Introduction

Tucson Electric Power

Watershed Management Group

Tucson Unified School District

Industry Partners
**Climate**

**Introduction**

**Temperature (Degrees)**
- Highest in summer: 110°F
- Difference between high and low: 20°F

**Yearly Rainfall (Inch)**
- Tucson: 13
- US average: 40

**Days of Sun**
- Sunny: 313
- Partly Sunny: 193
- Not Sunny: 91
Sunblock District Energy Loop System
Sunblock District Energy Loop System
Utility Easements
Design goals

- LEARNING ENVIRONMENT
- SUSTAINABILITY
- REPLICABILITY
- RENEWABLE ENERGY
- GREEN BUILDING

SunBlock
Airtightness

Envelope

Retrofit existing air handlers

Ventilation system

Thermal distribution
AeroBarrier works best if applied to areas of 10,000 sqft at a time. This means that Myers Ganoung will require 11 applications across the zones displayed below.

1. Before Application
2. First clear the room of furniture and be sure to cover all apertures that are not being caulked such as windows and powerpoints.
3. Pressurize and humidify the building with a blower door and then set up the nozzles and spray the AEROBARRIER caulking agent into the air for approximately two hours.
4. The caulking agent will change phases from liquid to solid when it comes into contact with the exterior environment at the point of leakage. The Product is capable of sealing holes up to 1/8th in diameter.
5. Depressurize the zone and allow 20 minutes for the remainder of the airborne AEROBARRIER to settle before entering.
6. Remove aperture coverings vacuum interior surfaces.
7. The area is now tightly airsealed and safe for occupation.
HVAC system
Ventilation system
Wall Section

- Existing Brick 4"
- CMU 3"
- Waffle membrane 1"
- Wrb 1"
- Air barrier
- Existing oil based paint on CMU 6" + Aerobarrier
- Mineral wool 2"
- Zeta Thermoplus Clad Fixed
- high performance windows
- Metal Flashing tray
- Grout bed
- Metal window mounting clips
- CLT 3.5"
- New Sheathing 6"
- SIGA Majrex Membrane

Whole Wall R-Value = 20

Air Control Layer
Vapor Control Layer
Water Control Layer
Thermal Control Layer

Vapor Profile
Innovation

Grid Stress
Innovation

System Operation

Day time

Radiates heat to ambient air from roof top

Night time
Myers Ganoun Radiative Cooling System Capacity

1. Fundamental Thermodynamic Principle
   - 1 lb of Water changing 1 degree Fahrenheit = 1 Btu of Energy

2. Cross-sectional area of PV array
   \[
   \text{Area} = \frac{\text{Base} \times \text{Height}}{2} = \frac{6.297 \times 9.92}{2} = 2.895 \text{sqft}
   \]

3. Length of Panels
   \[
   1300 \text{ Panels (6.417' per panel) / 2 per unit = 4,171.05 linear feet}
   \]

4. Total array volume
   \[
   \text{Cross-sectional area x length} = \text{volume}
   2.895 \text{sqft} \times 4,171.05 \text{ft} = 12,075.19 \text{ft}^3
   \]

5. Mass(lbs) of Water
   \[
   1 \text{ft}^3 \text{ of water} = 62.43 \text{lbs}
   12,075.19 \text{ft}^3 \times 62.43 \text{lbs} = 753,854.05 \text{lbs}
   \]

6. Thermal Capacity of system assuming 10 degree Fahrenheit temperature change.
   \[
   \text{Mass of water(lbs) x change in temperature(Fahrenheit) = cooling energy created(btu)}
   753,854.05 \text{lbs} \times 10 \text{F} = 7,538.54 \text{kbtu}
   \]
Design Introduction
Exterior Condition

Architecture
Program:
1. Mechanical room
2. Restroom
3. Gym/recreation area
4. Music room
5. Art room
6. Library
7. Home economics
8. Kitchen/service area
9. Classroom
10. Office/administration area
11. Cafeteria
12. Clothing Bank
13. Child care
14. Quiet Room
Architecture

New build
Comfort & Environmental Quality

Harvard School of Public Health study

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<th>3</th>
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<td>carbon dioxide</td>
<td>1400</td>
<td>950</td>
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<td>cognitive ability</td>
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<td>85%</td>
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Interior Render
Comfort & Environmental Quality

Planters
Energy Performance

Nighttime Radiative Cooling with Water

Solar Panels

Backup Chiller

Inverter

Battery

The Grid

Pump

Water Storage

Coil in AHU

Electricity

Water

Systems Diagram
Total Capacity

500,000 kWh existing + 471,269 kWh added = 971,269 kWh/yr

Energy Performance

PHIUS+ 2018 Space Conditioning Criteria Calculator v2

**Method:** Calculator

**Units:** Imperial (IP)

STATE / PROVINCE: Arizona

CITY: Tucson International Airport

Envelope Area (ft²) / CFM (ft³) = 3.61

CFM (ft³) / person = 95

Space Conditioning Criteria

- Annual Heating Demand: 2.7 kBTU/ft²/yr
- Annual Cooling Demand: 26.6 kBTU/ft²/yr
- Peak Heating Load: 4.4 BTU/hr
- Peak Cooling Load: 7.3 BTU/hr

Cooling & Heating Loads

Site Energy Use Intensity

Cooling & Heating Demand

Energy Performance
School Use

New addition buildings:
- Basketball
- Children’s Care
- Clothing bank
- Donation Center
- Classroom

Outdoor space:
- Playground
- Garden
- Sports

Community Use

New addition buildings:
- Weekend events
- Workshop
- Job fair

Outdoor space:
- Playground
- Dog Park
- Weekend Festival
- Farmer’s Market
- Sports
Resilience

Wooden Superstructure's Carbon Sequestration

- 39,737.87 cubic feet of Douglas Fir.
- Carbon Content Per 1000kg = 519kg
- Carbon Volume = 3.8%
- 308 Ton of Carbon Sequestered.

Equivalent to Carbon dioxide emissions from:

52 homes’ electricity use for 1 year.
35 homes’ energy use for 1 year.

Equivalent to Carbon Sequestered by:

402 Acres of U.S. forest land over a year
5,093 tree seedlings grown for 10 years
Disaster Resilience

POWER OUTAGE DISASTER EVENT

TEMPERATURE (F)

- TEMPERATURE OF EXTERIOR AIR
- EXISTING BUILDING
- RETROFIT AND NEW BUILDING
- BUILDING WITH CONSTANT SUPPLY

Livable temperature limit

SUPPLY OUTAGE POINT

TIME AFTER OUTAGE IN TUCSON SUMMER

DATE: JULY (1-7)
# Cost Breakdown

## Financial Feasibility

### Design
- Site Work:
  - Permitting:
    - Permits: $5,000
    - Impact fees: $2,000
- Contractor fees: $10,000
- Water Collection:
  - Total Cost: $30,000
  - Musical Equipment:
    - Air Handler:
      - $6,000
    - Water Tank:
      - $5,000
- AER-entered:
  - $3,000
- High Performance windows:
  - $500
- Doors for addition:
  - $500
- HVAC:
  - $400
- Air handling Units for addition:
  - $200
- Electrical:
  - $100
- Plumbing and electrical:
  - $70
- Fixtures:
  - $50
- Appliances:
  - $50
  - Stoves:
    - $50
- Kitchen Cabinet:
  - $50
- Oven:
  - $50
- Microwave:
  - $50
- Refrigerator:
  - $50
- Commercial Range hood:
  - $50
- Outdoor furniture:
  - $50
  - Tables:
    - $50
- Gymnasium equipment:
  - $50
- Total:
  - $80,000

## Household Income

### HOUSING INCOME DISTRIBUTION

- Transport, 15%
- Food, 25%
- Housing, 35%
- Utilities, 10%
- Housing, 25%
- Housing, 10%
- Housing, 5%
- Housing, 5%
- Housing, 5%
- Housing, 5%
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- Housing, 5%
- Housing, 5%
Market Potential

Tucson Unified School District Map
Conclusion: Engineering
Conclusion: Innovation

Day time

Radiates heat to ambient air from roof top

Night time
Conclusion: Comfort & Environmental Quality
Conclusion: Operations
Conclusion: Financial Feasibility

HOUSEHOLD INCOME DISTRIBUTION

- Housing, 35%
- Food, 25%
- Transport, 15%
- Saving, 15%
- Utilities, 10%