ARIZONA STATE UNIVERSITY

ISTB-7

INTERDISCIPLINARY SCIENCE AND TECHNOLOGY BUILDING

A'18 AIA Conference on Architecture 2018
June 21-23, New York City

ASU | STUDIO MA

ASU SUSTAINABILITY

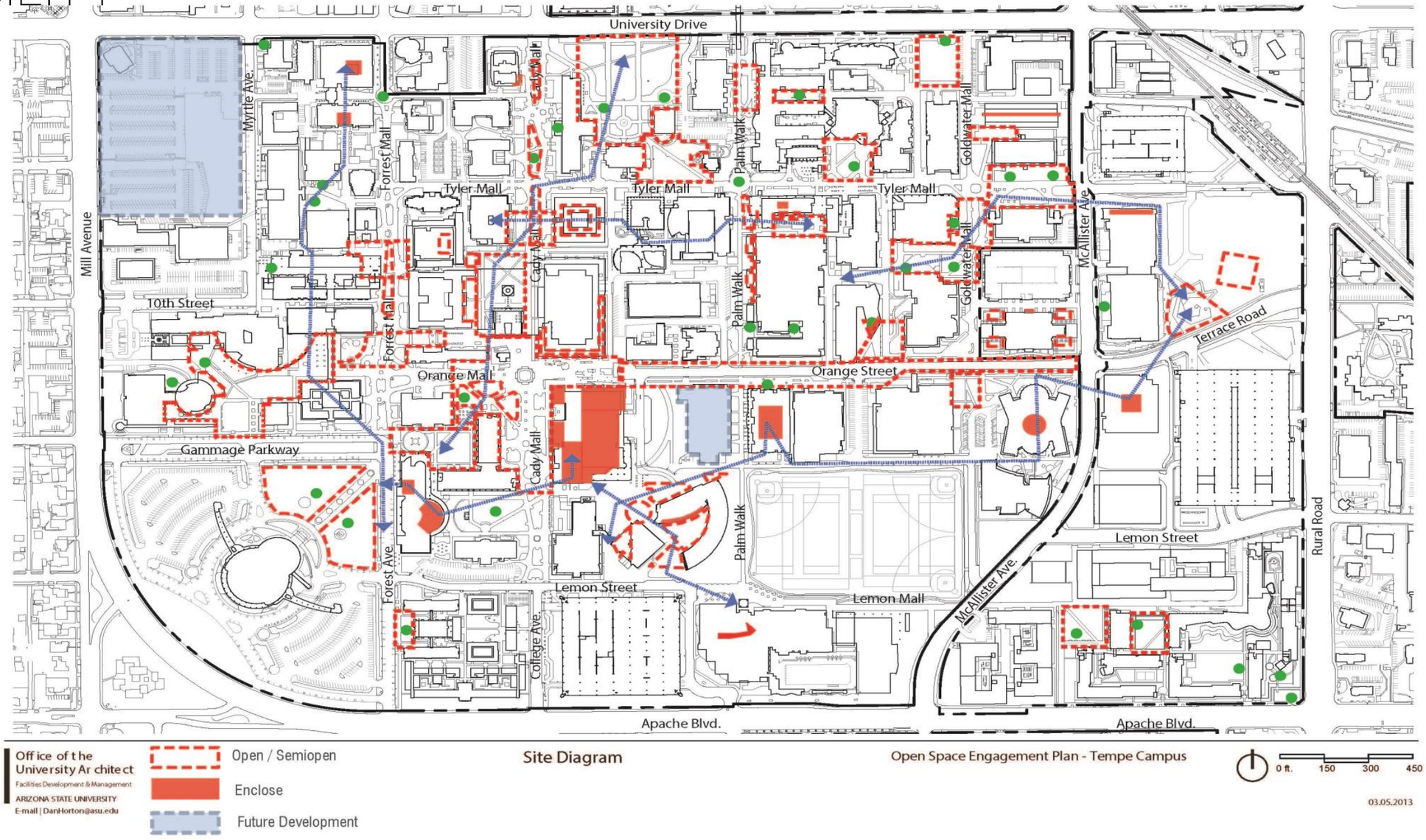
INITIATIVES

ASU SUSTAINABILITY

INITIATIVES

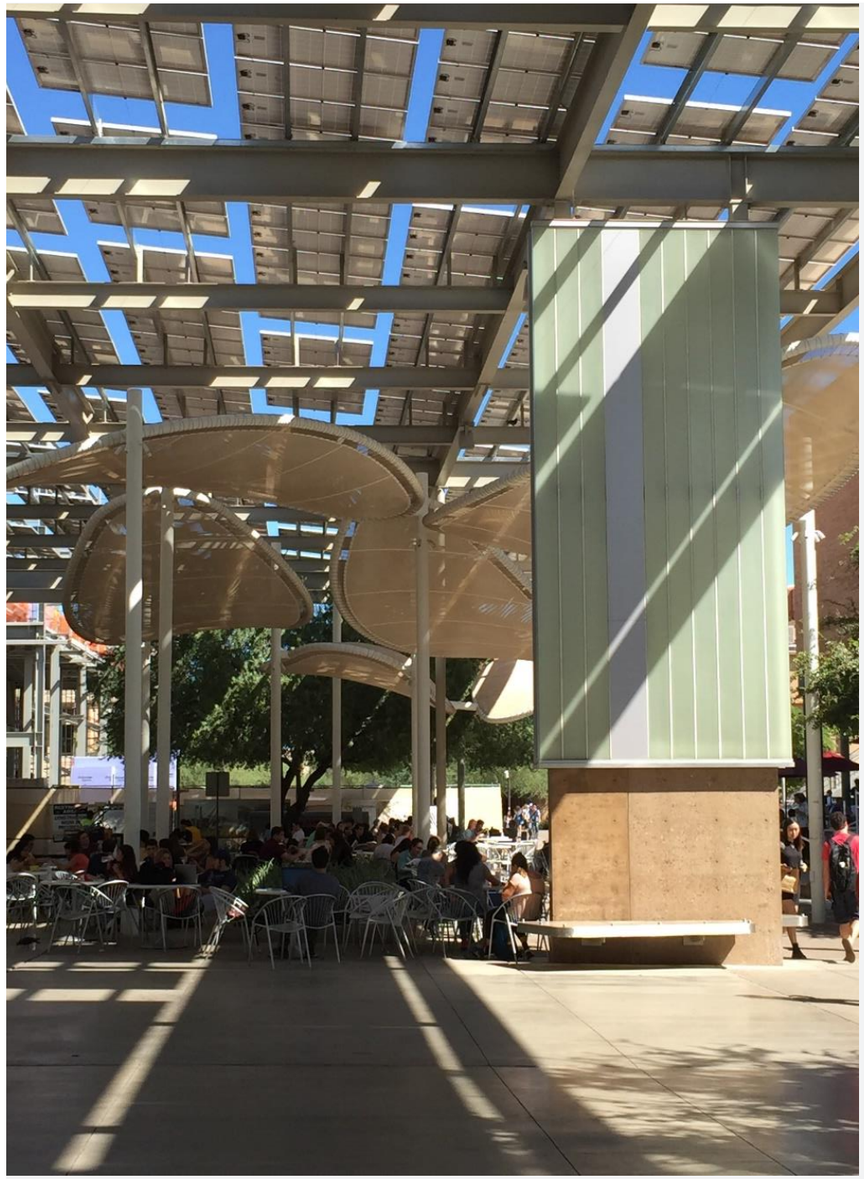
ASU SUSTAINABILITY

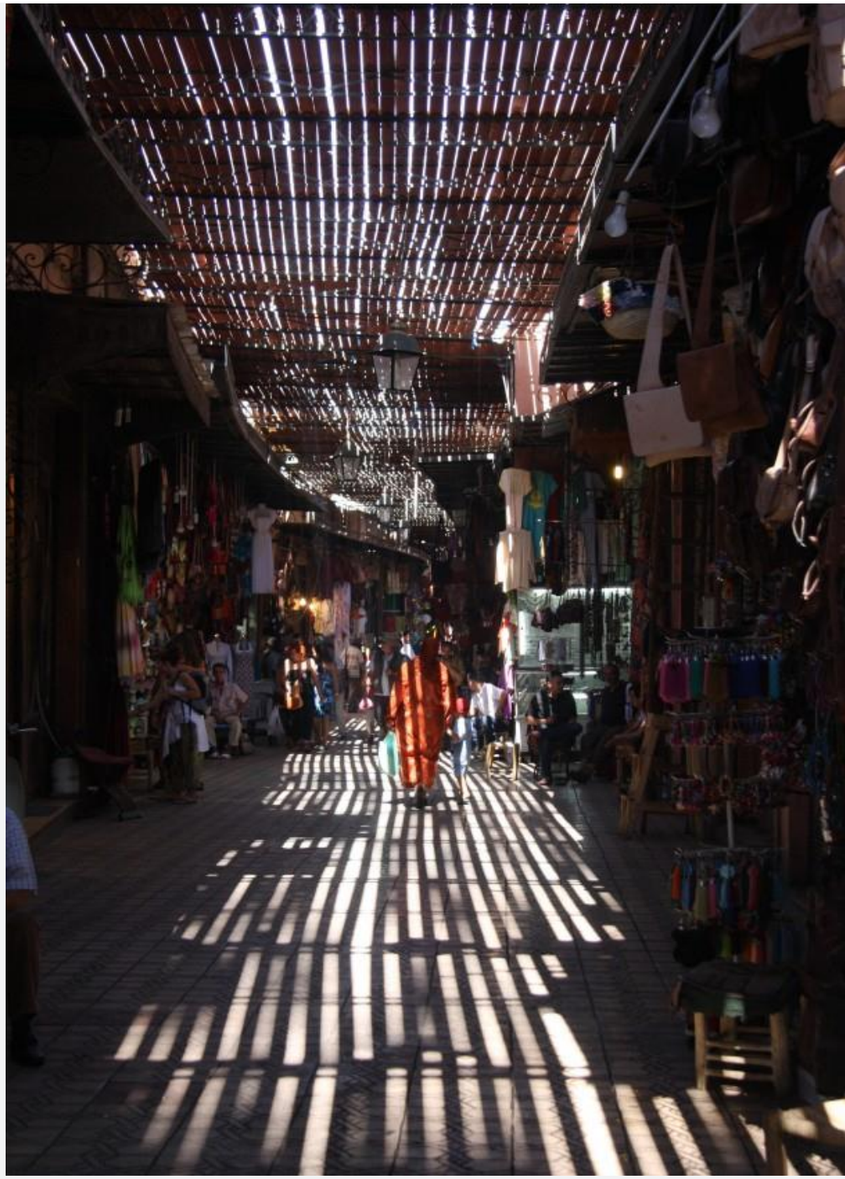
INITIATIVES



ASU SUSTAINABILITY

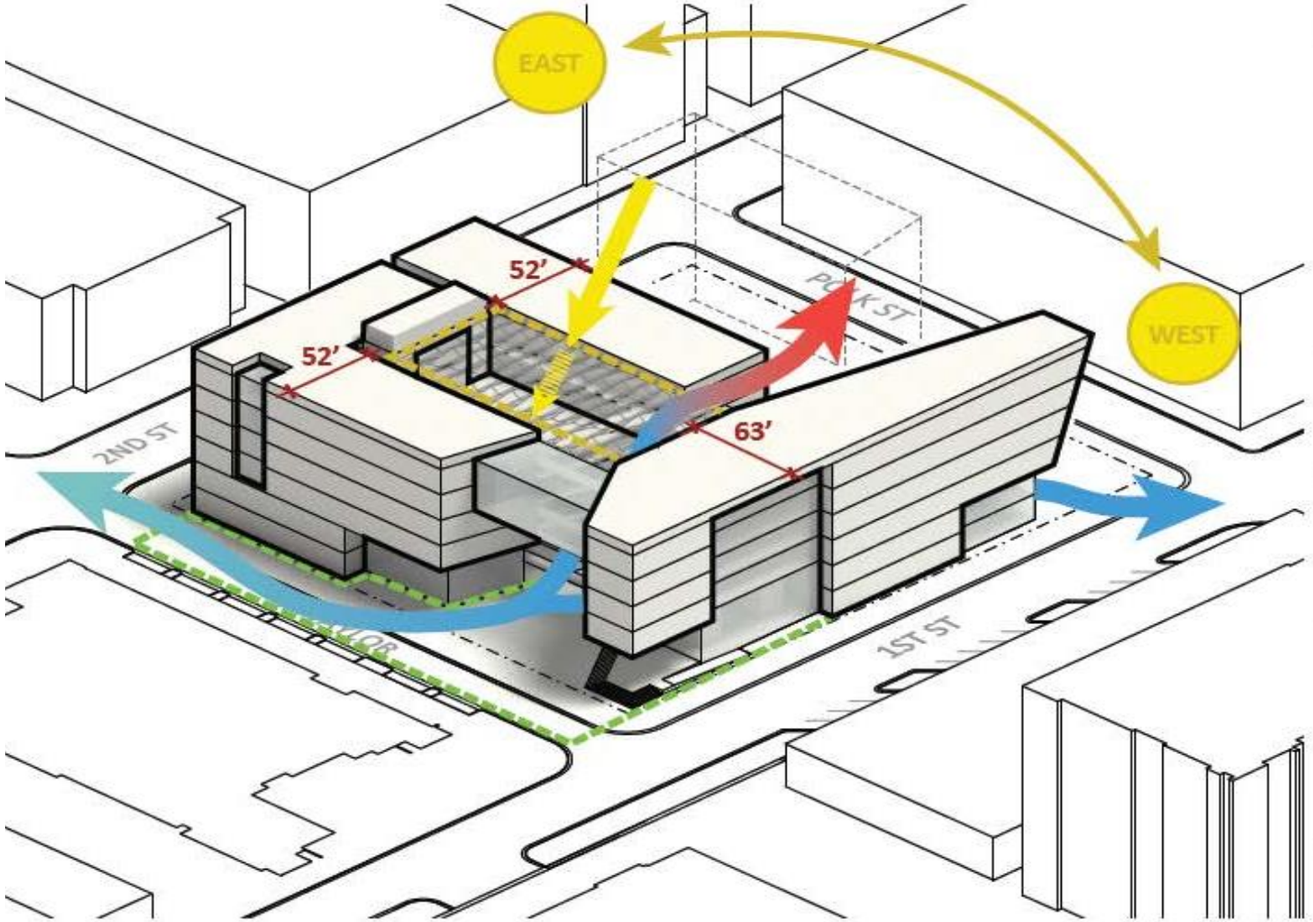
INITIATIVES





ASU SUSTAINABILITY

INITIATIVES



Performance

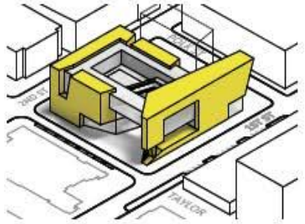
- Massing Provides Self-Shading; Allows for an Increase in Transparency along the Inner Courtyard and Inset Locations
- Heavy, More Opaque Construction Protects Interior Spaces from Excess Solar Gain
- Prevailing Winds Cool CoL Courtyard and Lower Level Exterior Public Spaces
- Extensively Shaded Courtyards Provide Comfortable, Private Outdoor Spaces w/Social Connectivity
- Full-Height Exterior Courtyard Allows Daylight to Animate the Ground Plane
- Narrow Floor Plates Afford Good Daylight Penetration and Opportunities to Cross-Ventilate
- Overhang Creates "Deep Shade" Over Public Plaza on Taylor Mall and Over Exterior Elevated Terrace

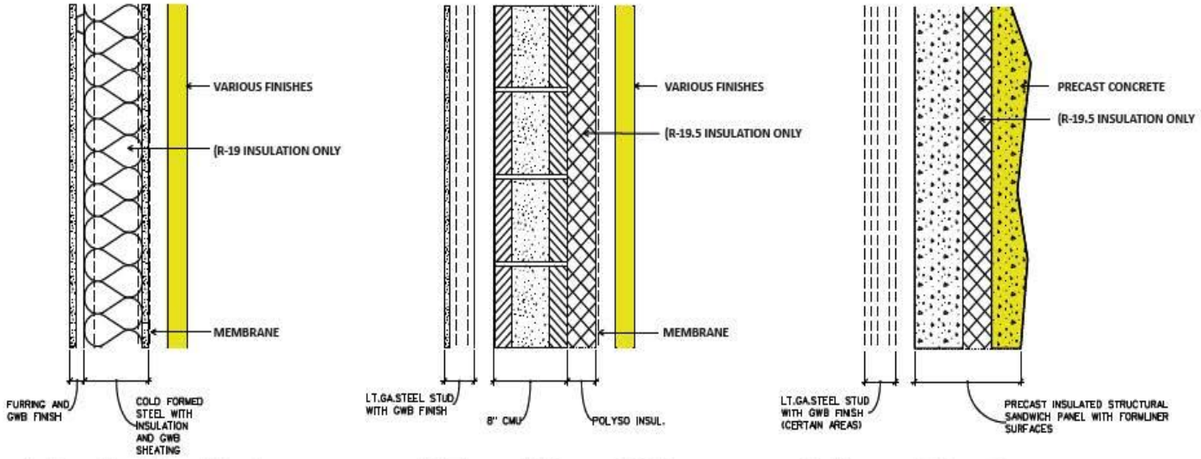
ASU SUSTAINABILITY

INITIATIVES

PARAMETRIC ENERGY ANALYSIS

Exterior Wall Options Study



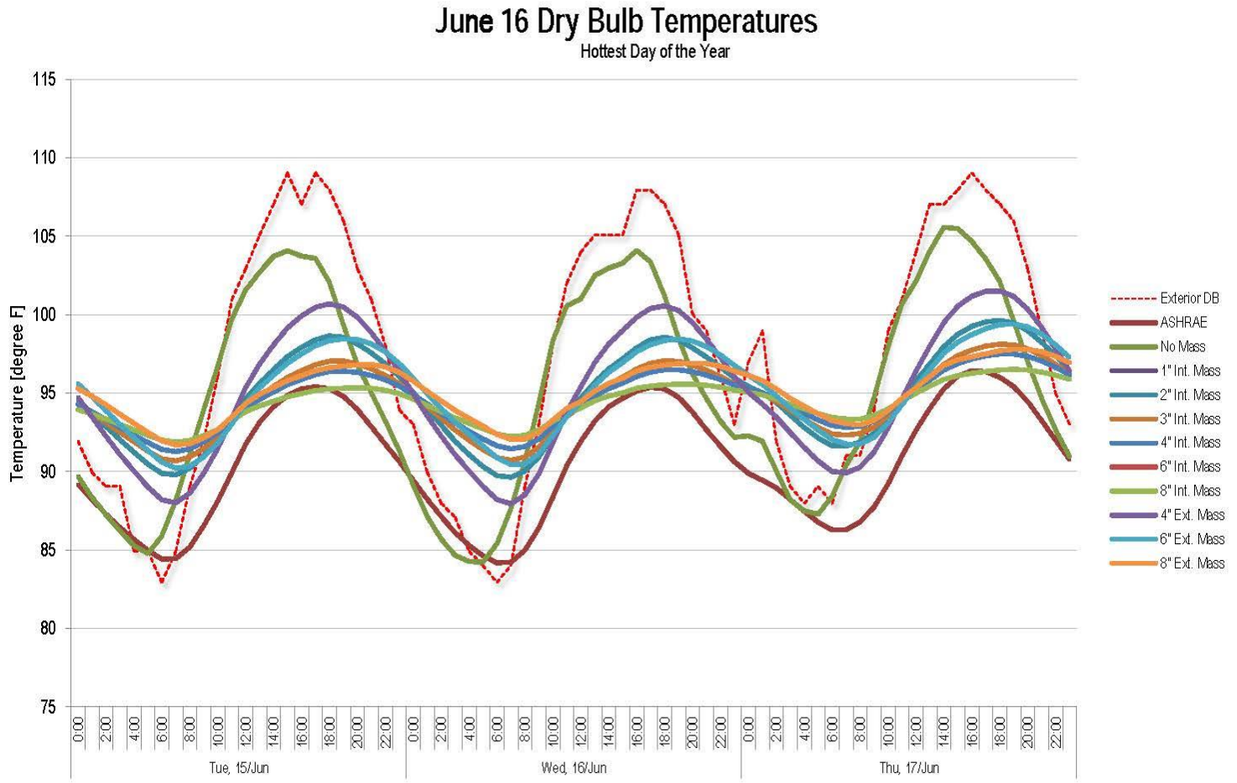


A: Baseline Metal Stud Back-up Wall

B: Thermal Mass - CMU Back-up Wall

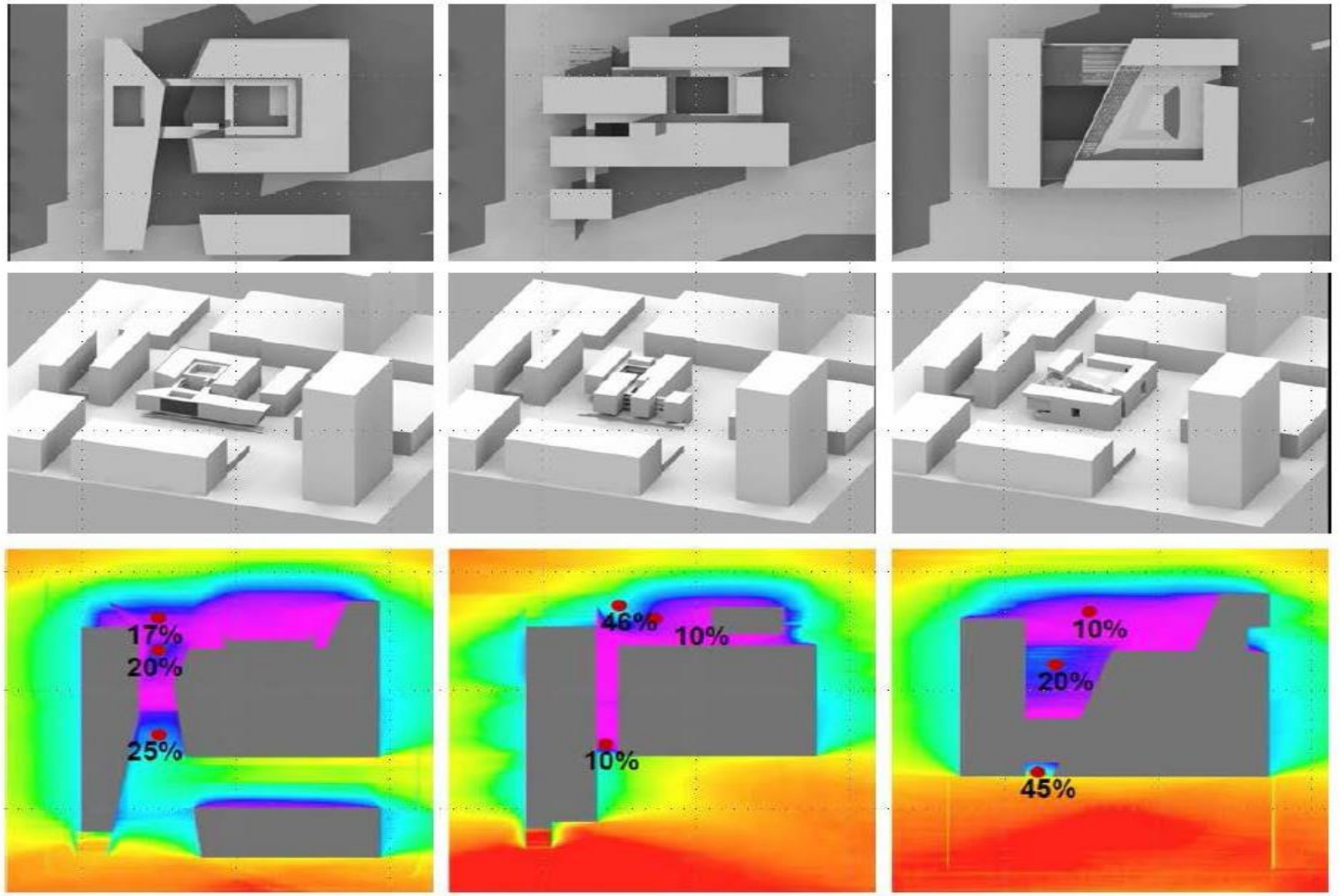
C: Thermal Mass- Precast Sandwich Panel

THERMAL MASS STUDY



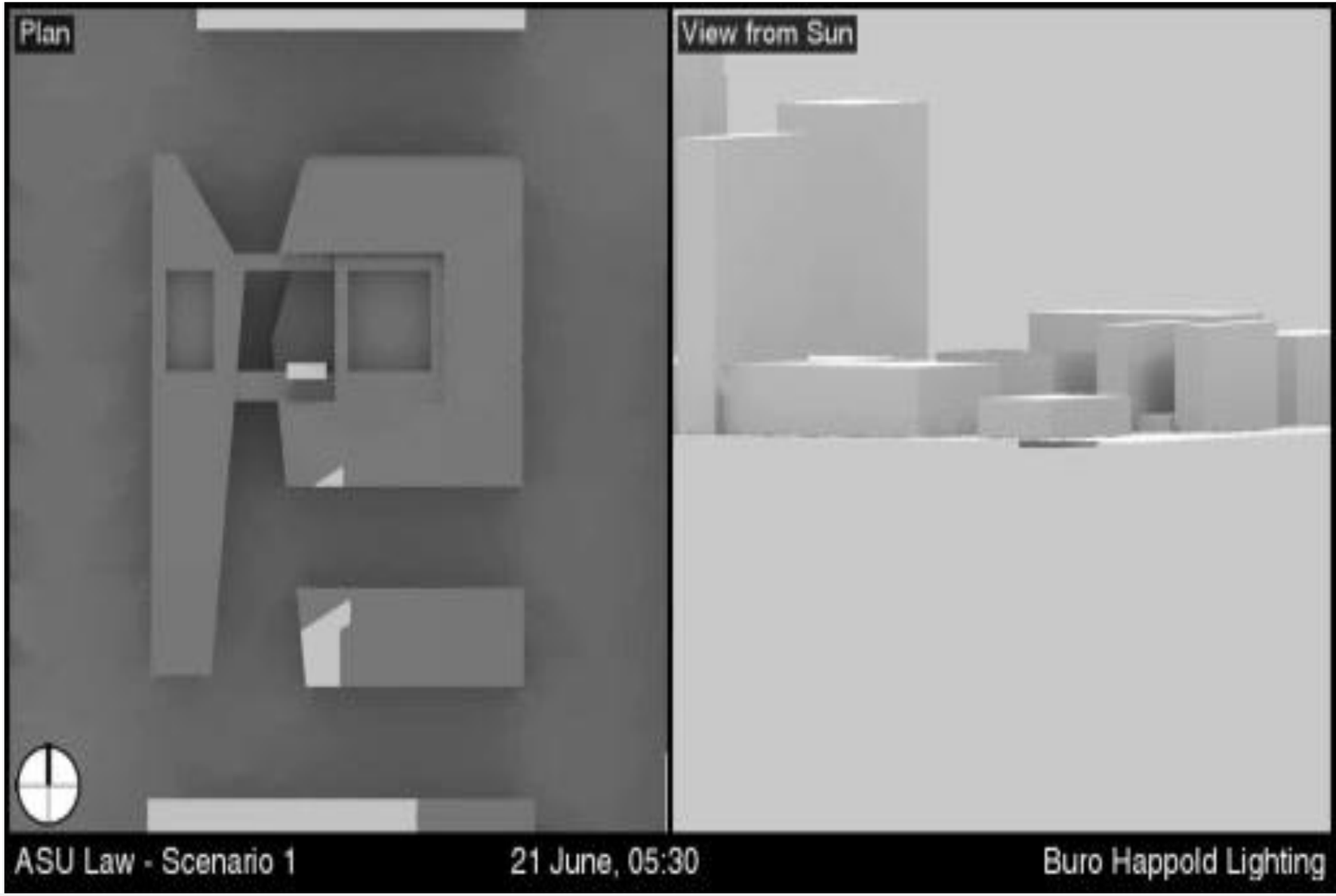
ASU SUSTAINABILITY

INITIATIVES



ASU SUSTAINABILITY

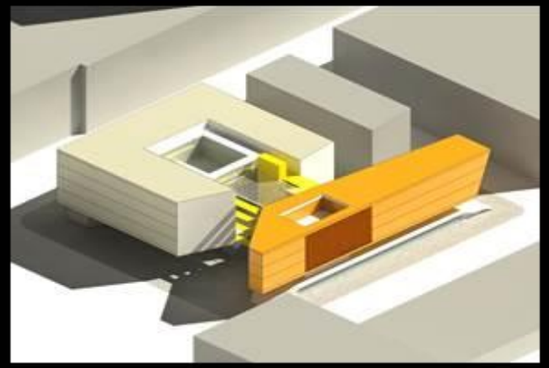
INITIATIVES



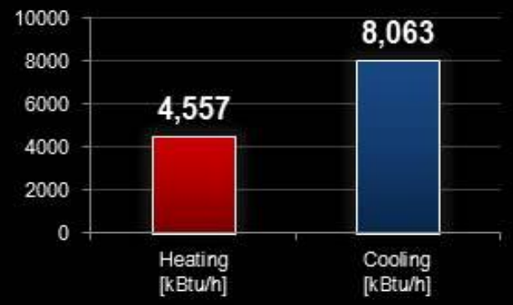
ASU SUSTAINABILITY

INITIATIVES

Peak Load & Annual Energy Block Model

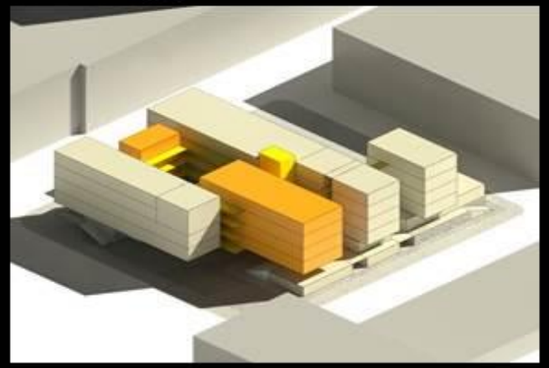


SPLAY

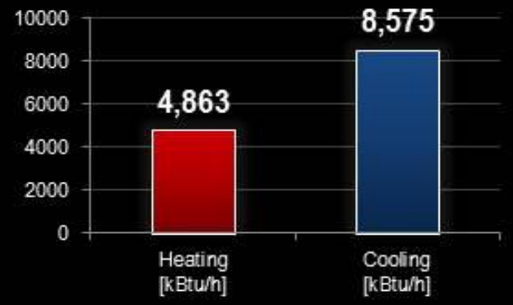


Heating [Btu/SF]: **21.08**

Cooling [Btu/SF]: **37.31**

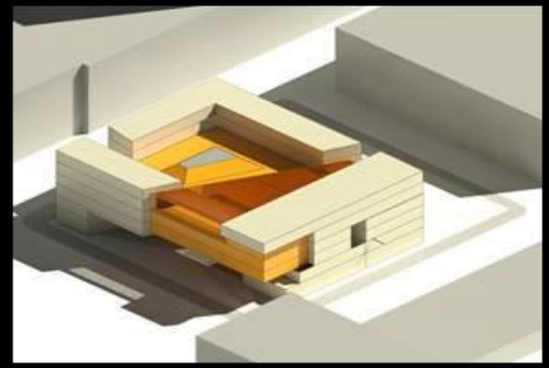


BARS



Heating [Btu/SF]: **21.91**

Cooling [Btu/SF]: **38.65**



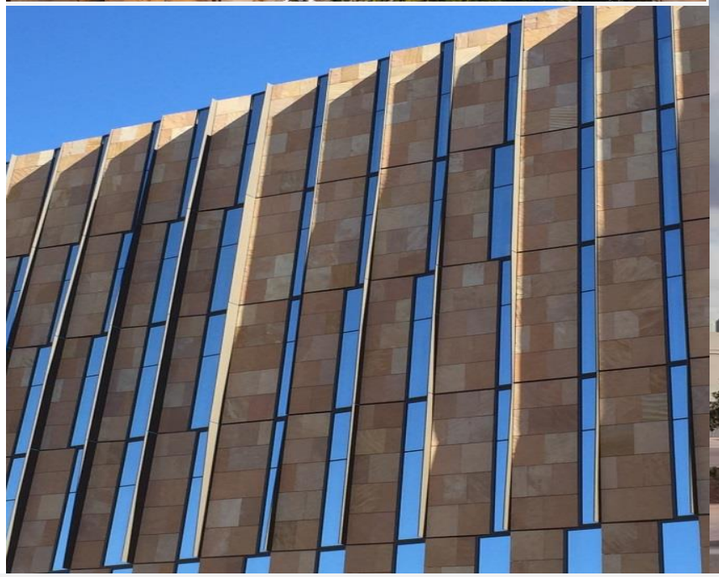
RING

Heating [Btu/SF]: **19.98**

Cooling [Btu/SF]: **34.85**

ASU SUSTAINABILITY

INITIATIVES



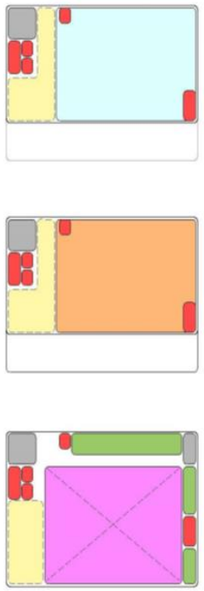
ASU SUSTAINABILITY

INITIATIVES

OPTION A

DIAGRAM . OPTION A

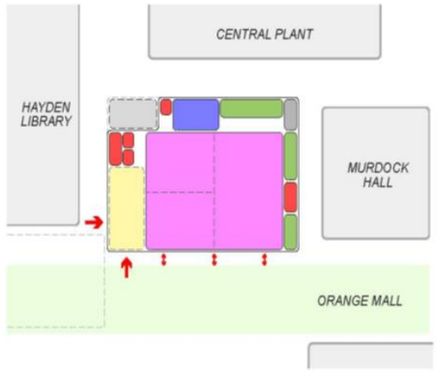
- **EVENT SPACE**
  15,200 sf . 1,220 seats
- **EOSS**
  Level 2
- **UNIVERSITY OFFICE - ACADEMIC**
  Level 3
- **LOUNGE - INFORMAL GATHERING**
  Entry & Lobby, Grand Stair
- **FINISHING KITCHEN**
  Catering Set-up, Warming, Coolers, Freezer
- **EVENT SUPPORT**
  Storage, Equipment Rooms, Event Space Support
- **BUILDING SERVICE**
  Mechanical, Toilet Rooms
- **VERTICAL CIRCULATION**
  Stair & Elevator
- **LOADING**
  Dock, Waste & Building Support



LEVEL 3

LEVEL 2

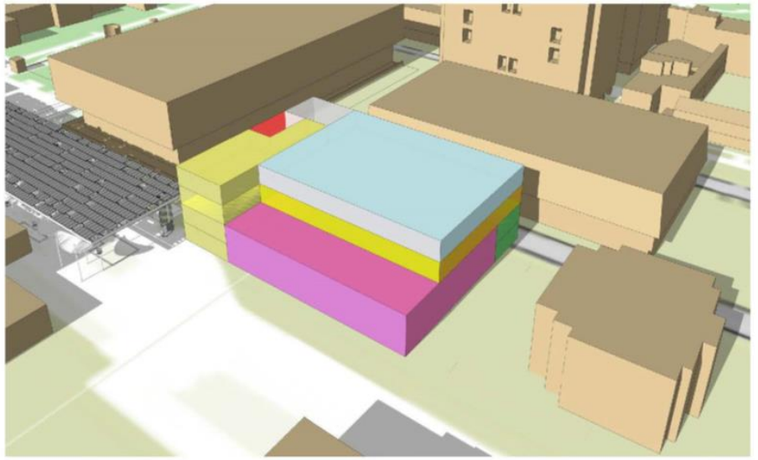
MEZZANINE



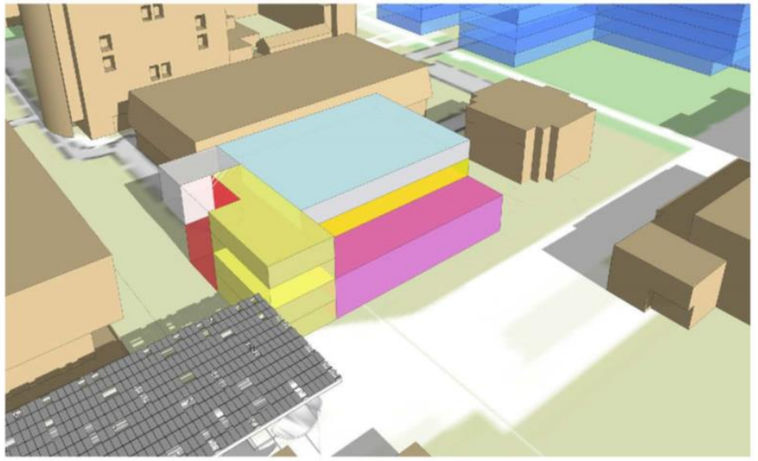
LEVEL 1

Stacking Diagram . Option A

MASSING



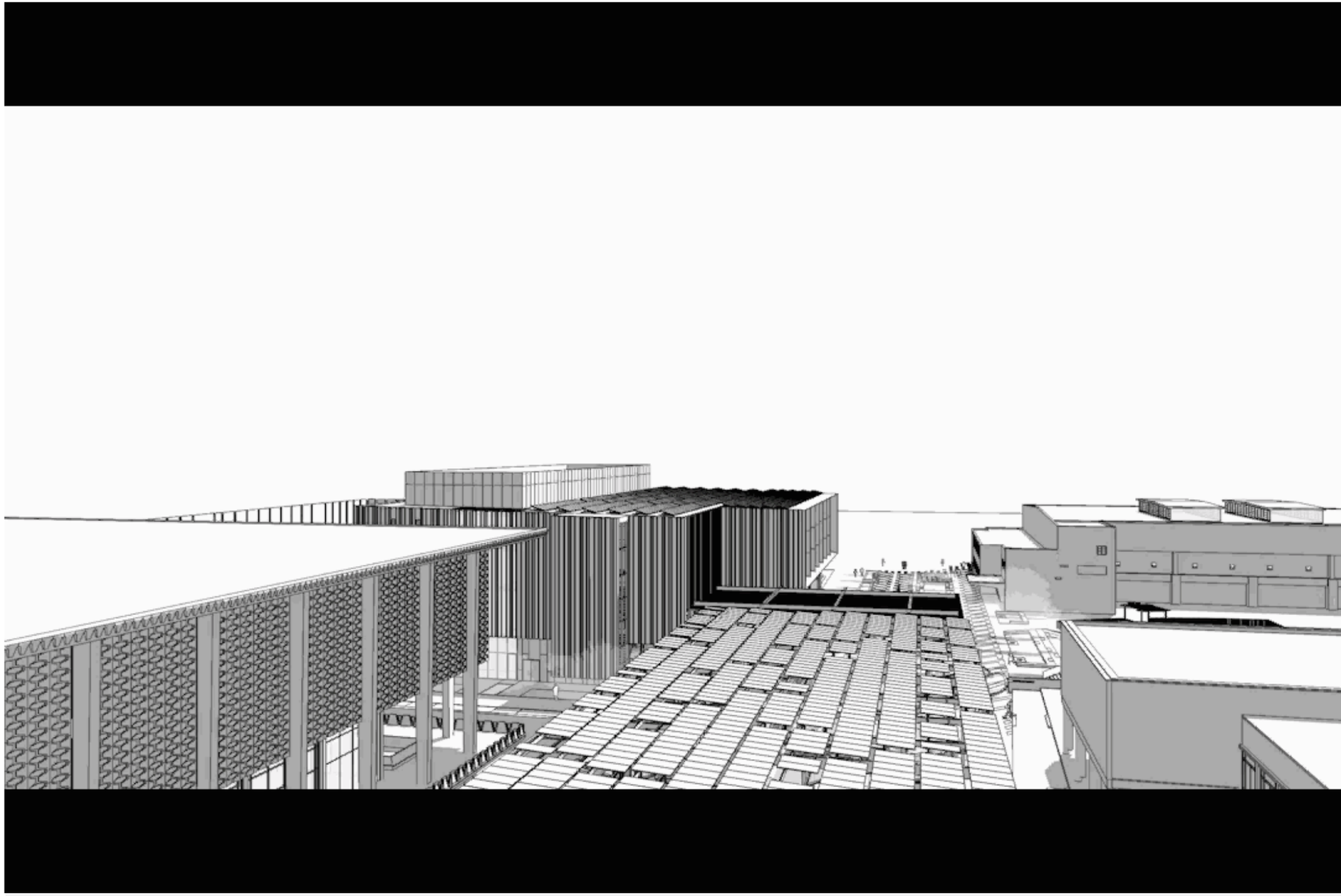
Massing Study - Option A . East



Massing Study - Option A . West

ASU SUSTAINABILITY

INITIATIVES



ASU SUSTAINABILITY

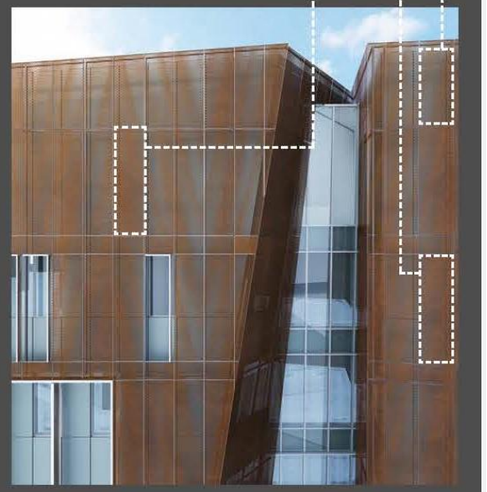
INITIATIVES

ASU SUSTAINABILITY

INITIATIVES

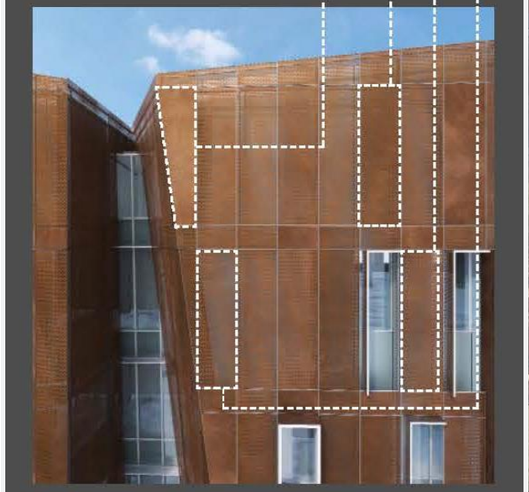
NORTH FACADE

- 60% PERFORATED
- 45% PERFORATED
- 30% PERFORATED



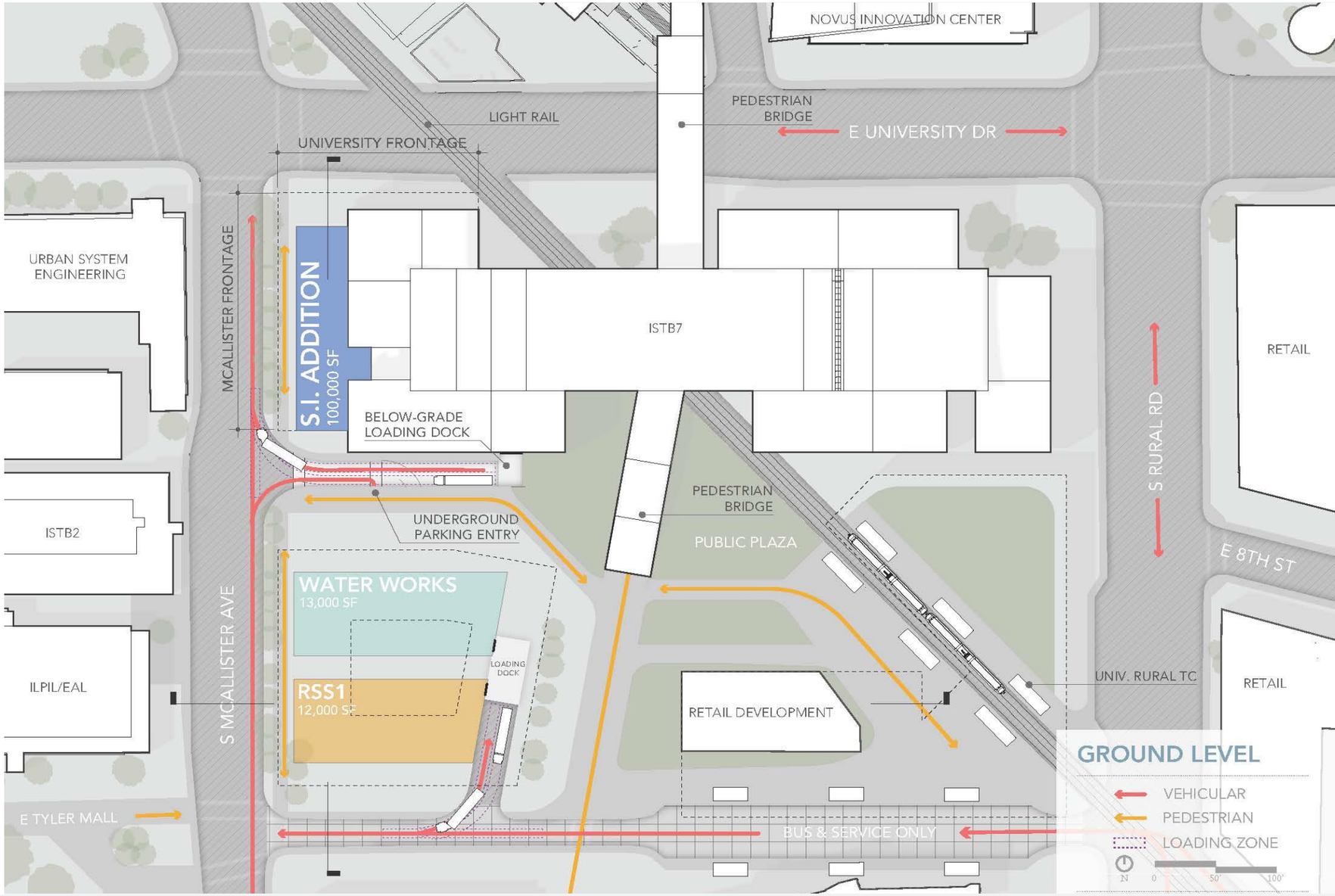
SOUTH FACADE

- 45% PERFORATED
- 30% PERFORATED
- 15% PERFORATED
- SOLID PANEL



ASU SUSTAINABILITY

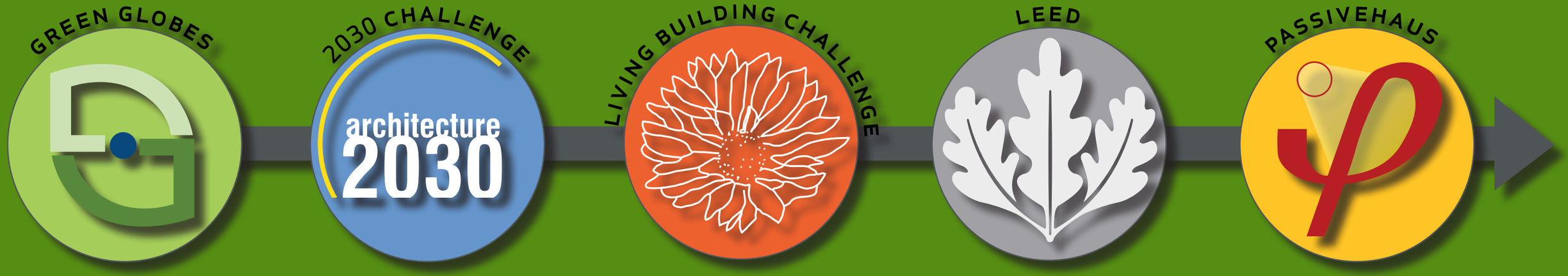
INITIATIVES



WHAT NEXT?

WHAT DOES THE FUTURE OF SUSTAINABILITY LOOK LIKE?

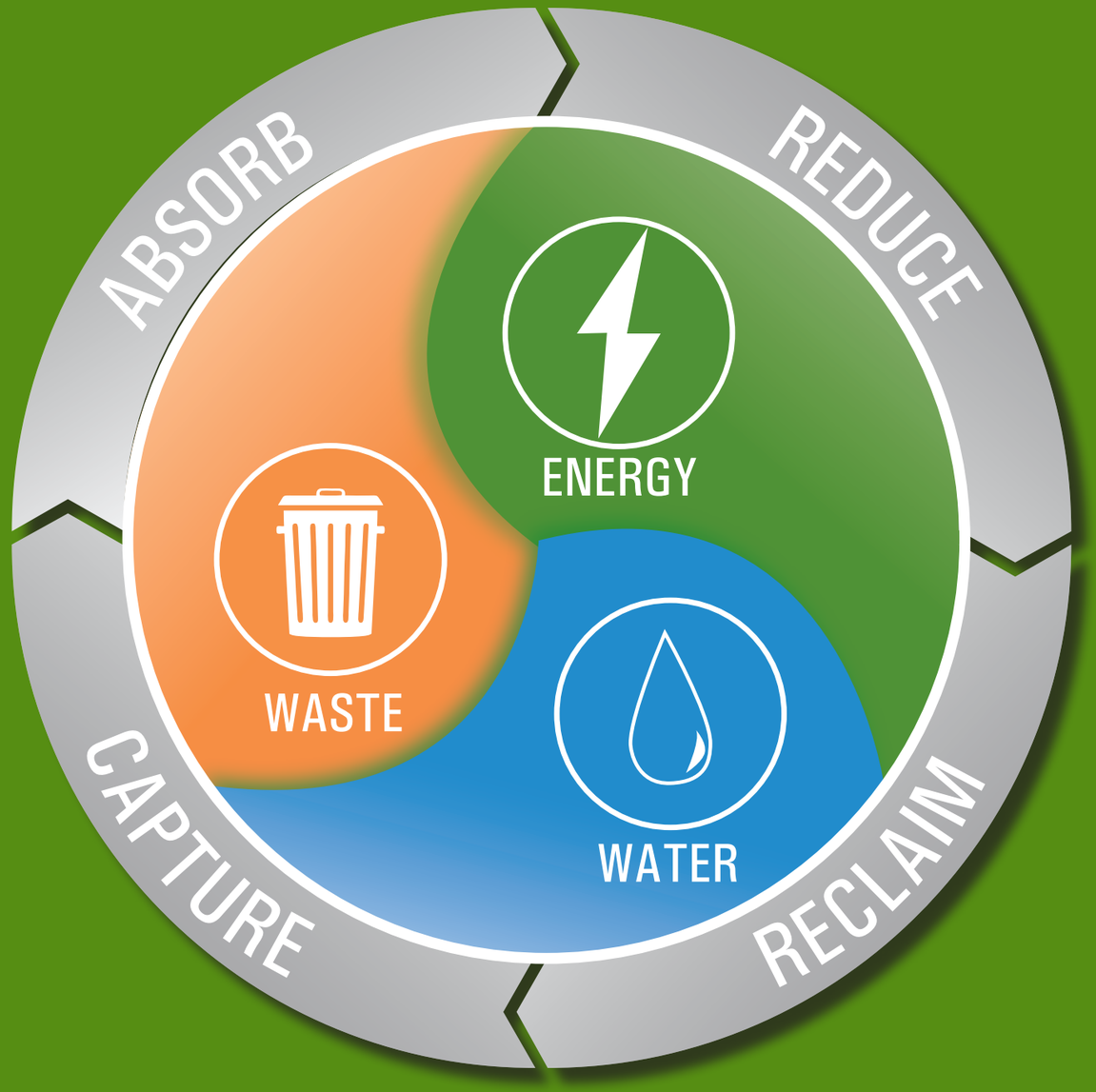
ASU's ISTB-7 demonstrates the next generation of sustainable design.



CARBON POSITIVE DESIGN

NEXT GENERATION SUSTAINABLE BUILDING

ASU's ISTB-7 is a new sustainable research facility designed to regenerate carbon with energy, water and waste to achieve Triple Net Zero.



STRATEGIES & TACTICS

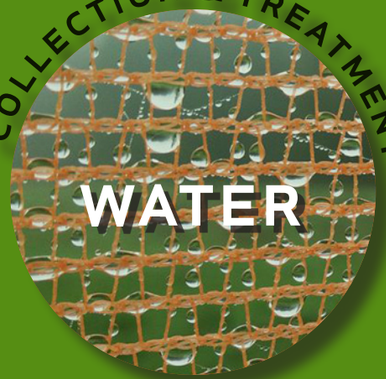
TRIPLE NET ZERO | POSITIVE CARBON DESIGN

ASU's ISTB-7 will clean air, clean wastewater, collect water and absorb carbon, producing a living, positive conversion of fugitive carbon into life-giving nutrients for durable materials and enriching soil.

KLAUS LACKNER
ASU REACHER

FARMING | ENRICHING SOIL

COLLECTION & TREATMENT



PASSIVE & ACTIVE SOLAR

BIOME | ERV

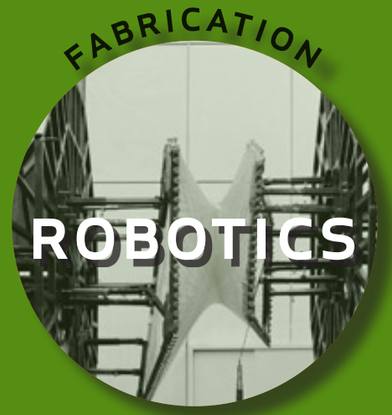
CARBON CONVERSION

RESEARCH

SUPPORTED AND DEMONSTRATED IN THE AREAS OF SUSTAINABILITY AND ROBOTICS

ASU's ISTB-7 will simultaneously support and demonstrate research advancing sustainability. One example of a potential ASU researcher is Klaus Lackner, PhD, and his integrated carbon capture technology.

KLAUS LACKNER
ASU REACHER



TRIPLE NET ZERO

WASTE, ENERGY, WATER

CLT
SEQUESTERING CARBON THROUGH THE USE OF MASS TIMBER.

SUNSHADING
REDUCING ENERGY USE BY **LOWERING** DIRECT HEAT GAIN.

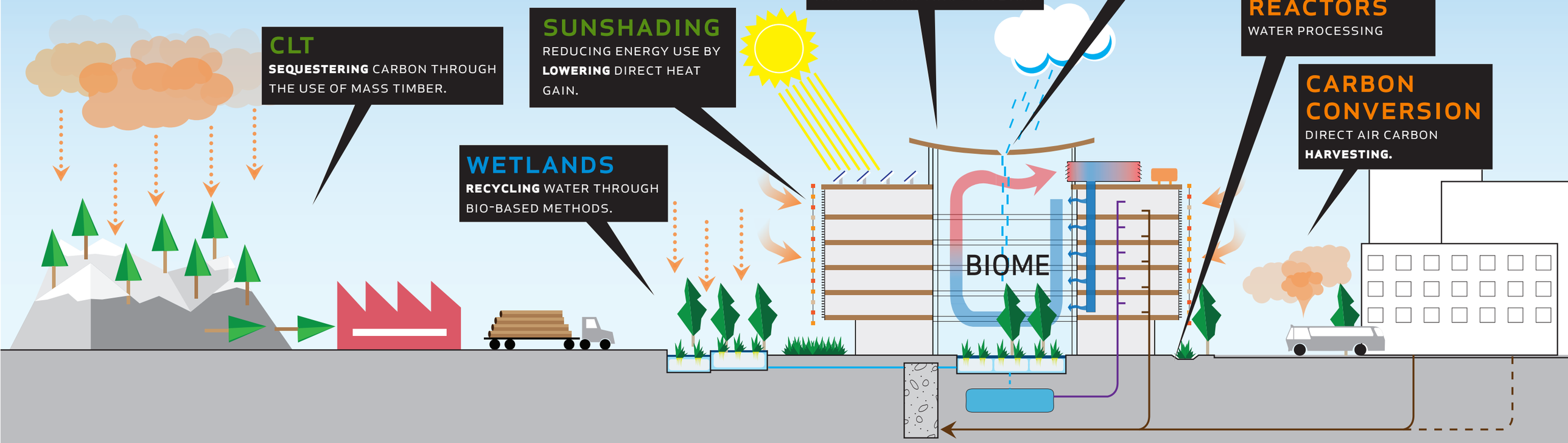
WETLANDS
RECYCLING WATER THROUGH BIO-BASED METHODS.

BIOME
REDUCING ENERGY USE THROUGH PURIFYING WASTE AIR.

WATER COLLECTION
RAINWATER IS COLLECTED AT ROOF-TOPS, TREATED TO POTABLE REQUIREMENTS.

HYDROPONIC REACTORS
WATER PROCESSING

CARBON CONVERSION
DIRECT AIR CARBON **HARVESTING.**



WASTE
WASTE IS CLEANED, STORED AND RECYCLED NON-POTATBLE GREYWATER IS THEN DISTRIBUTED TO CAMPUS.

ENERGY
THE PROJECT WILL ACHIEVE NET-POSITIVE ENERGY USING PASSIVE DESIGN PRINCIPALS.

WATER
THE PROJECT RECYCLES AND COLLECTS THE WATER USED IN THE BUILDING AND SITE TO ACHIEVE A NET-POSITIVE WATER USAGE.

A'18 AIA Conference on Architecture 2018
June 21-23, New York City

ASU | STUDIO MA

SITE

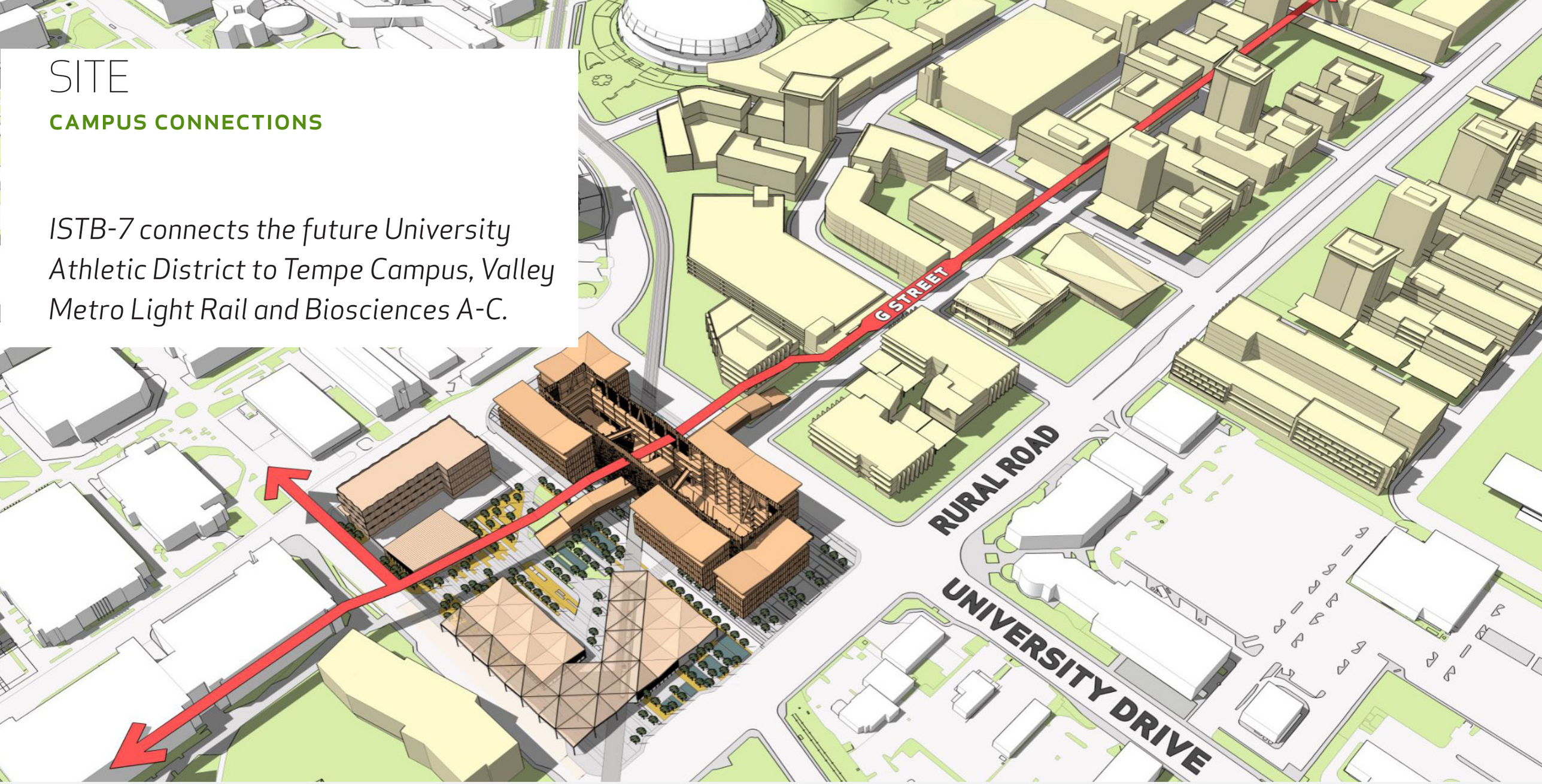
A CAMPUS GATEWAY

ASU's new ISTB-7 connects ASU's future University Athletic District to the Tempe Campus.

SITE

CAMPUS CONNECTIONS

ISTB-7 connects the future University Athletic District to Tempe Campus, Valley Metro Light Rail and Biosciences A-C.



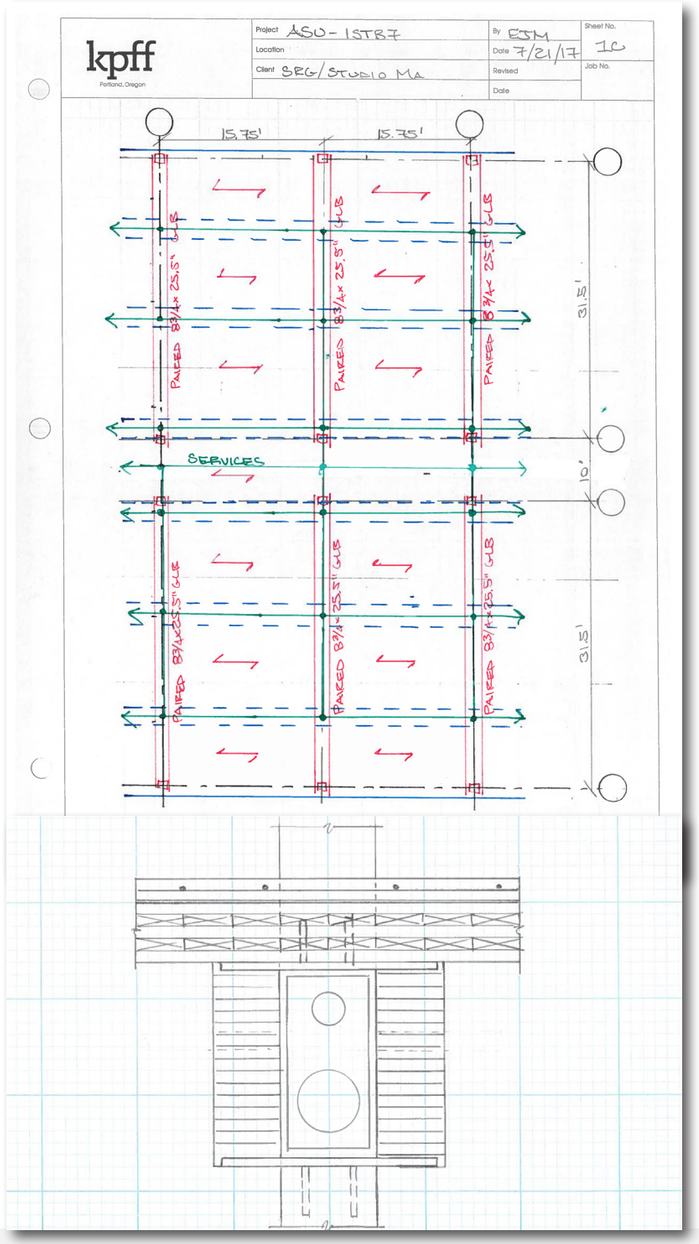
MATERIALITY

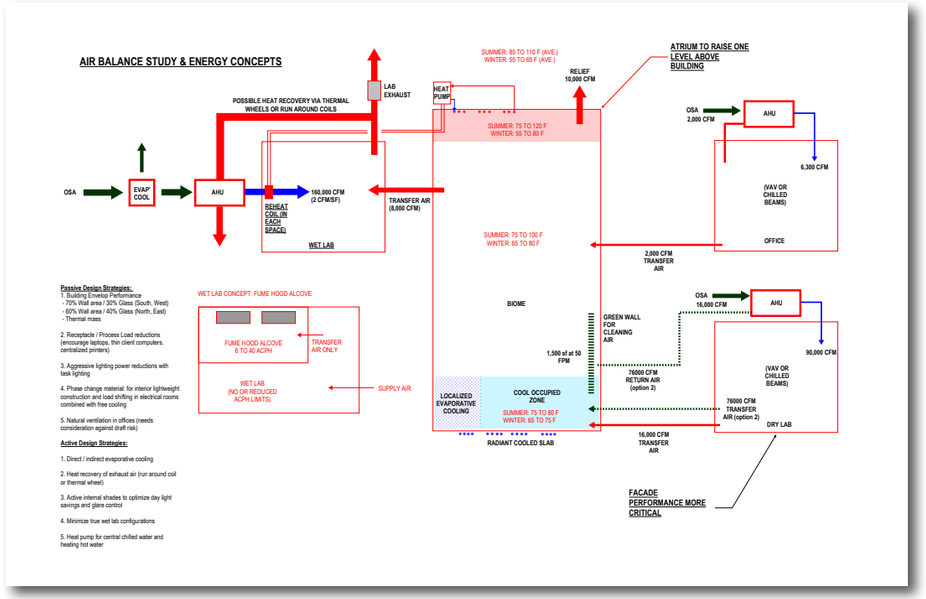
LOW EMBODIED CARBON AND CARBON HARVESTING

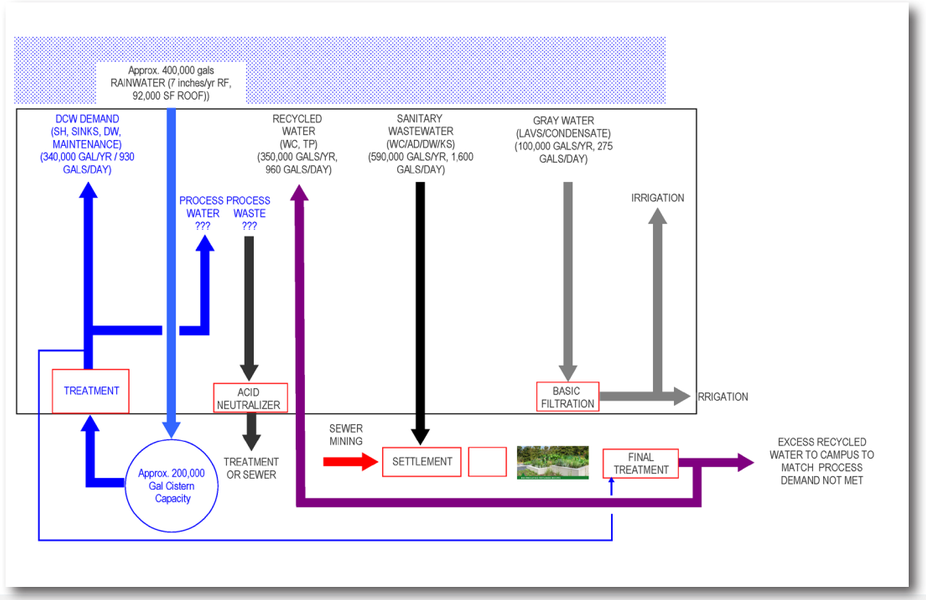
Terracotta, cross-laminated timber and carbon capture panels combine to shade and sequester carbon in a desert inspired palette of colors, textures and variegated natural light.

EVALUATION

STRUCTURAL + MPE SYSTEMS







ENERGY

STRATEGIES

SOLAR COLLECTION
PV PANELS COLLECT SUNS ENERGY TO GENERATE ELECTRICITY FOR BUILDING CONSUMPTION.

AIR FILTRATION
EXHAUST AIR RECIRCULATED THROUGH BIOME TO REDUCE OUTSIDE AIR REQUIREMENTS.

SUN SHADING: ROOF
ROOF OVERHANGS SHADE BUILDING TO REDUCE SOLAR HEAT GAIN.

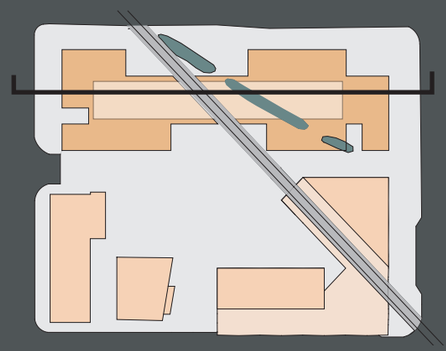
SUN SHADING: FACADE
TERRACOTTA BAGUETTES SHADE BUILDING FROM DIRECT SUNLIGHT TO REDUCE HEAT TRANSFER.

CLT STRUCTURE
LOW EMBODIED ENERGY AND CARBON SEQUESTRATION IN MASS TIMBER CONSTRUCTION.

NATURAL VENTILATION
CONNECTIVE AIR FLOW IN BIOME ENHANCES BUILDING VENTILATION.

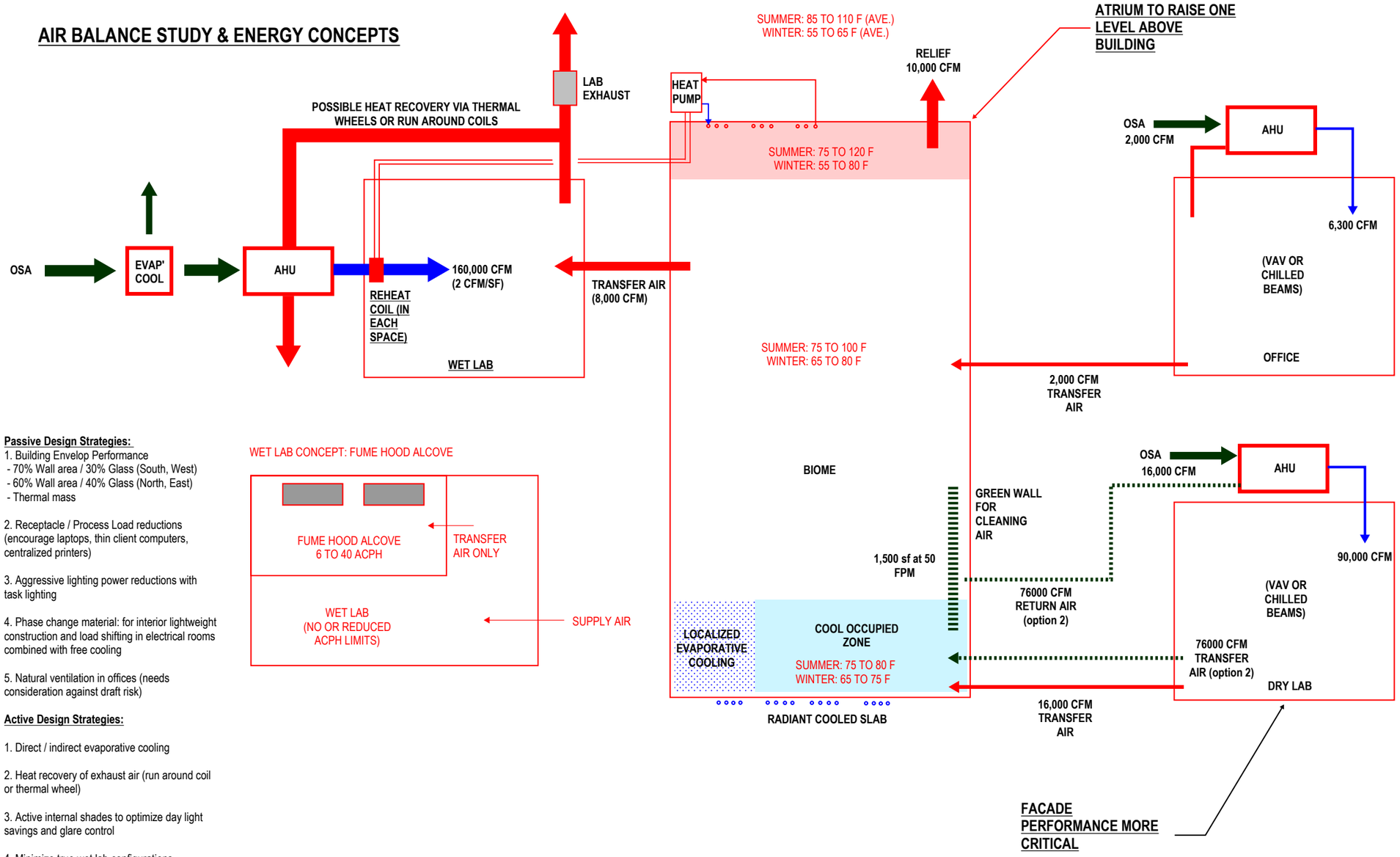
EXISTING CANAL

HYDROPONIC REACTORS
WATER PROCESSING



ENERGY STRATEGIES

AIR BALANCE STUDY & ENERGY CONCEPTS



Passive Design Strategies:

1. Building Envelop Performance
 - 70% Wall area / 30% Glass (South, West)
 - 60% Wall area / 40% Glass (North, East)
 - Thermal mass

2. Receptacle / Process Load reductions (encourage laptops, thin client computers, centralized printers)

3. Aggressive lighting power reductions with task lighting

4. Phase change material: for interior lightweight construction and load shifting in electrical rooms combined with free cooling

5. Natural ventilation in offices (needs consideration against draft risk)

Active Design Strategies:

1. Direct / indirect evaporative cooling

2. Heat recovery of exhaust air (run around coil or thermal wheel)

3. Active internal shades to optimize day light savings and glare control

4. Minimize true wet lab configurations

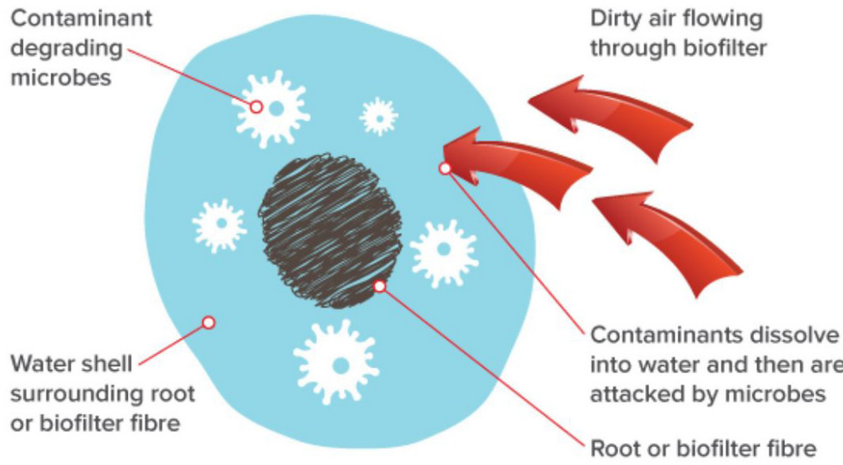
5. Heat pump for central chilled water and heating hot water

What's Inside | Plan an Event | Net Zero | Contact Us

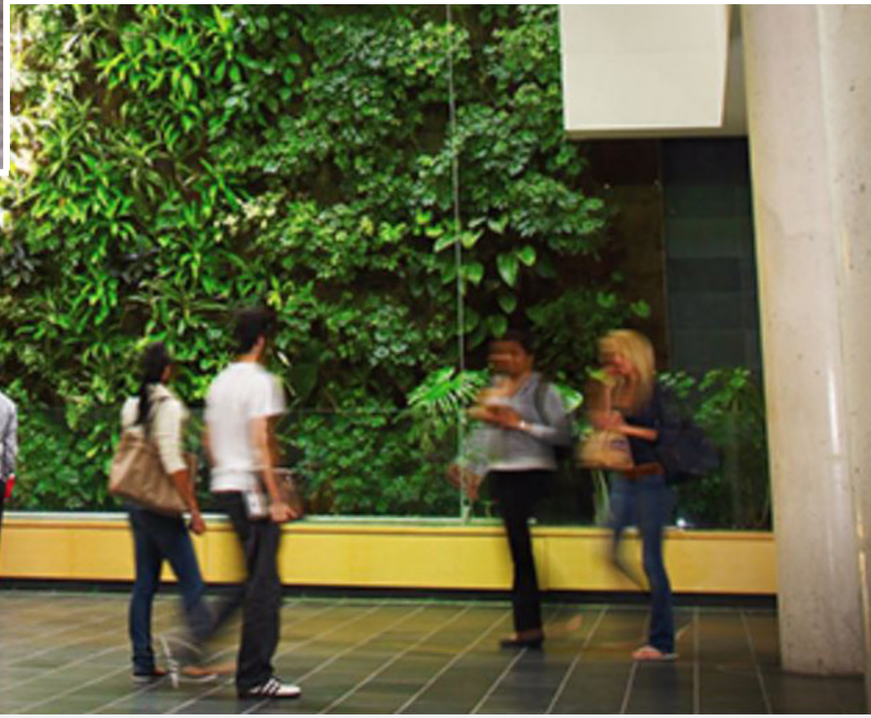
ENERGY STRATEGIES

Direct / Indirect Evaporative Cooling

Air Recycling / Biofiltration

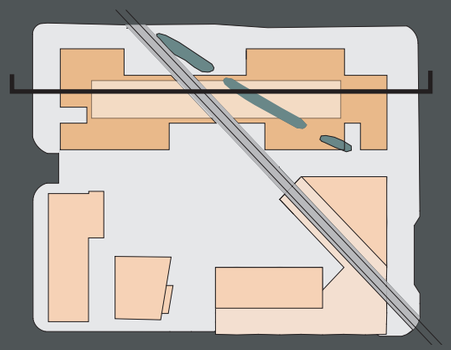


Targeted EUI of
35 to Net Zero



WATER

STRATEGIES



WATER TREATMENT

RECYCLED WATER FROM BUILDING PURPLE PIPE SYSTEM AND ASU'S DISTRICT SEWER SYSTEM.

EFFICIENT FIXTURES

DUAL-FLUSH AND LOW-FLOW PLUMBING FIXTURES.

WATER COLLECTION

RAINWATER IS COLLECTED AT ROOF-TOPS, TREATED TO POTABLE REQUIREMENTS.

EXISTING CANAL

WATER STORAGE

RESERVE ALLOWS FOR VARIABILITY IN DEMAND.

HYDROPONIC REACTORS

WATER PROCESSING

WETLANDS

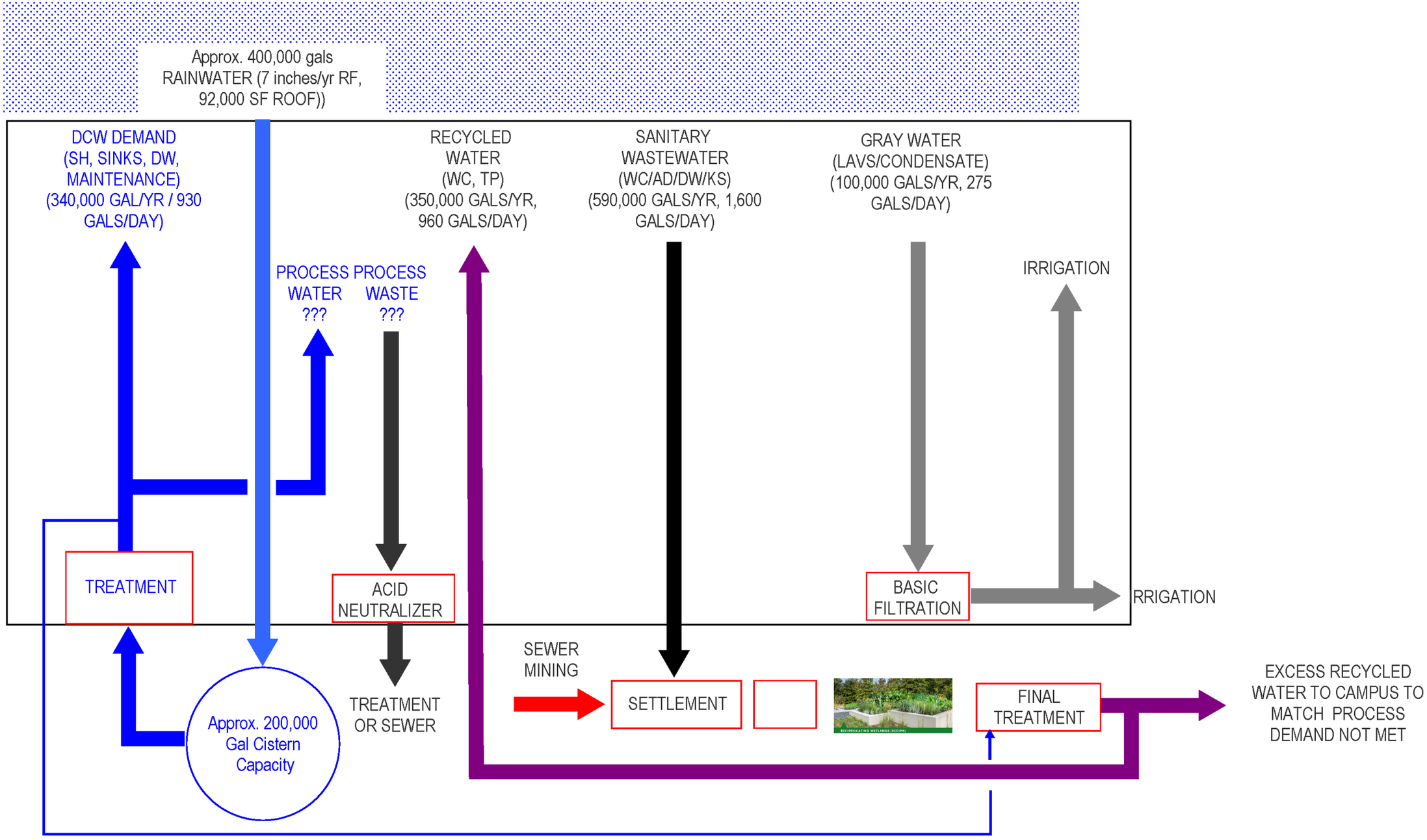
PROVIDES WATER FOR FOOD AND GARDENS AND RIPARIAN PLANTINGS.

WATER RECLAMATION

AIR-HANDLER CONDENSATE IS DIVERTED TO THE BIOSWALES.

WATER

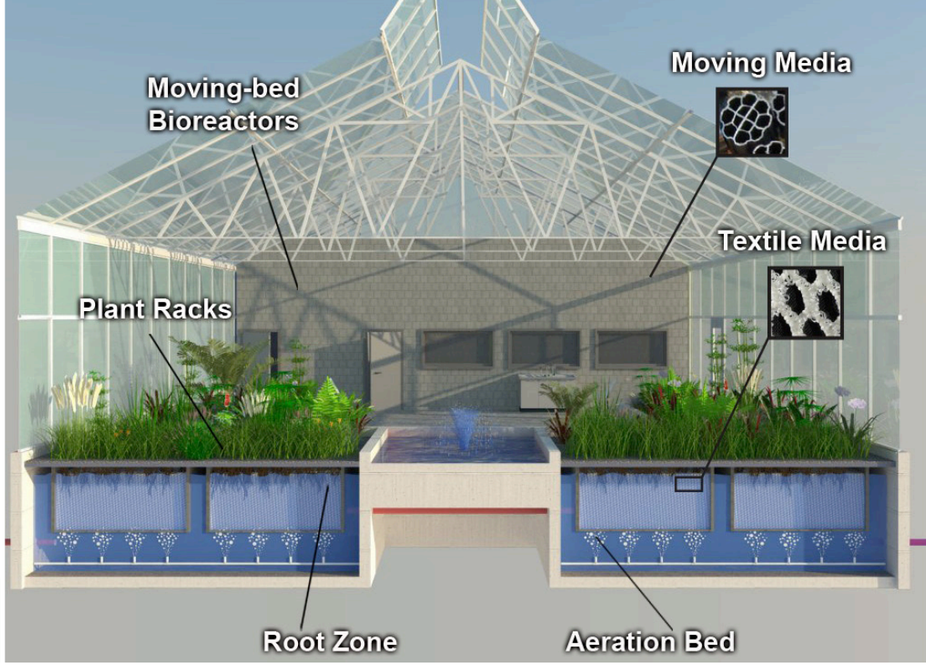
STRATEGIES



WATER

STRATEGIES

INTEGRATED FIXED-FILM HYDROPONIC SYSTEMS



targeted water reduction of
85% to Net Zero

EMORY UNIVERSITY - WATER HUB

WASTE

STRATEGIES

CARBON CONVERSION

DIRECT AIR CARBON CAPTURE FACADE PANELS REMOVE CARBON FROM AIR. CHEMICALLY ALTERED CARBON IS STORED IN TANKS FOR MATERIAL PROCESSING.

CLT STRUCTURE

MASS TIMBER SEQUESTERS CARBON CAPTURED IN TREES.

HARDSCAPE

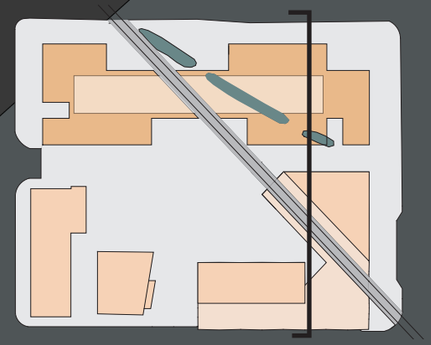
PAVING STONES SEQUESTER CARBON THROUGH MINERAL CARBONATION.

WETLANDS

AQUEOUS PLANTS IN POOLS WILL PROCESS WASTE WATER AND CREATE NUTRIENTS FOR AGRICULTURE.

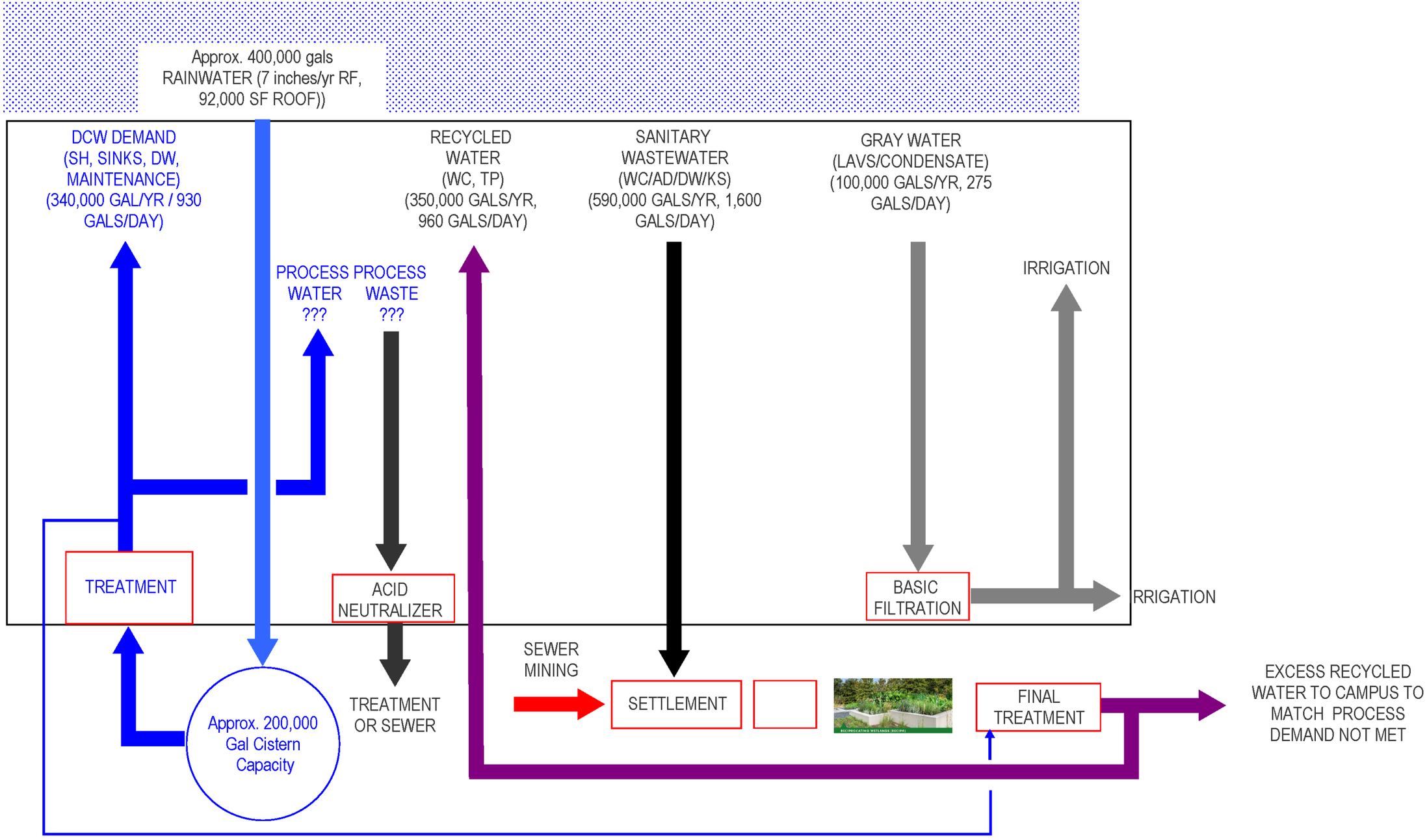
WASTEWATER TREATMENT

SEWAGE/BLACKWATER IS TREATED ON SITE AND USED IN BUILDING AND SITE GREYWATER.



WASTE

STRATEGIES

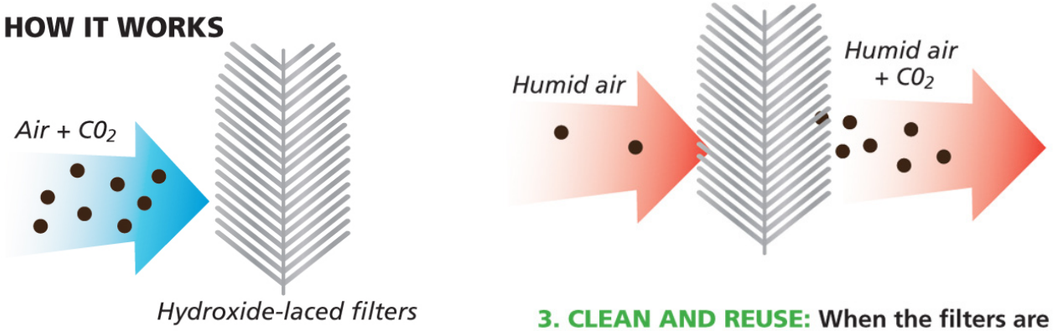


WASTE

STRATEGIES

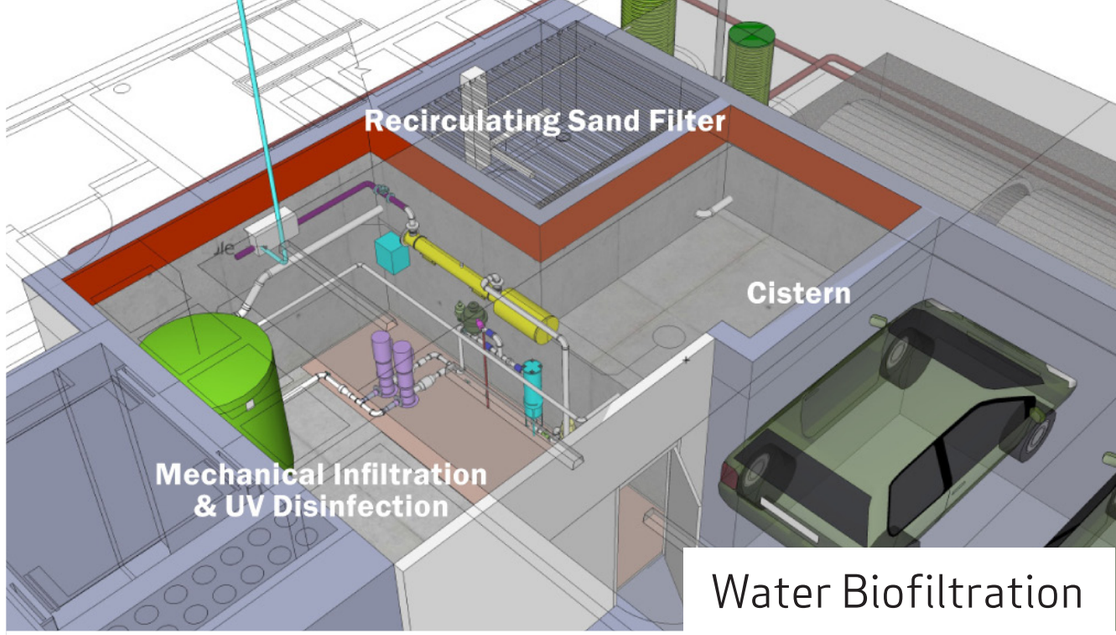
Klaus Lackner

HOW IT WORKS

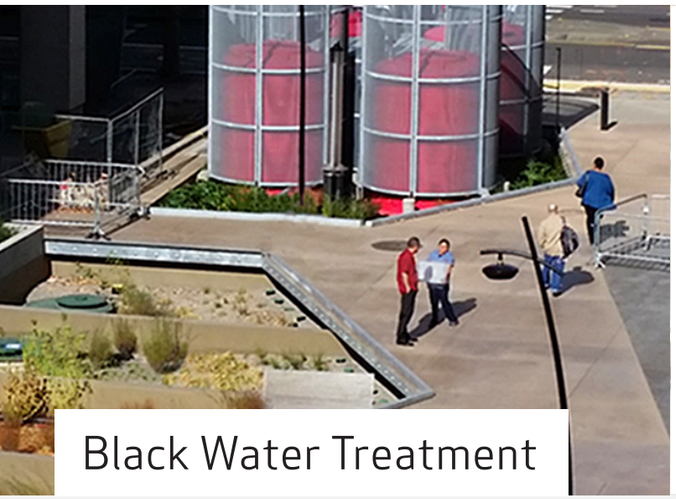


1. TRAP: Wind blows air through plastic filters laced with an absorbing agent that is full of negatively charged hydroxide ions that attract CO2. Through a chemical reaction, the CO2 molecules stick to the hydroxides and form bicarbonate ions.

3. CLEAN AND REUSE: When the filters are saturated with CO2, they are rinsed with moist air, which lowers their affinity for CO2, causing them to release the captured carbon dioxide. The CO2 is compressed into a liquid that can be stored underground or used in industrial processes. The filters are reused to capture more CO2 from the air.

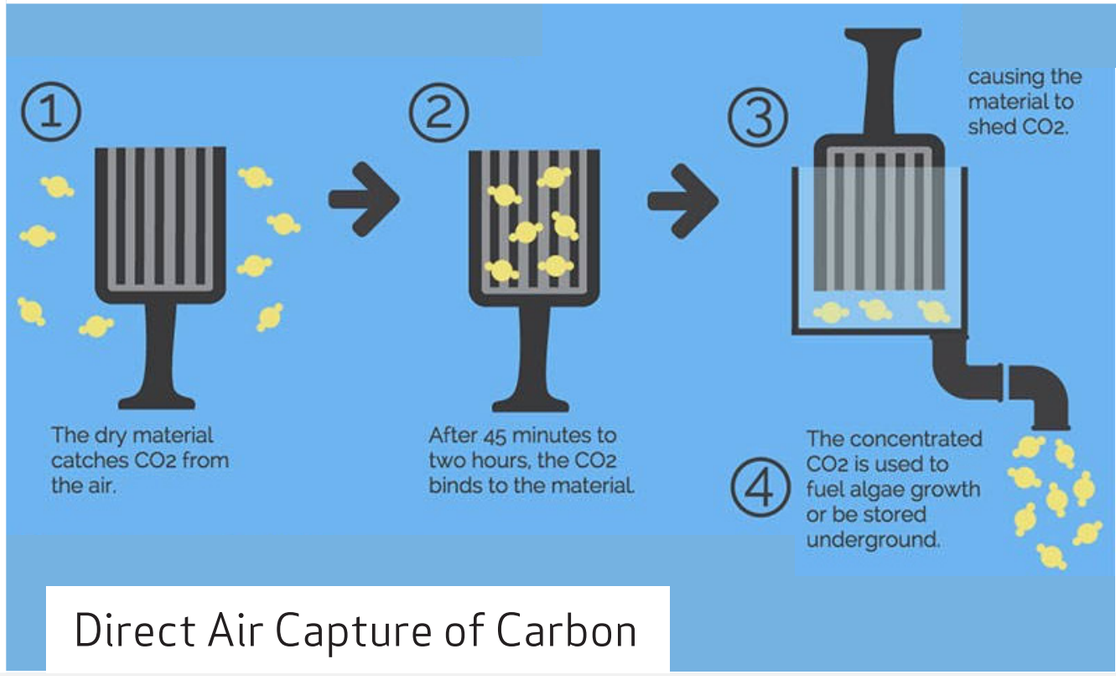


Water Biofiltration



Black Water Treatment

Regenerate Carbon for Soil Nutrients

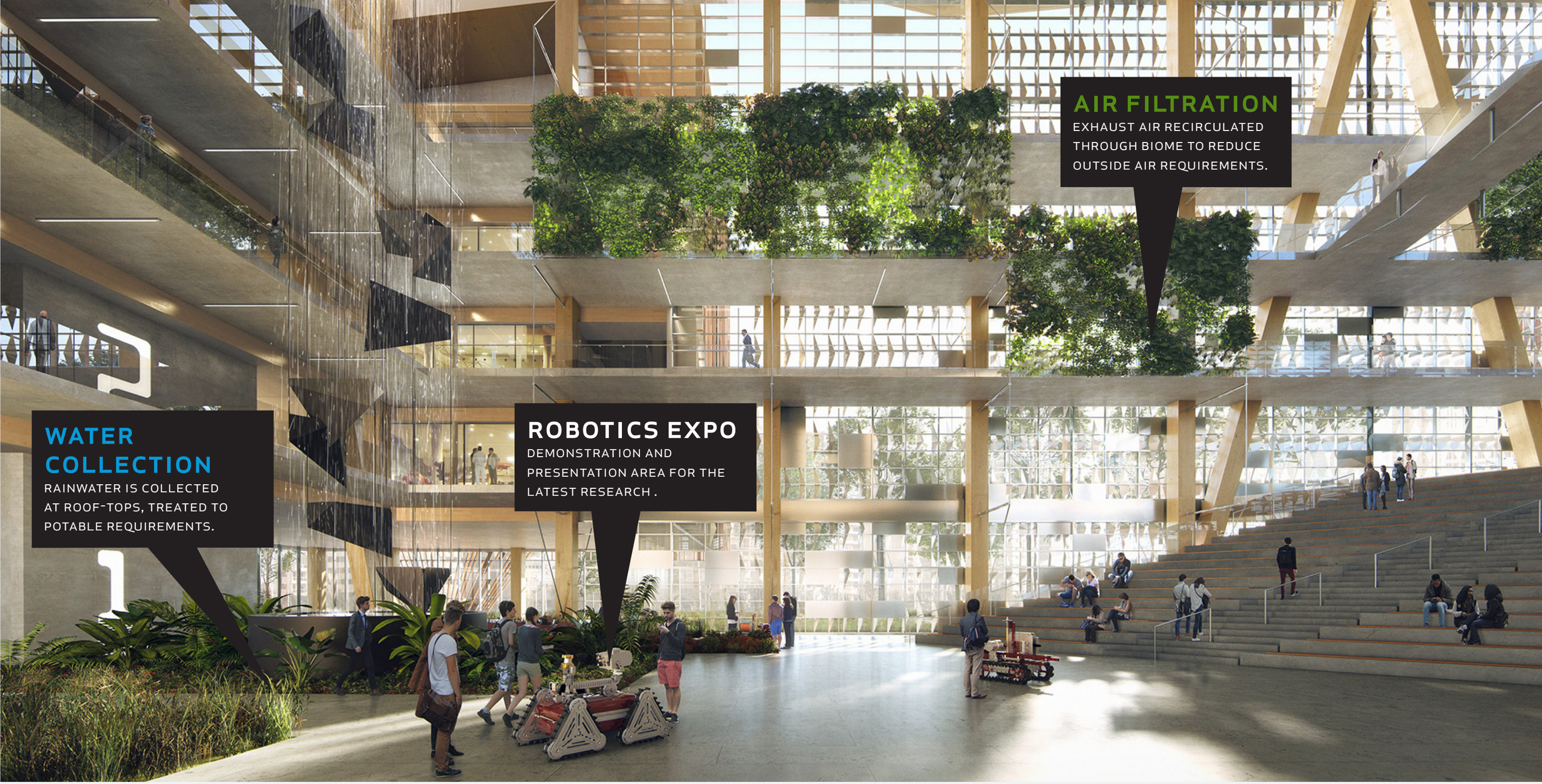


Direct Air Capture of Carbon


SUN SHADING
TERRACOTTA BAGUETTES CHANGE ORIENTATION AND DENSITY TO SHADE EVERY FACADE APPROPRIATE TO SOLAR ORIENTATION.
GREENLINE
BRIDGING CONNECTION TO THE UNIVERSITY ATHLETIC DISTRICT. PLANTED AND SHADED, IT CUTS DIRECTLY THROUGH ISTB-7.


BIOME
PLANTS CLEAN WATER THROUGH HYDROPONIC REACTORS AND CLEAN AIR REDUCING OUTSIDE AIR REQUIREMENTS.
CARBON CAPTURE
DIRECT HARVESTING OF CARBON DIOXIDE. CONVERSION INTO DURABLE FORMS AND SOIL ENRICHMENT.
RECIPROCATING WETLANDS
PROVIDES ALTERNATING ANOXIC AND AEROBIC TREATMENT. TREATMENT SYSTEM APPROPRIATE TO RURAL AND DEVELOPING COUNTRIES.


SOLAR PHOTOVOLTAICS
ROOF TOP PVS ACCOMPLISH THE NET-ZERO ENERGY GOAL THROUGH PASSIVE ENERGY REDUCTION DESIGN MEASURES.
WATER TREATMENT
FINAL DISINFECTION AND ULTRAVIOLET LIGHT TREAMENT TO REMOVE MICRO-ORGANISMS. DISTRIBUTION OF RECLAIMED WATER TO CAMPUS

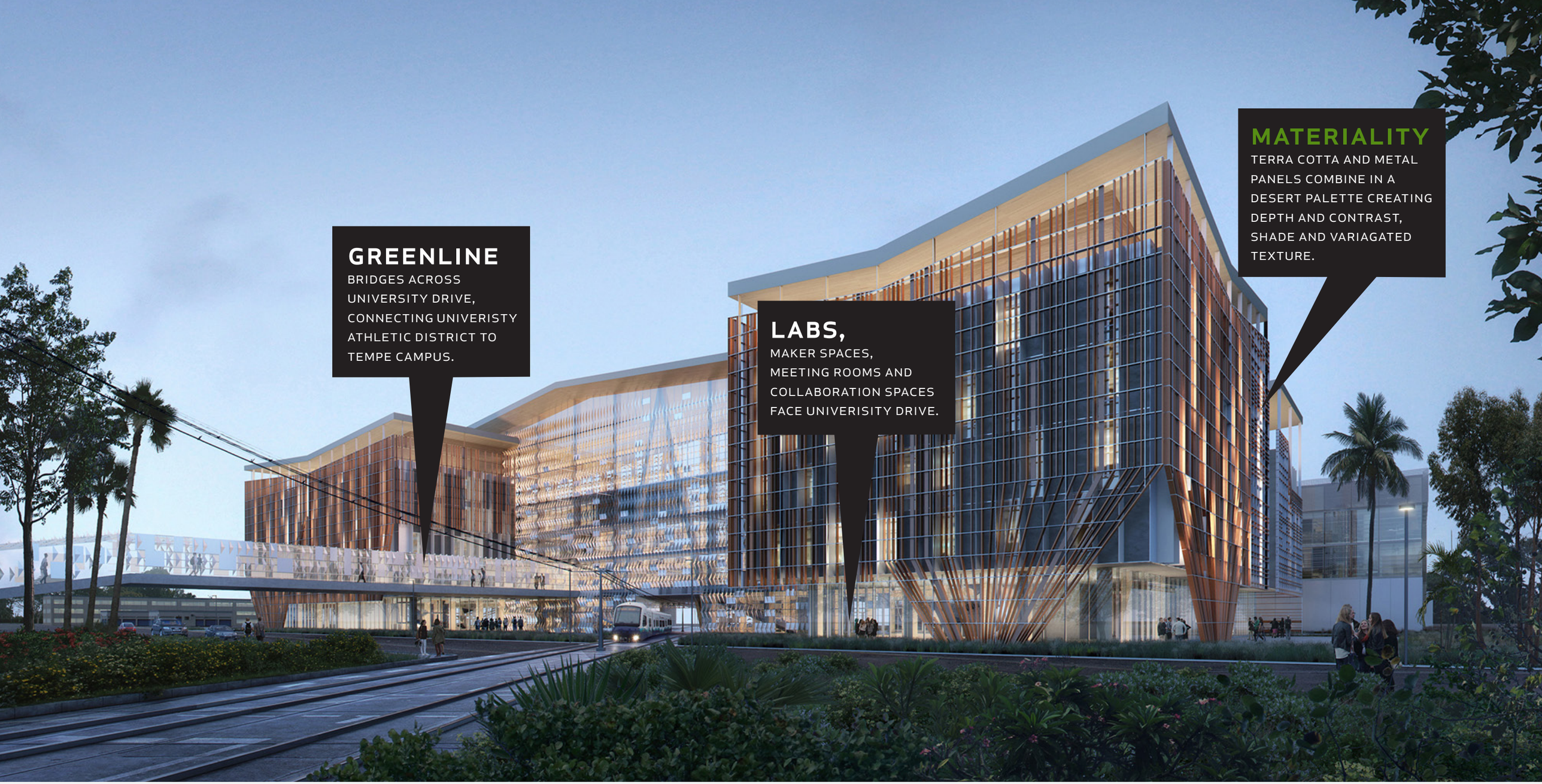

AIR FILTRATION
EXHAUST AIR RECIRCULATED THROUGH BIOME TO REDUCE OUTSIDE AIR REQUIREMENTS.
ROBOTICS EXPO
DEMONSTRATION AND PRESENTATION AREA FOR THE LATEST RESEARCH .
WATER COLLECTION
RAINWATER IS COLLECTED AT ROOF-TOPS, TREATED TO POTABLE REQUIREMENTS.


CANAL
KIRKLAND-MCKINNEY DITCH WILL SURFACE IN THE BIOME AS A STRUCTURED CANAL, AN EDUCATIONAL FEATURE TO EXHIBIT THE HISTORIC USE OF WATER.
HYDROPONIC REACTOR
WATER PROCESSING
FARMING
SOIL ENRICHING CARBON SEQUESTRATION.


DAYLIGHTING
REDUCES OVERHEAD LIGHTING USE BY UTILIZING THE NATURAL AMBIENT LIGHT PRESENT IN THE BIOME.
LIGHT RAIL
EXISTING METRO LIGHT RAIL CUTS DIRECTLY THROUGH ISTB-7 ALLOWING THE PUBLIC TO SEE INTO THE BIOME.
TRANSPARENCY
LABS AND RESEARCH SPACES ARE AMPLY DAYLIT AND VISUALLY CONNECTED TO THE BIOME.


INDOOR | OUTDOOR
THE BIOME SHADES, CLEANS AIR AND WATER, PROVIDING A TEMPERED TRANSITIONAL SPACE BETWEEN INTERIOR AND EXTERIOR.
EVENT SPACE
GATHERING FOR EXPOSITIONS AND PUBLIC LECTURES.
CROSS LAMINATED TIMBER
LOW EMBODIED ENERGY AND CARBON SEQUESTRATION IN MASS TIMBER CONSTRUCTION.


GREENLINE
BRIDGING CONNECTION TO THE UNIVERSITY ATHLETIC DISTRICT 'G' STREET.
LIGHT RAIL
CROSSES THE PLAZA AND UNDER ISTB-7 IN A PROTECTED ENCLOSURE.
BIOSWALE
HARVESTING SURFACE RAINWATER FOR LANDSCAPE.


GREENLINE
BRIDGES ACROSS UNIVERSITY DRIVE, CONNECTING UNIVERISTY ATHLETIC DISTRICT TO TEMPE CAMPUS.
LABS,
MAKER SPACES, MEETING ROOMS AND COLLABORATION SPACES FACE UNIVERISITY DRIVE.
MATERIALITY
TERRA COTTA AND METAL PANELS COMBINE IN A DESERT PALETTE CREATING DEPTH AND CONTRAST, SHADE AND VARIAGATED TEXTURE.

ALTERNATE DESIGN

PERFORATED METAL SKIN

ALTERNATE DESIGN

PERFORATED METAL SKIN

ALTERNATE DESIGN

PERFORATED METAL SKIN

ALTERNATE DESIGN

PERFORATED METAL SKIN

THANK YOU