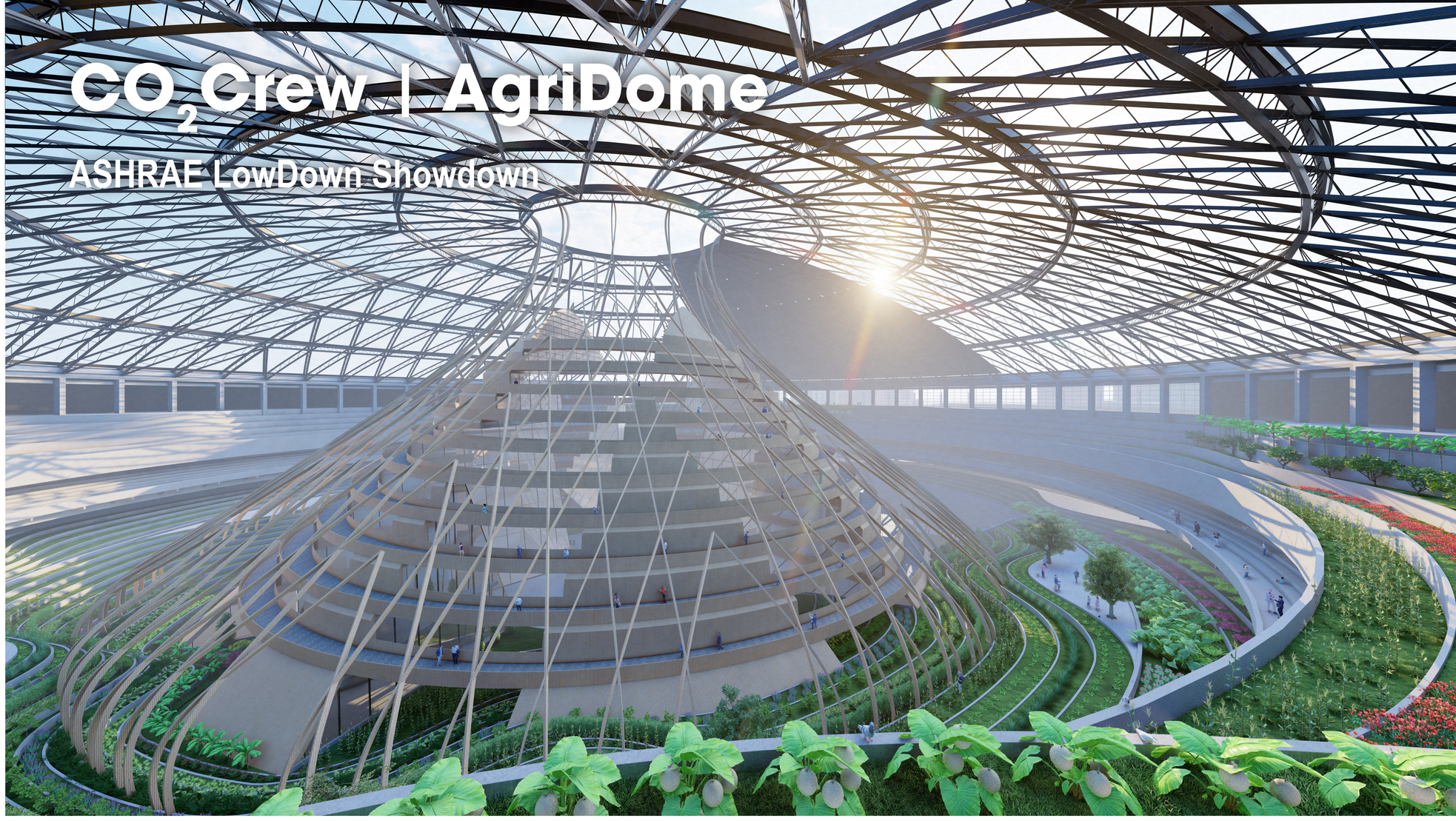
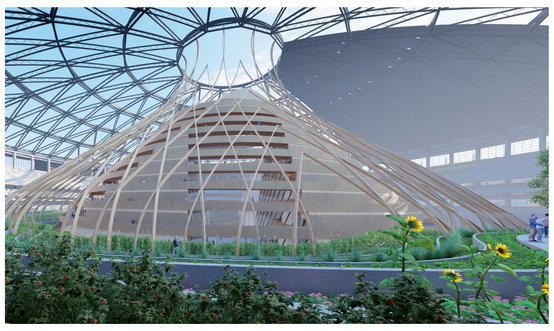
CO_2 Crew | AgriDome

ASHRAE LowDown Showdown



2023 Building Performance Analysis Conference



Building Type: Houston Astrodome
Location: Houston, TX

Total Site Energy Usage

7,345,098 kBTU

Site EUI

8.71 kBTU /ft²/ year

Source EUI

0 kBTU /ft²/ year

Annual Operational Carbon

0 kgCO2e /ft²

Total Embodied CO2e

3,929,000 kgCO2e

Annual Water Usage

1,975,263 gallons

Annual Energy Costs

0.00 $/ft²

Annual Water Costs

0.01 $/ft²

Total Annual Costs

0.01 $/ft²

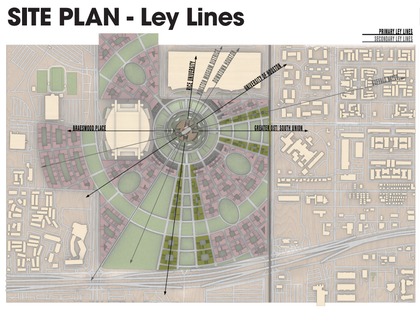
Total Energy Generation

7,345,098 kBTU

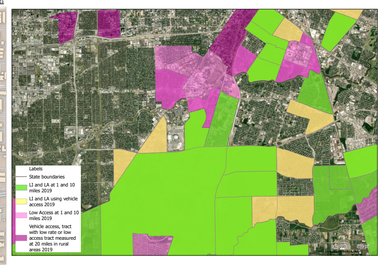
Team

Michael Banman | Winnipeg, Manitoba | Architect
James Bererton | Calgary, Alberta | Mechanical Engineer
Kyle Boyko | Edmonton, Alberta | Building Performance Consultant
Bradley Cowan | Houston, Texas | Landscape Architect
Ben Javate | Winnipeg, Manitoba | Building Performance Consultant
William Ketcham | Chicago, Illinois | Architect
Russell Lavitt | Winnipeg, Manitoba | Mechanical Engineer
Anders MacGregor | Edmonton, Alberta | Building Performance Consultant
Daniel Massaro | Chicago, Illinois | Architect
Aaditya Patel | Ottawa, Ontario | Sustainability Consultant
Chinmayee Patil | Seattle, Washington | Mechanical Designer
Aditya Potipireddi | San Francisco, California | Sustainable Design Analyst
Peter Sharma | Calgary, Alberta | Sustainability Consultant
Amir Tabadkani | Brisbane, Queensland | Design Automation Specialist
Samira Zare Mohazabieh | Denver, Colorado | Sustainable Building Specialist
Corey Leb | Melbourne, Victoria | CFD Engineer
Daniel Lansell-Kenny | Melbourne, Victoria | CFD Project Technical Lead

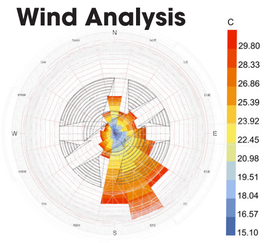
SITE PLAN - Ley Lines



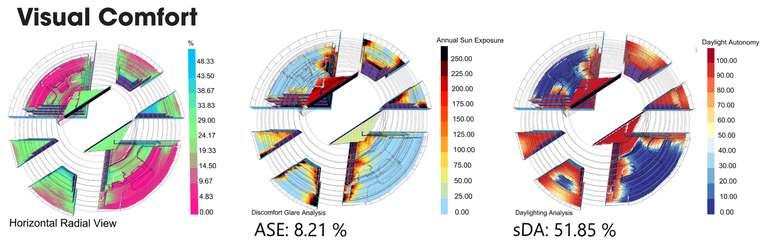
Houston Astrodome Food Desert



Wind Analysis



Visual Comfort

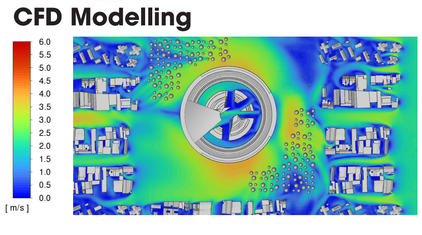


Horizontal Radial View

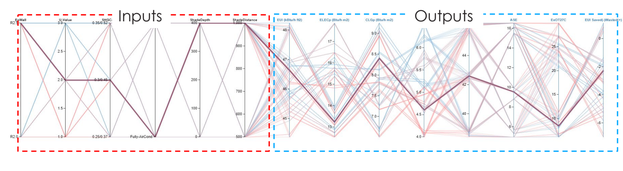
Discomfort Glare Analysis
ASE: 8.21 %

Daylighting Analysis
sDA: 51.85 %

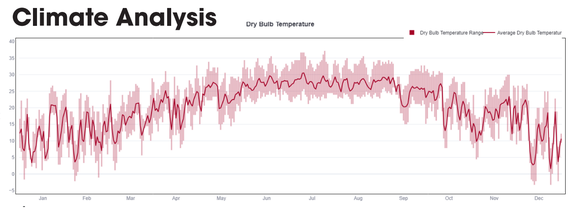
CFD Modelling



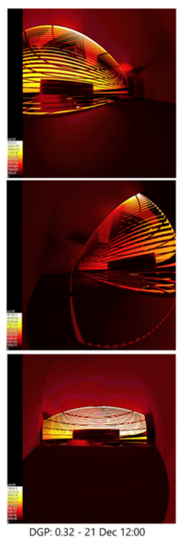
From Design Optioneering To Detailed Modeling

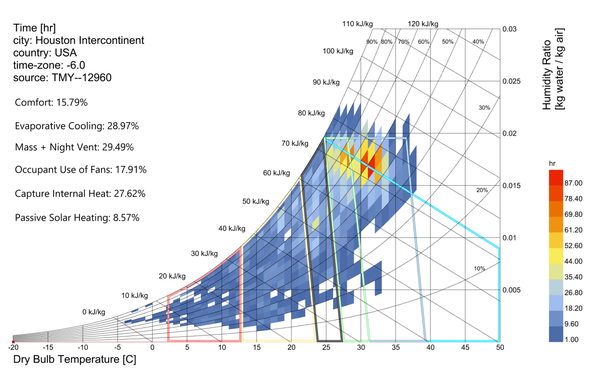


Climate Analysis



Hourly Glare Study

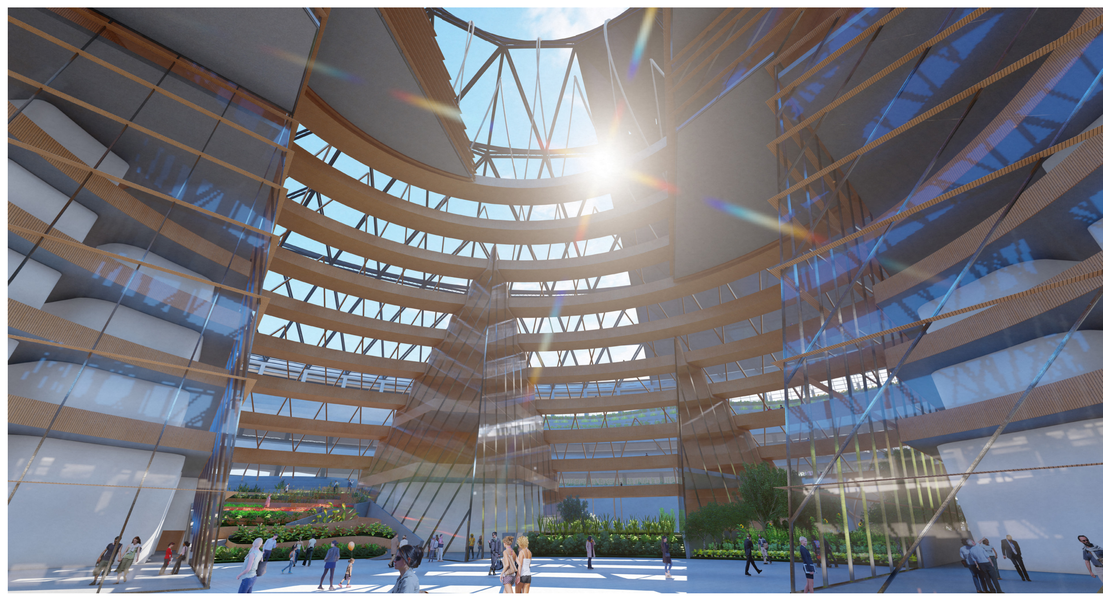




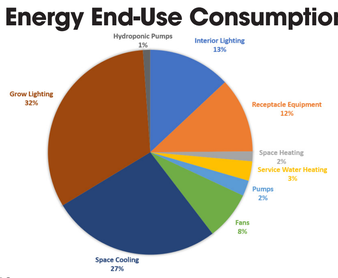
AgriDome Narrative

AgriDome is a project centered around transforming the Houston Astrodome into a sustainable community hub. The design integrates a new neighborhood atop the existing parking lots. The Astrodome has been repurposed into an urban farm, and an education center, for addressing food security and sustainability. The education center, designed in a pyramid shape, promotes learning about nutrition, agriculture, and climate resilience. The center's mass timber lattice structure supports vegetation for temperature control and pollution filtration. The project emphasizes urban farming, green spaces, and renewable energy with solar arrays and hydroponic garden tower systems. The Astrodome's metamorphosis includes removing the roof, exposing its lamella structure, and using it to support and harness solar energy. The development aims to foster a vibrant, sustainable, and interactive community while respecting the Astrodome's historic significance.

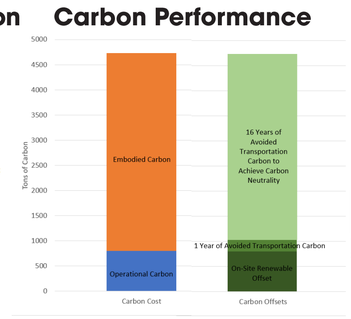
The Houston Astrodome's transformation focuses on sustainability and efficiency. The hot and humid climate led to the implementation of a liquid desiccant dehumidification system to separate latent and sensible loads. Direct evaporative cooling and displacement ventilation were utilized, while a borehole thermal energy storage (BTES) field stored cooling energy and was recharged using PV/Thermal arrays. The design optimization process encompassed geometry, orientation, fenestration, lighting, and ventilation, achieving a low energy consumption. The facility's energy consumption of 7,345,098 kBTU was offset by 100% renewable energy generation, including innovative solutions like rotating solar glazing and shade trees with dual-axis tracking. The overall approach showcases a high level of seasonal cooling efficiency, contributing to a net-zero energy state. The project embraces low embodied carbon materials such as mass timber, low-carbon concrete, and recycled steel for rebars. The design incorporates various water-saving measures like rain gardens, porous pavements, hydroponic farming, and efficient irrigation, aiming to reduce water usage by 92% and eliminate 96% of freshwater consumption.



Energy End-Use Consumption



Carbon Performance



Heat Transfer Simulation