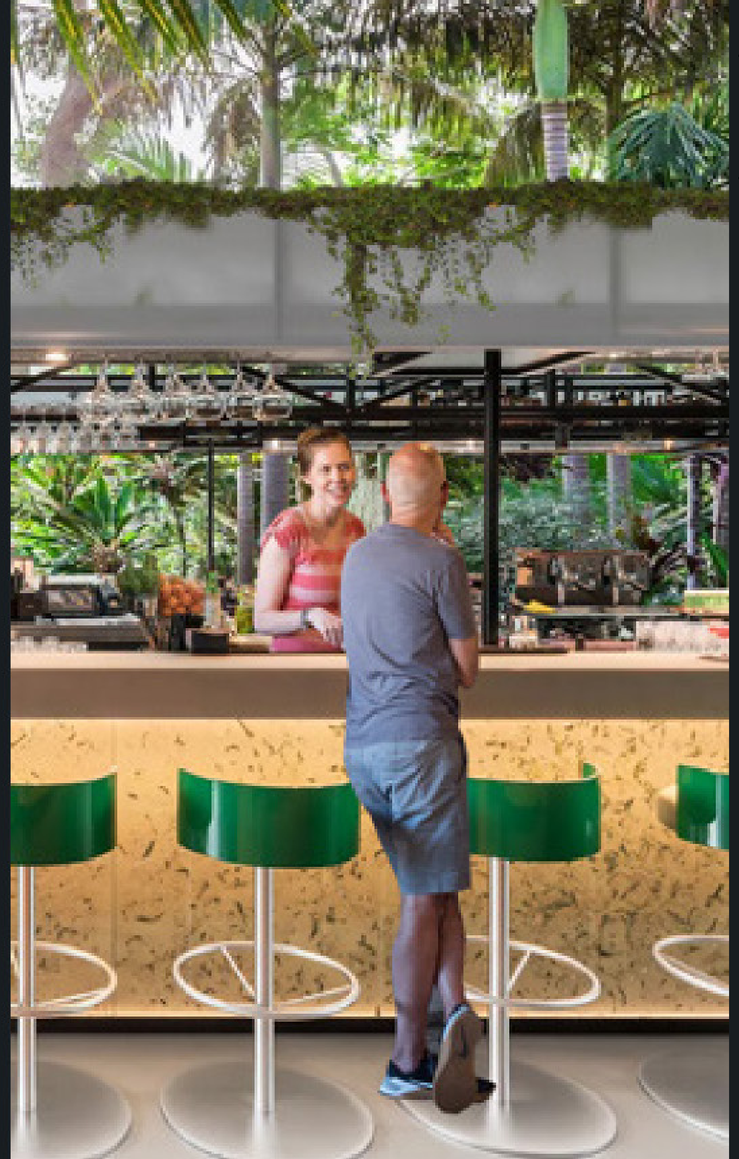


- The second way in which this wonderful concept of phytoremediation can impact sustainable internal systems is in greywater treatment.
- The same 60,000 square meters of greenwall that purifies the air in Aera can be watered by greywater, - while at the same time purifying and recycling that greywater for future toilet flushing, - before it leaves the building as blackwater.
- Greywater treatment via the greenwall also has the benefit of being an amenity, - a visual feature that contributes to the psychological wellbeing of guests.
- It also reduces the need to introduce external water, which is a key consideration in water-depleted destinations, such as the Middle East.

AERA'S MICROCLIMATE

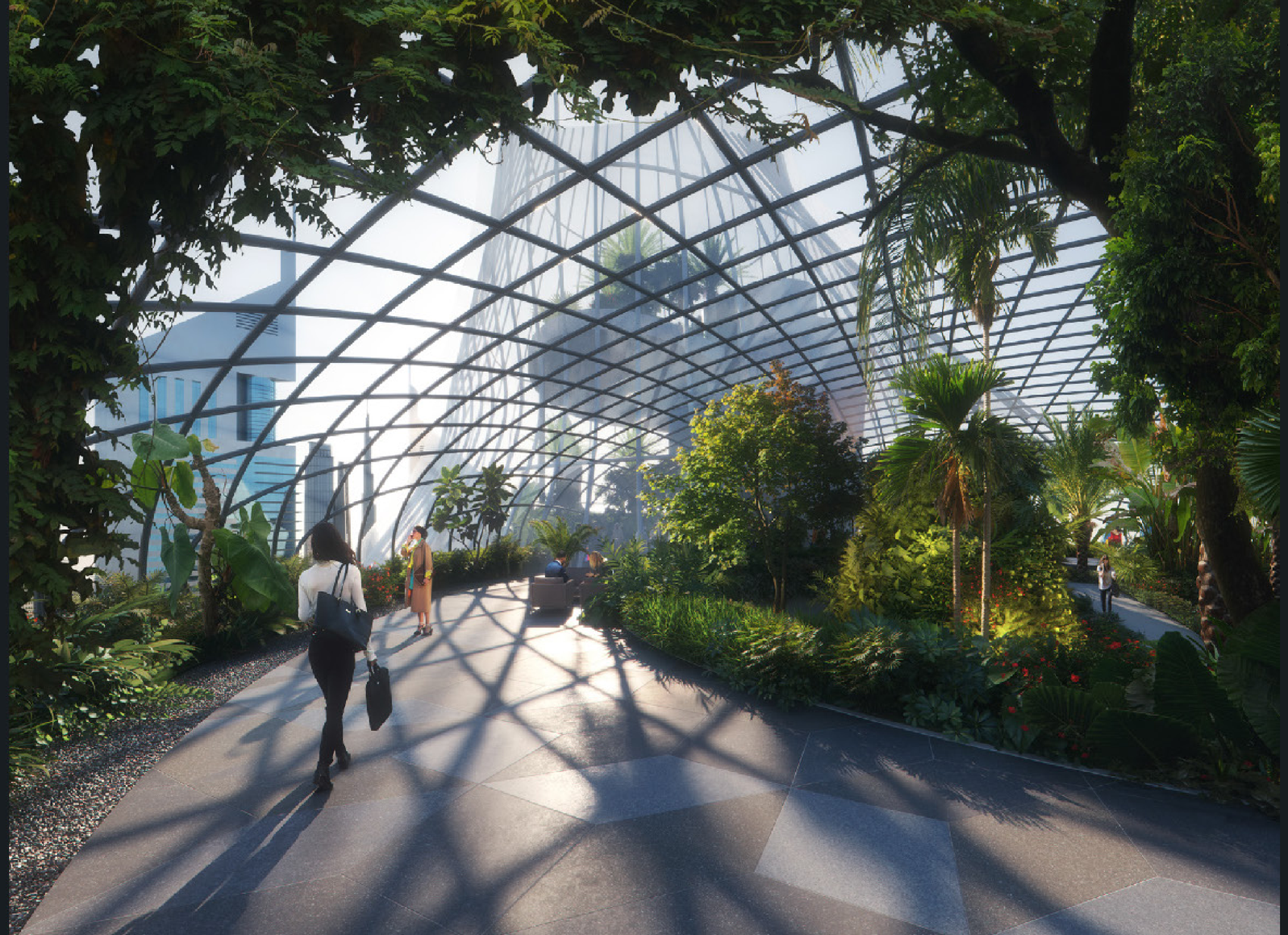
- And there's more:
  - Phytoremediation also impacts sustainability through passive air conditioning.
- Placed just inside Aera's PTFE cloth skin, - shade planting creates a microclimate,- shading resort occupants from extreme temperatures in hot environments.
  - This reduces the need for mechanical air conditioning, reducing energy requirements, resulting in a positive impact on the environment - and of course, a positive impact on the hotel owner's bottom line.
- Visible from the exterior through the resort's skin, the vegetation enables Aera to become a good citizen in its neighborhood, - a distinct and appealing addition to the city skyline.

EDIBLE GARDENS



- Edible plants are yet another aspect of phytoremediation that can impact sustainability.
- Instead of transporting food from elsewhere, it can be grown sustainably on site, and used in the resort's restaurants, offering (rather than "farm to table") - "landscape to table" — while at the same time contributing to air purification and passive air conditioning.

GUEST WELLNESS



- And, of course, along with the benefits I've just mentioned, proximity to plants is good for our psychological and holistic human wellness.
- Humans evolved for a formative part of their existence right next to plants, - but then architecture came in and put a divider between plants and us humans.
  - Considered resort design can put us back right next to plants, - making them part of the guest experience everywhere you turn.

FINANCIAL WELLNESS

BUSINESS ADMINISTRATION PROJECTIONS

DOUBLED HVAC COST — $40 PER PERSON

HR SAVINGS — $6,000 PER PERSON

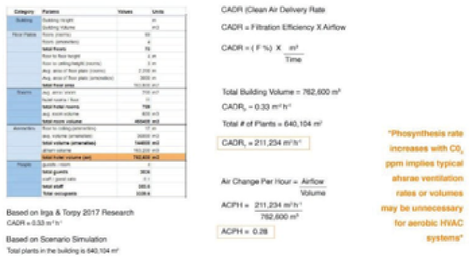
$5,960 - $6,960 TOTAL SAVINGS PER STAFF MEMBER

PLANT WALL ALTERNATIVE OR SUPPLEMENT TO HVAC

PLANT REPLACEMENT + DECREASED ENERGY COSTS

AERA PROPOSAL PROJECTIONS

ASHRAE VENTILATION METHOD



FOR 100% FRESH AIR SUPPLY: $\frac{16}{1m^2} = \frac{100}{(x)m^2}$ => 6.25m² PER PERSON

IN AERA: PLANT AREA NEEDED PER FLOOR = 286m²; PROPOSED = 534m²

HR SAVINGS WITH HVAC COSTS REPLACED BY PLANT AIR SUPPLY: $6,000 PER PERSON

AERA SCENARIO
306 STAFF MEMBERS
$6,000 x 306 STAFF MEMBERS
= $1,826,000 TOTAL HR SAVINGS

- This type of design has quantifiable financial benefits as well.
- A study by the Harvard T.H. Chan School of Public Health demonstrated that a $40 per person per year increased expenditure on improving air quality results in HR savings of $6,000 to $7,000 per person per year in reduced sick days.
- How does this translate to the benefits of phytoremediation in a resort like Aera?
  - CASE crunched the numbers, and the 100% fresh air breathed in Aera by its 306 staff members would result in more than $1.8 million in savings on potential sick days every year.

A DATABASE OF PLANTS FOR BIO-CLIMATIC DESIGN

CASE Center for Architecture, Science and Ecology at Rensselaer

Rensselaer

The Architecture of Plants and Wellbeing

Simulating Relationships Between Plants, Environments, and Humans to Inform Design Decisions

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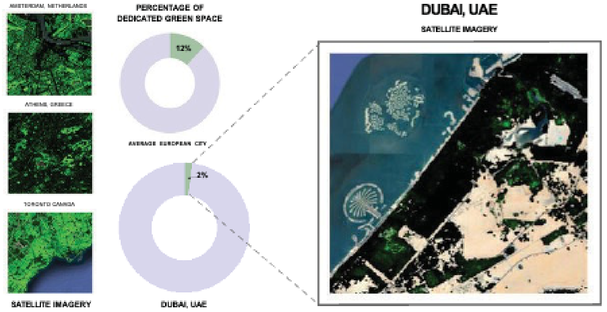

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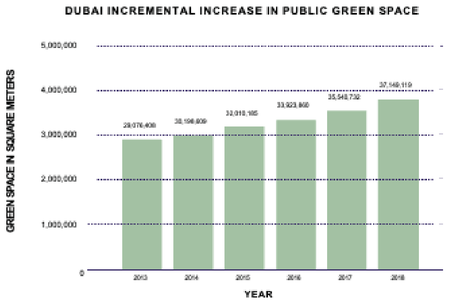

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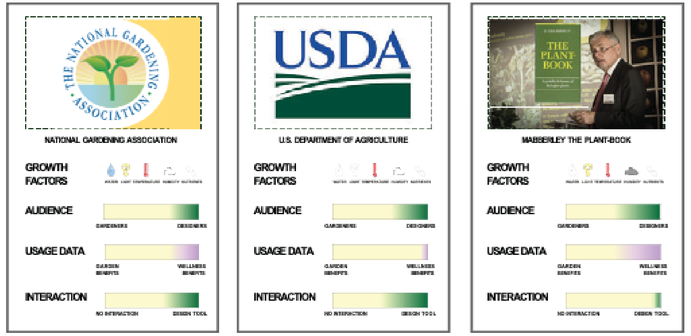

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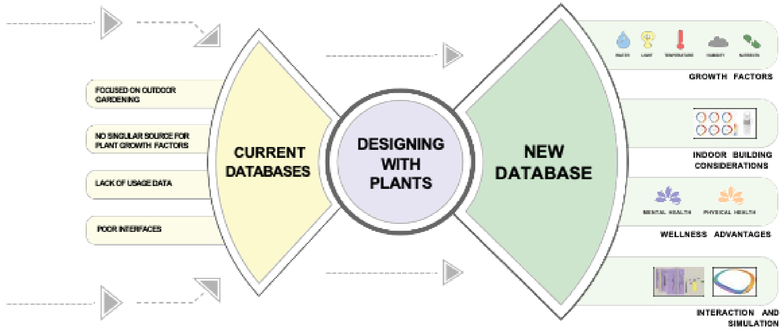


DATABASE COMPARISON DIAGRAM

STATE OF THE ART

- In order to optimize all of the positive effects of phytoremediation, CASE is compiling an exhaustive database of plants based on their response to five contributing factors:
  - Water, light, temperature, humidity, and nutrients.
- The database will serve as a bio-climatic design menu, enabling resort designers to utilize plants in the built environment to connect sustainability and human health in the hospitality context.

- Interestingly - Many of the positive applications of phytoremediation we have discussed for Aera can be directly translatable to The Line, with its focus on a landscaped linear core to the design.
- This design approach creates a natural, circulatory system in the middle of the technical mechanical, electrical, and sewage systems found in the built environment, ...
  - Repositioning nature from a peripheral role to a central one in the resort experience.

PROJECT SPOTLIGHT

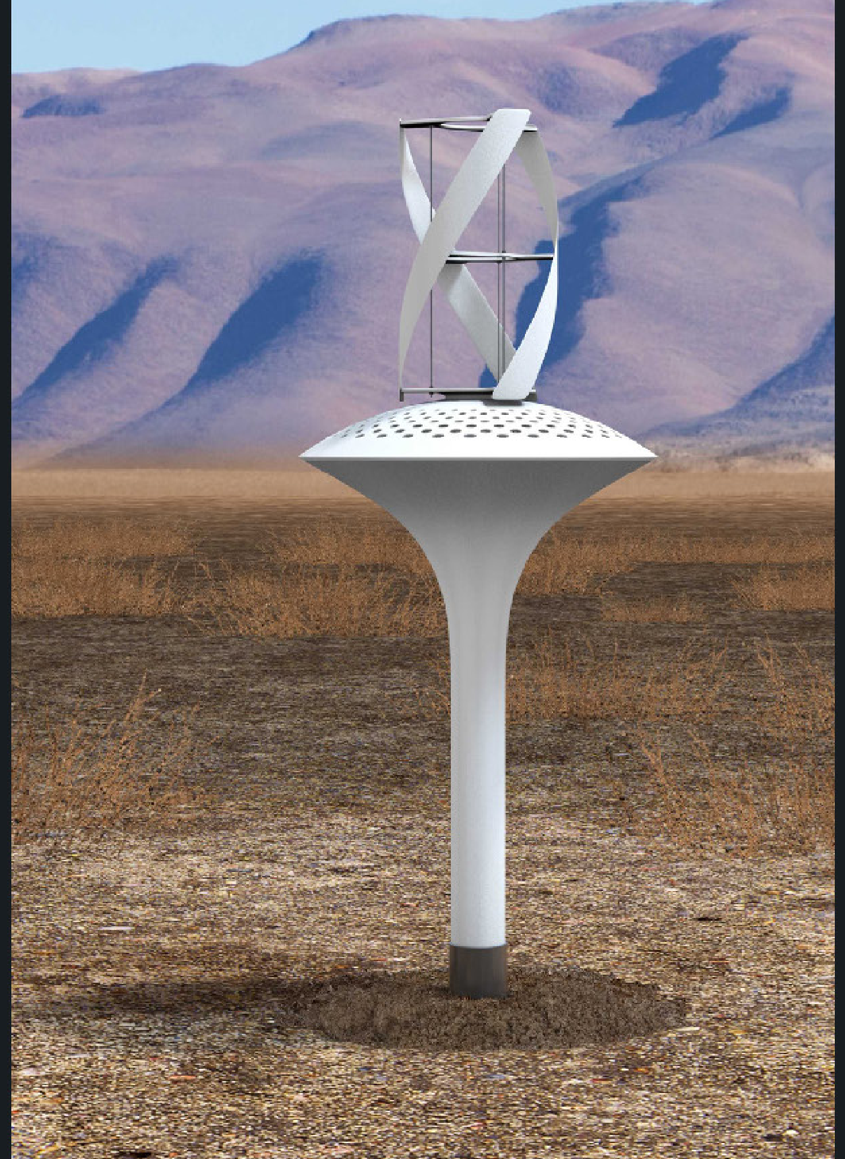
OCEAN DISTILLER FARM

Designed by
Nicholas Souchko Architecture

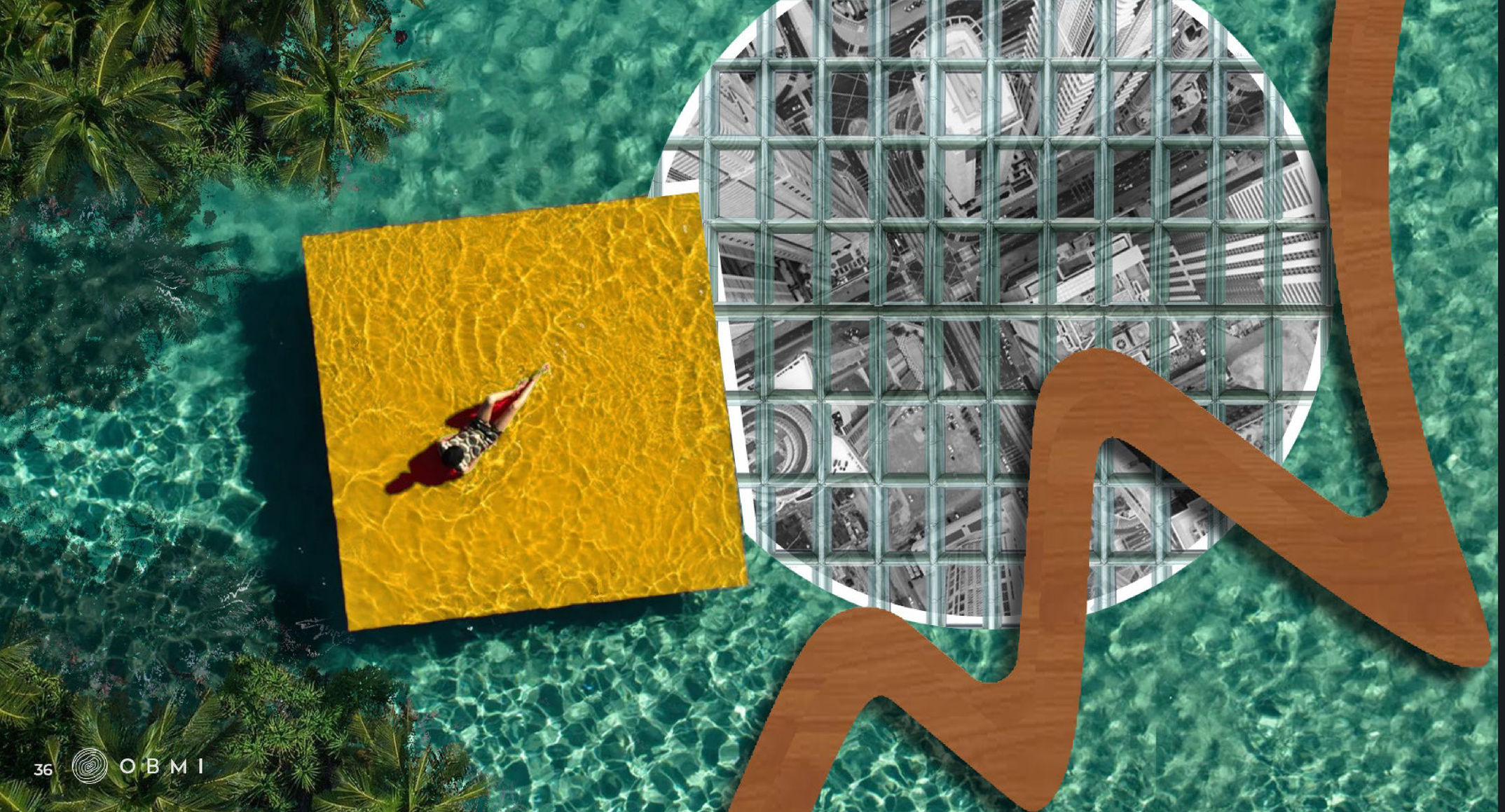
- Because the Middle East suffers from such water shortages, I wanted to circle back to water for a moment and mention a couple of other very interesting sustainable design ideas for addressing water challenges for hospitality.
- The first is seawater greenhouse agriculture, embodied in the project Ocean Distiller Farm, inspired by the anatomy of a jellyfish.
- The greenhouse is situated on the ocean and uses a steam recovery system powered by the sun to convert seawater to desalinated water in order to grow vegetation. The greenhouse's unique, dual-membrane structure utilizes direct air intake from outside, while protecting plants from harsh elements, minimizing energy costs.

WATERSEER

Designed by VICI Labs, in collaboration with UC Berkeley and the U.S. National Peace Corps Association



- The second idea is WaterSeer, from VICI Labs, in collaboration with UC Berkeley and the US National Peace Corps Association.
- An elegant, 6-foot structure can be placed in the driest of climates, and its wind-propelled turbine collects condensation from the warm air, gathering it in a chamber embedded below ground, which can then be easily collected for use.
- An added benefit of WaterSeer for less-developed regions is its ability to reduce the instances of water-borne illness.



- These are just few examples of the way in which designers, architects, scientists, and researchers can utilize biophilic and sustainable design to create low-carbon, zero-carbon, and — hopefully — even net-carbon resorts, - as well as holistic guest experiences that promote and improve human comfort and wellness.
- I believe that the future of a truly sustainable hospitality industry is very bright.

- One day, hopefully in the not-too-distant future, your guest will have flown in on a plane powered by sustainable air fuel, arriving at the resort on pavements and roads generating energy from the movement of the passing traffic, and traveling to their rooms through a landscape with vertical wind turbines discretely spinning in the breeze.
- The resort will have been constructed from a combination of recycled building materials and agricultural biproducts, the resort windows and building fabric will be harvesting energy from the sun and your plants will be purifying your air and water.
- Your guest will feel comfortably immersed in sustainability – so they can concentrate, with a clear conscience on the wonderful relaxing guest experience of your resort.

Thank you.

TIM PECK
CHAIRMAN, OBMI