How Rigorous Planning and Effective Design Help Hit Ultra-Low Energy Goals

Getting to Zero National Forum
April 18, 2018

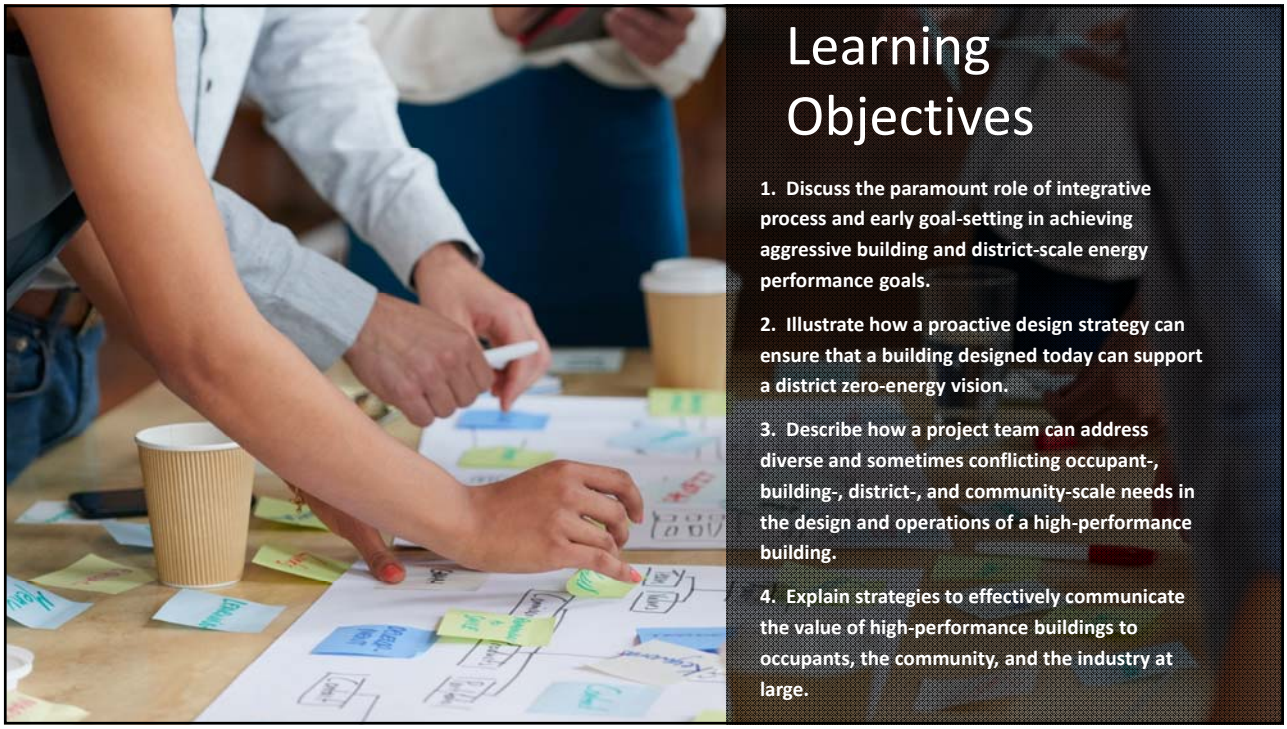
WU2

Agenda

1. Introduction & City Leadership
2. Living Building Challenge (LBC): A Case Study – Arch | Nexus
3. City District Design - MKK
4. Public Building Design Impacts - Stantec
5. Occupant Productivity and Lessons Learned – City of Fort Collins
6. LBC Process and Results, Occupant Behavior, and Water Independence– Arch | Nexus
7. Final Q & A – Presentation Team

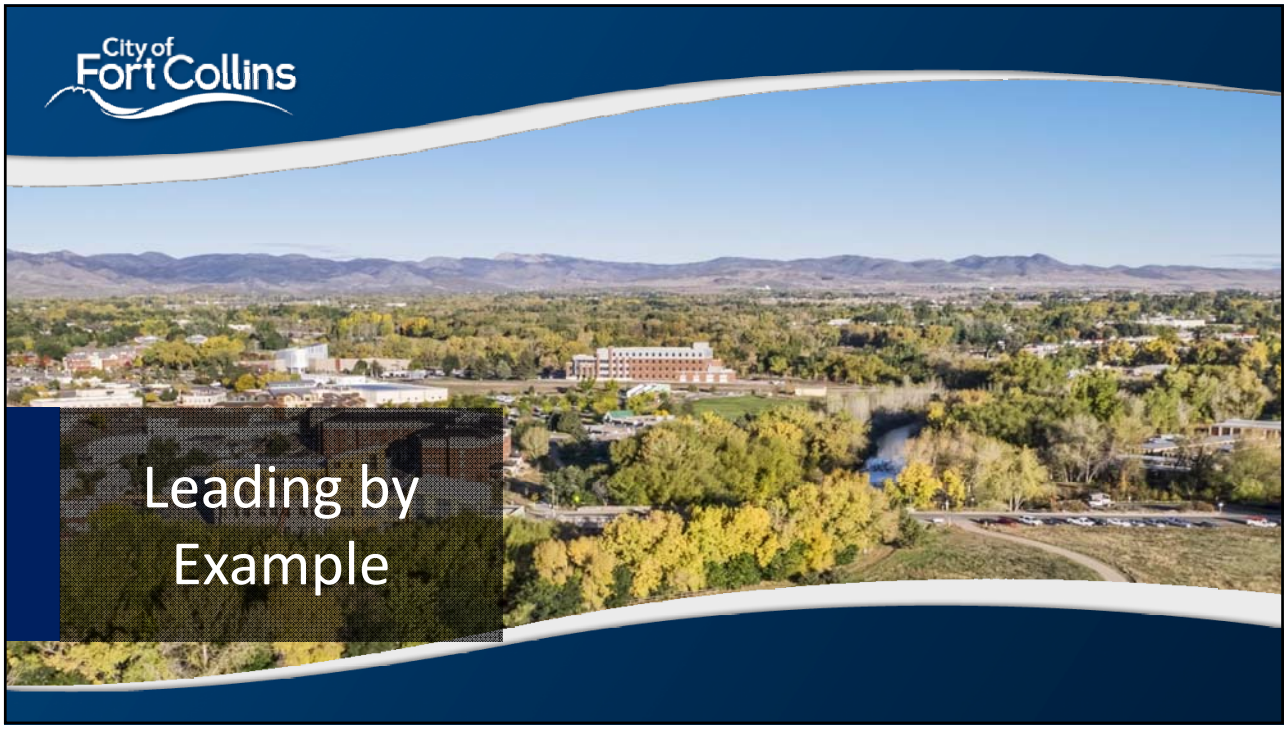
Slide 2

WU2 Windows User, 4/5/2018

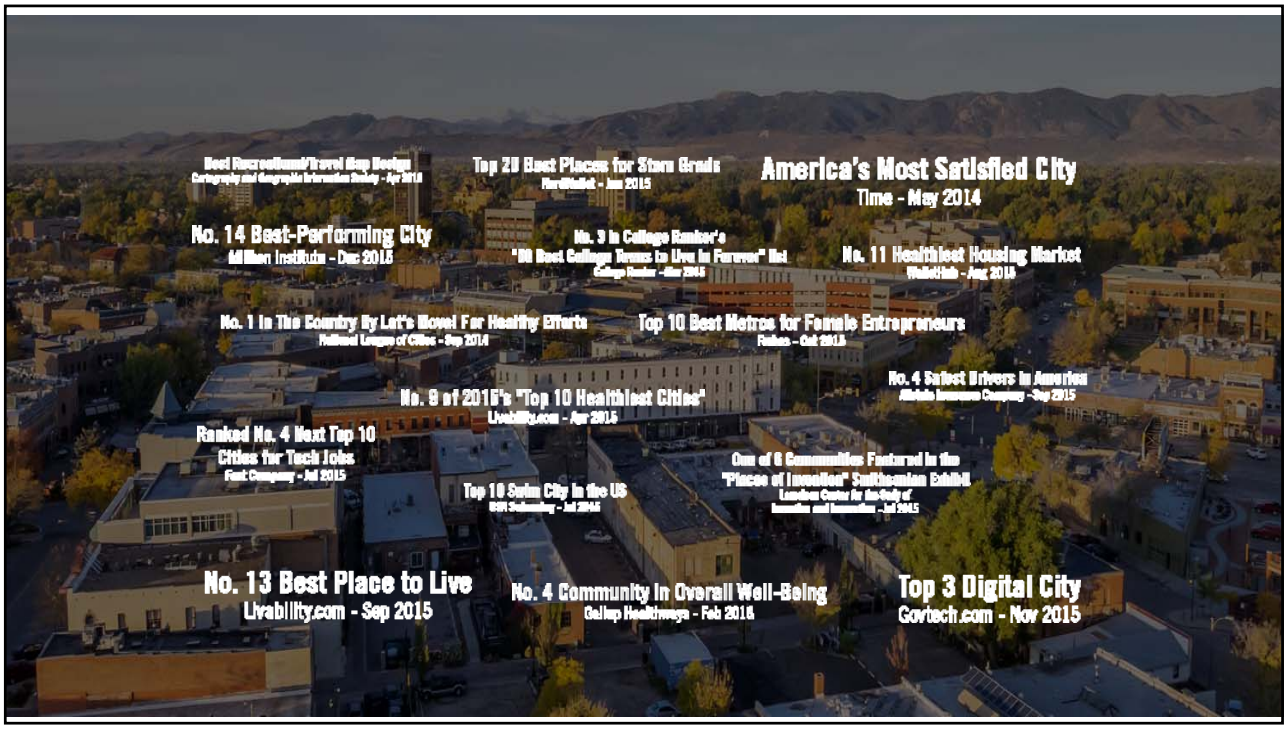


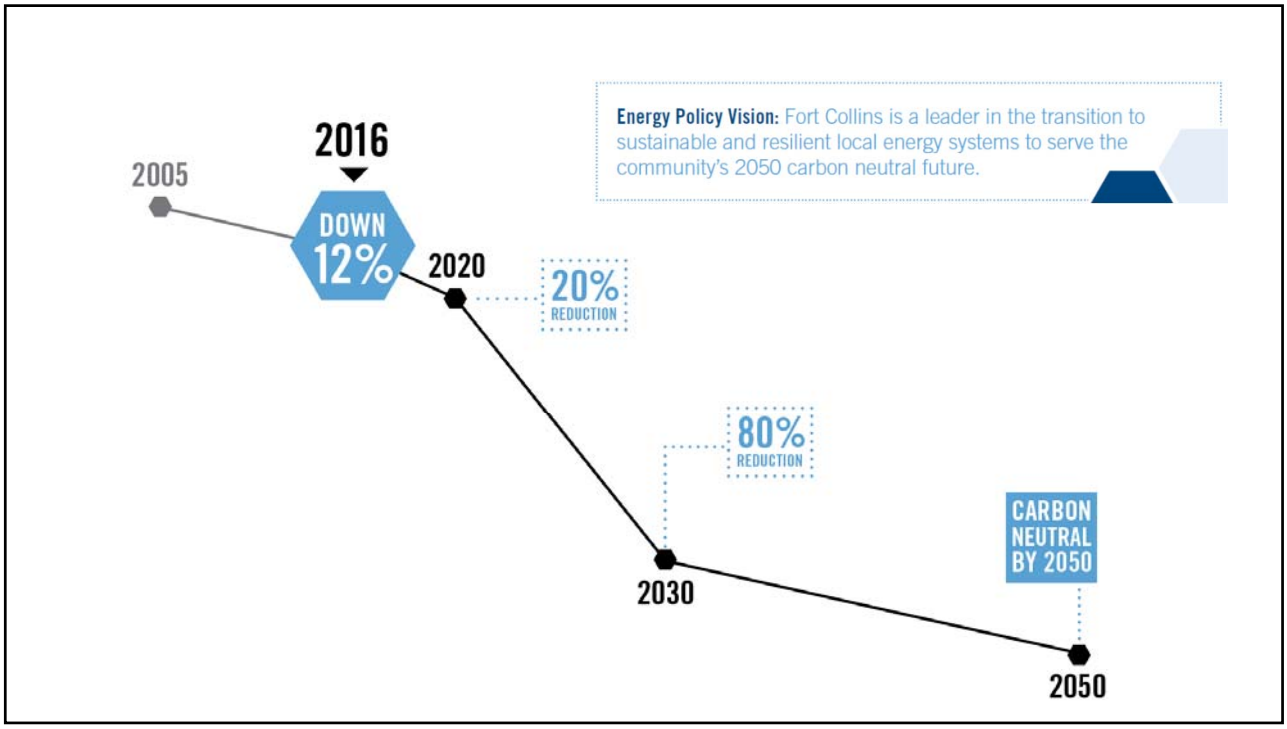
Learning Objectives

1. Discuss the paramount role of integrative process and early goal-setting in achieving aggressive building and district-scale energy performance goals.
2. Illustrate how a proactive design strategy can ensure that a building designed today can support a district zero-energy vision.
3. Describe how a project team can address diverse and sometimes conflicting occupant-, building-, district-, and community-scale needs in the design and operations of a high-performance building.
4. Explain strategies to effectively communicate the value of high-performance buildings to occupants, the community, and the industry at large.



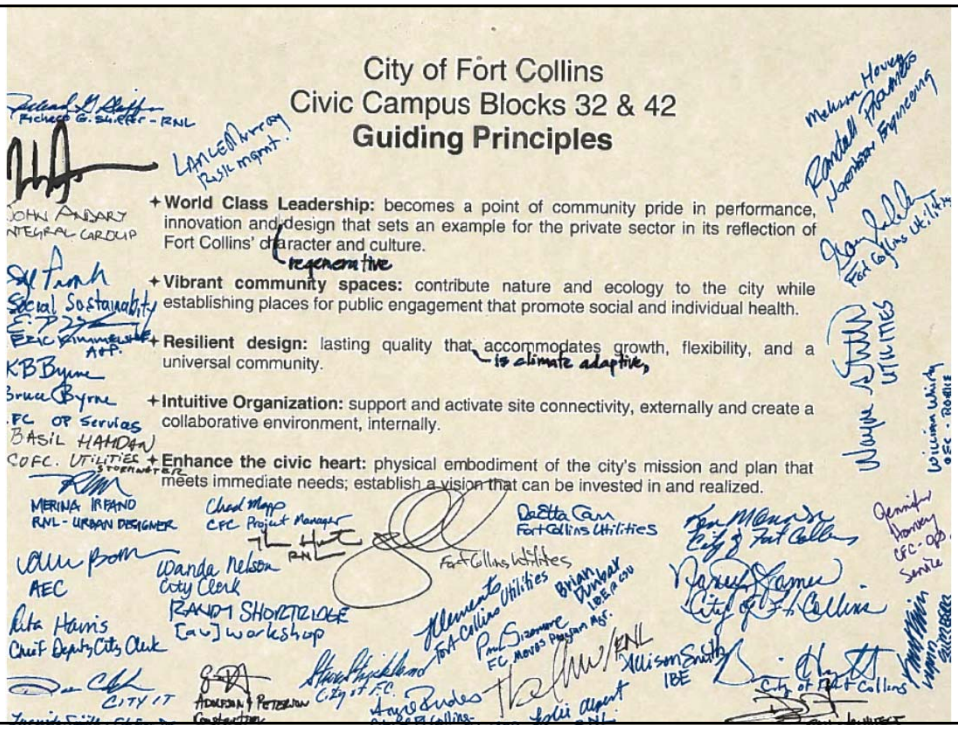
Leading by Example


Top 20 Best Places for Stem Grads
America's Most Satisfied City
Time - May 2014
No. 14 Best-Performing City
No. 3 in College Ranker's
No. 11 Healthiest Housing Market
No. 1 In The Country By Let's Move! For Healthy Efforts
Top 10 Best Metros for Female Entrepreneurs
No. 4 Safest Drivers in America
No. 9 of 2015's "Top 10 Healthiest Cities"
Ranked No. 4 Next Top 10
Cities for Tech Jobs
Top 10 Swim City in the US
No. 13 Best Place to Live
Livability.com - Sep 2015
No. 4 Community in Overall Well-Being
Gallup Healthways - Feb 2016
Top 3 Digital City
Govtech.com - Nov 2015


Energy Policy Vision: Fort Collins is a leader in the transition to sustainable and resilient local energy systems to serve the community's 2050 carbon neutral future.
2005
2016
DOWN 12%
2020
20% REDUCTION
80% REDUCTION
2030
CARBON NEUTRAL BY 2050
2050

This Design Development Energy Report (DDER) is a tool to assist the design team in making decisions to improve the energy performance of the Utility Administration Building design. As a participant in Fort Collins Utilities Integrated Design Assistance Program (IDAP), a goal of the project is to achieve a Target EUI (Energy Use Intensity) of 32.9 kBtu/SF/year, a 60% energy reduction below the regional median EUI of 82.3 for office buildings. At least 40% of this reduction must come from efficiency and the remaining 20% reduction can come from renewables. This goal aligns the project design with the Architecture 2030 Challenge. In addition, the project team has set a stretch goal of achieving an Energy Use Intensity of 20 kBtu/SF/year.

The project team intends to achieve a rating of 100 through EPA's ENERGY STAR program and to certify the building. In accordance with a goal of attaining a Platinum rating through LEED for New Construction version 4, the project is targeting a minimum of 15 points for Optimize Energy Efficiency and 3 points for Renewable Energy Production.



City of Fort Collins
Civic Campus Blocks 32 & 42
Guiding Principles

+ **World Class Leadership:** becomes a point of community pride in performance, innovation and design that sets an example for the private sector in its reflection of Fort Collins' character and culture.
regenerative
+ **Vibrant community spaces:** contribute nature and ecology to the city while establishing places for public engagement that promote social and individual health.
+ **Resilient design:** lasting quality that accommodates growth, flexibility, and a universal community.
is climate adaptive,
+ **Intuitive Organization:** support and activate site connectivity, externally and create a collaborative environment, internally.
+ **Enhance the civic heart:** physical embodiment of the city's mission and plan that meets immediate needs; establish a vision that can be invested in and realized.

DESIGNED FOR
RESOURCE CONSERVATION

DESIGNED FOR
COMFORT

DESIGNED FOR
CHARACTER

DESIGNED FOR
EFFICIENCY AND SUSTAINABILITY

DESIGNED FOR
STEWARDSHIP

DESIGNED FOR
CONNECTIVITY

ARCH | NEXUS

ARCH | NEXUS SAC

LEED v4 Platinum Certified 4/20/17
LEED v4 Existing Buildings - Submitted
Living Building Challenge - Submitted
SEED Certification - Submitted
Energy Star Certification - Submitted
WELL - Registered

Reveal Label
JUST Certified Employee-Owned Company

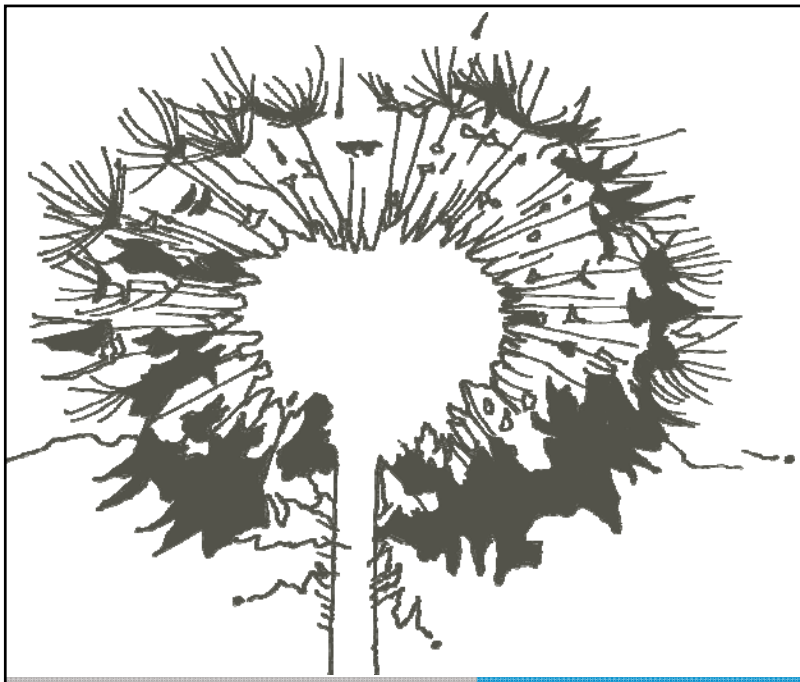
ENR Best Green Project of the Year 2017

INSPIRATION

REGENERATION

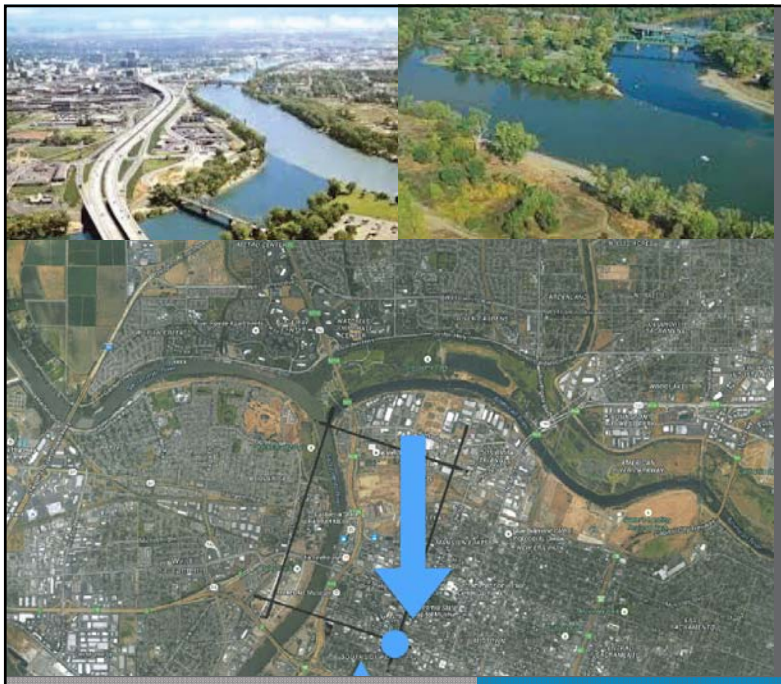
STEWARDSHIP

NBI Getting to Zero National Forum 2018
How Rigorous Planning and Effective Design Help Hit Ultra-Low Energy Goals



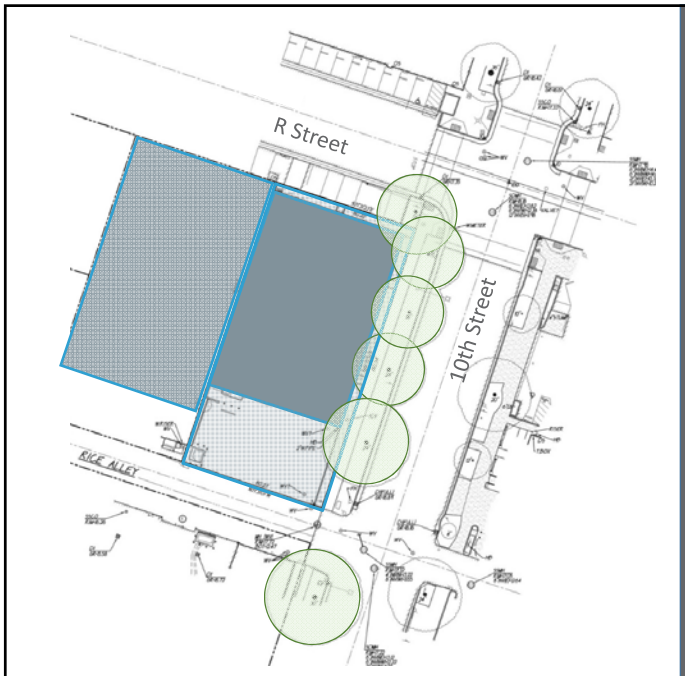
LBC PETALS

PLACE	1
ENERGY	2
WATER	3
HEALTH + HAPPINESS	4
MATERIALS	5
EQUITY	6
BEAUTY	7



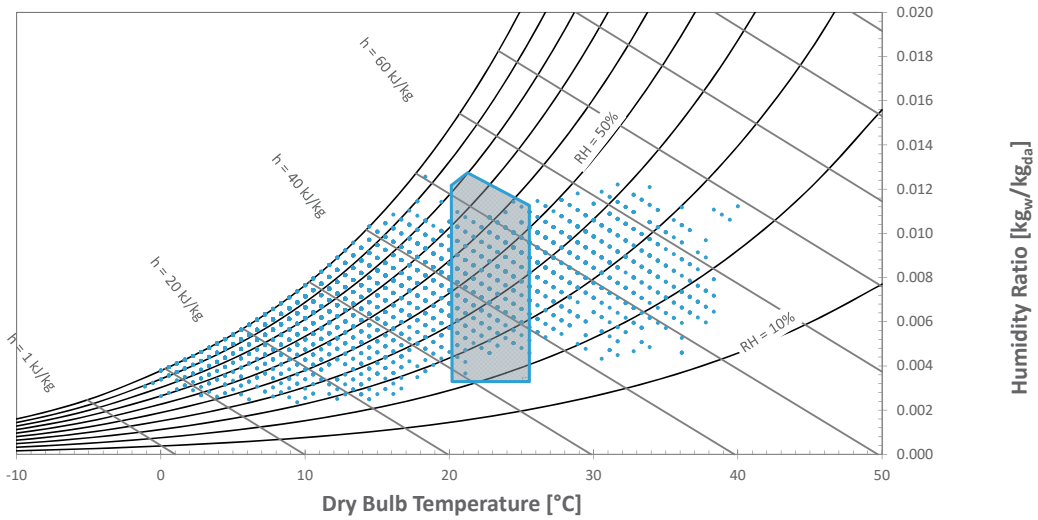
SITE CONTEXT

- Nature
- History
- Culture

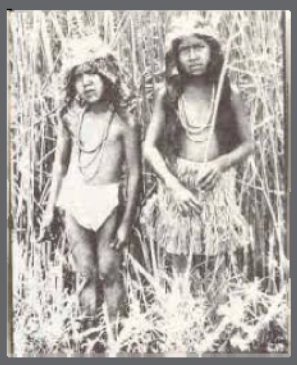


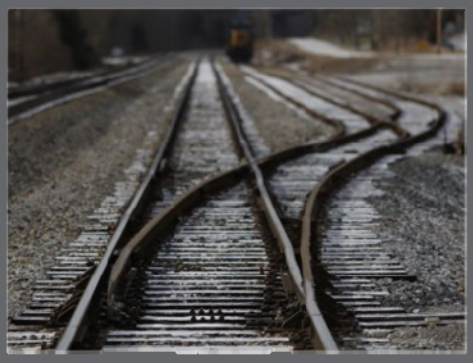
SOLAR ACCESS

CLIMATE



OCCUPANT BEHAVIOR





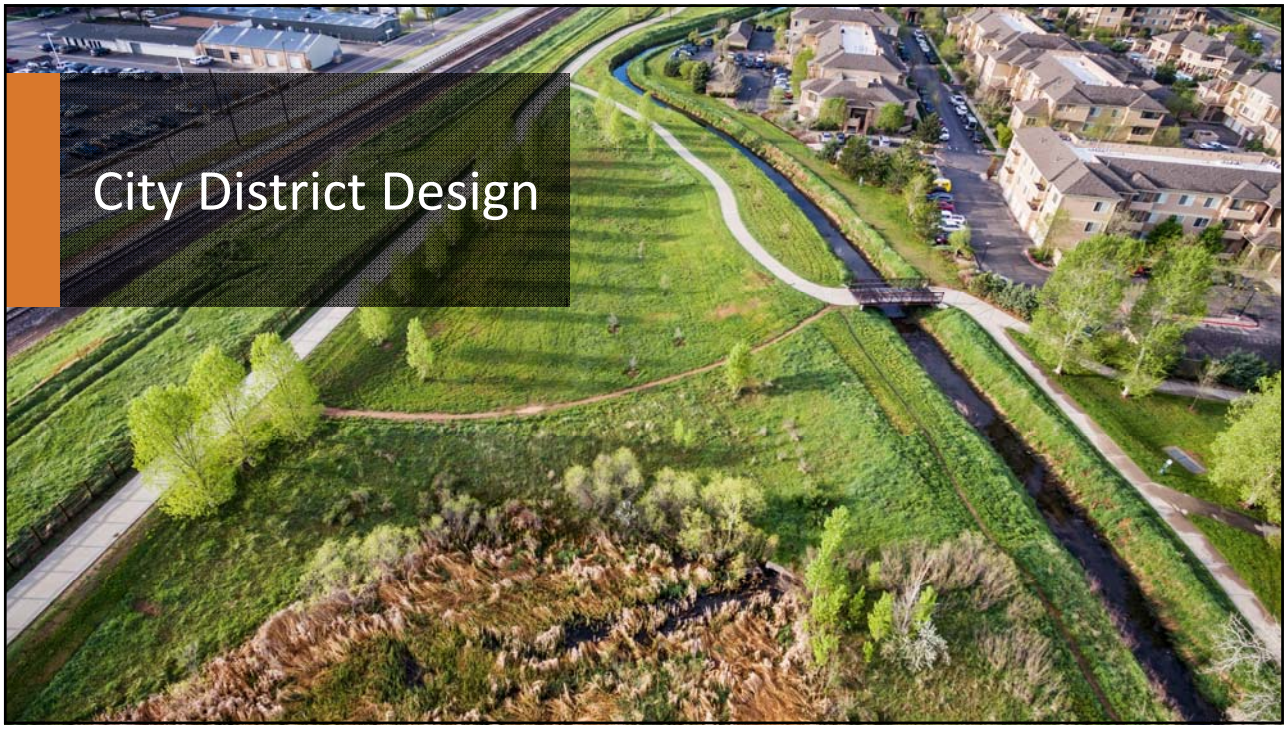
PROJECT REQUIREMENTS

Space Types
- Office, Conference, Storage, Restroom (Locker/Shower), Breakroom, Mechanical Room, Print Area, Housekeeping, Recycling, Server Room, Bike Storage

- Schedules
  - 8-5 M-F
- Site Design
  - Existing Trees, Adjacent Buildings
- Budget
  - $300/SF for Good Quality Commercial Construction
  - $150/SF for LBC
- Energy Code Min/Max
  - Do they really matter?

Goal: 30 kBtu/SF/yr


Brainstorm and Report
15:00
Stop
MakeAGIF.com


City District Design

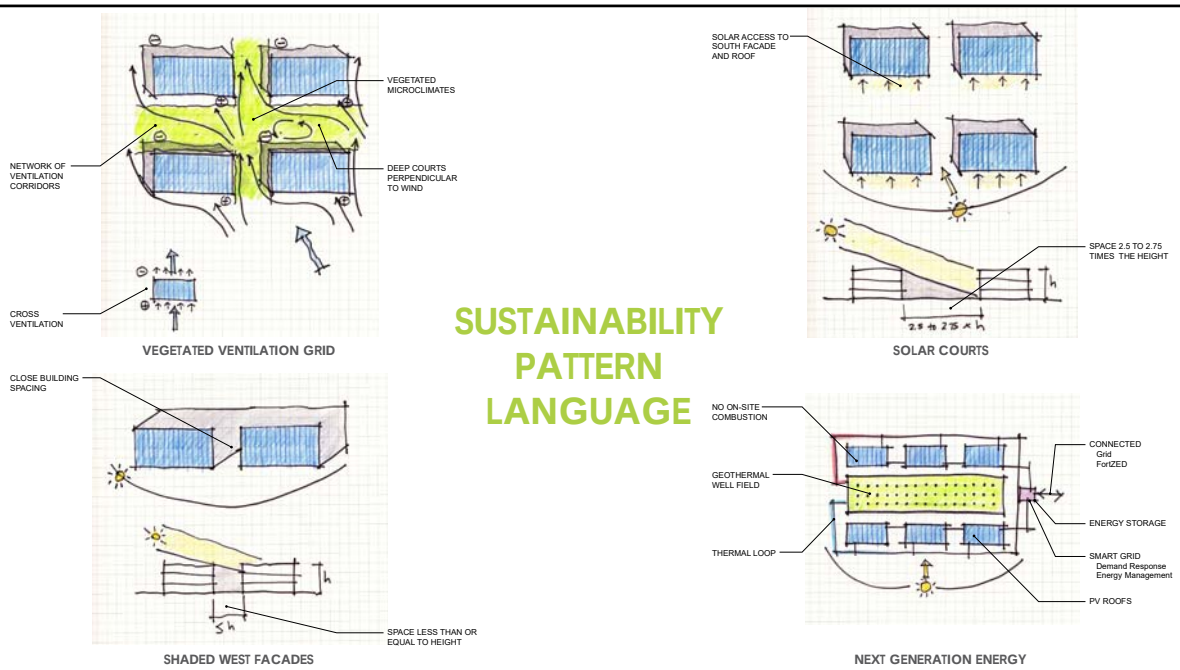

MAPLE STREET
FUTURE PARKING STRUCTURE
CITY/PRIVATE FUTURE DEV.
HOWES STREET
CITY/PRIVATE FUTURE DEV.
PARKING AND RETAIL
MASON STREET
WEST WING
CITY HALL
EAST WING
REPURPOSED OLD CITY HALL
ECO-EDUCATION
215 N. MASON
OPS SERVICES
UTILITY ADMINISTRATION BUILDING
LAPORTE AVENUE

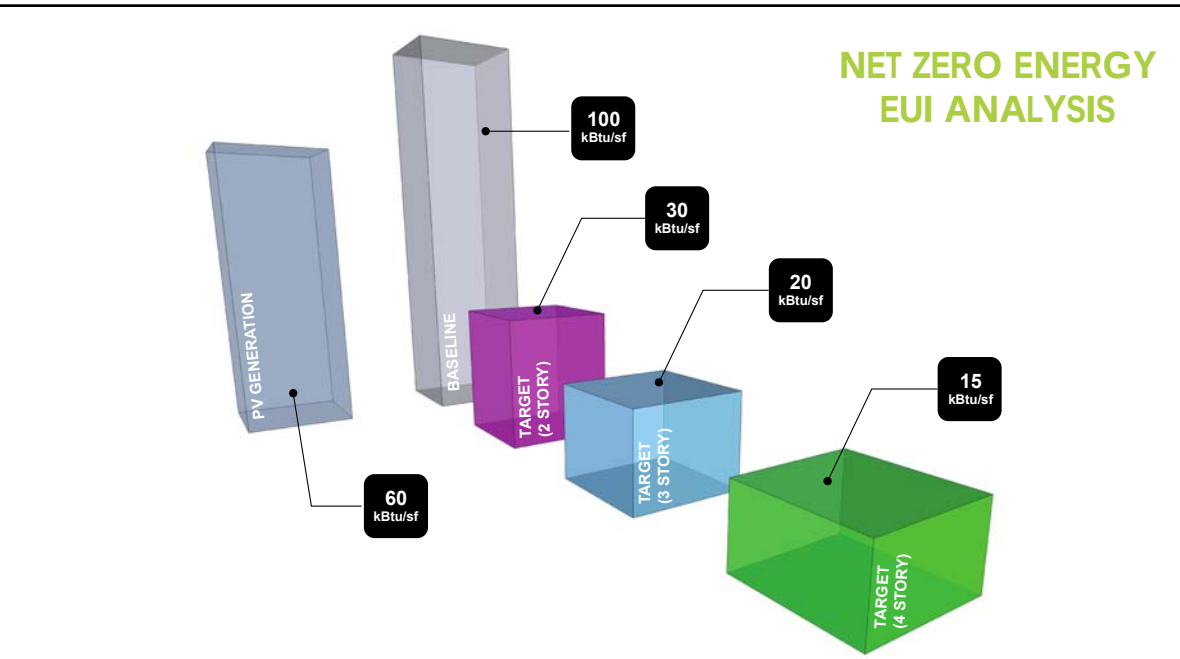

Low Energy Architecture


Integrated Process

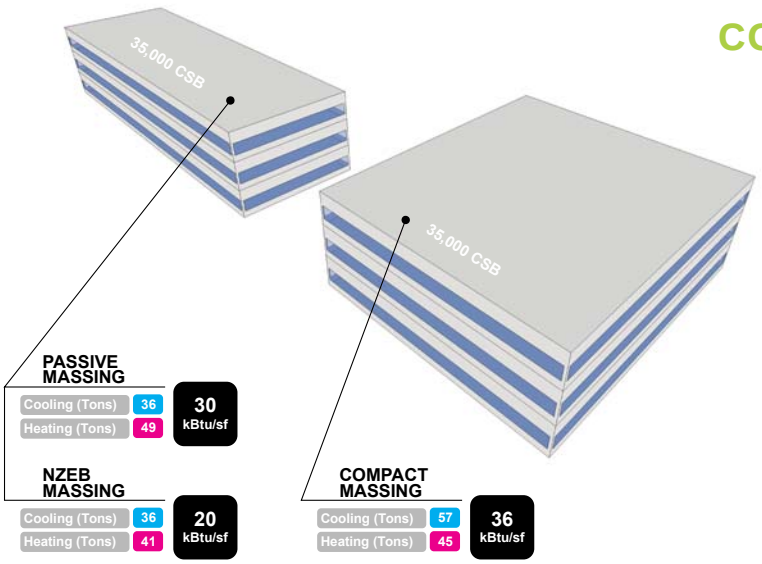

Energy Driven Planning

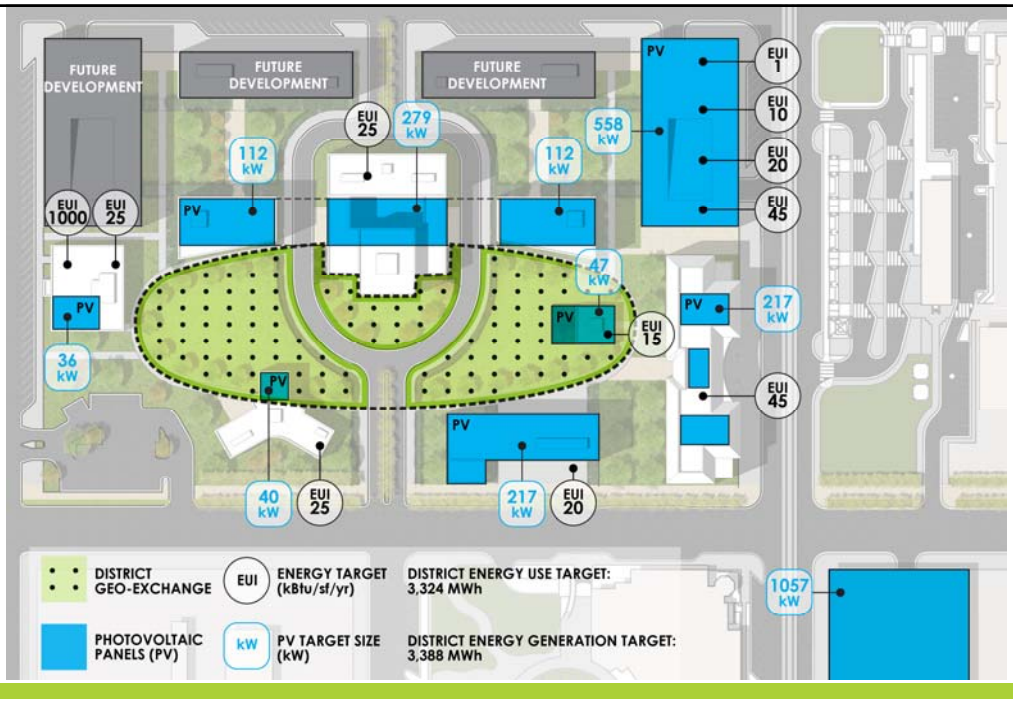

On-Site Renewable Energy

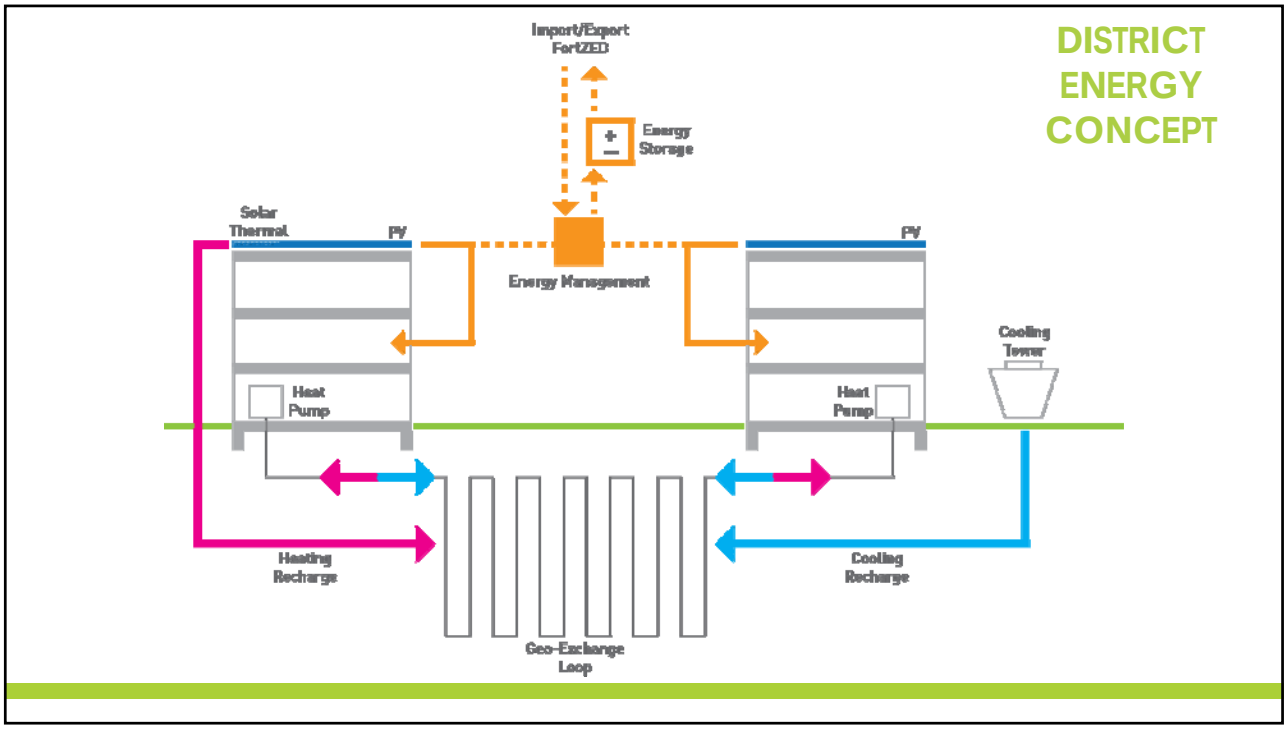

SUSTAINABILITY PATTERN LANGUAGE
VEGETATED MICROCLIMATES
NETWORK OF VENTILATION CORRIDORS
DEEP COURTS PERPENDICULAR TO WIND
CROSS VENTILATION
VEGETATED VENTILATION GRID
SOLAR ACCESS TO SOUTH FACADE AND ROOF
SPACE 2.5 TO 2.75 TIMES THE HEIGHT
SOLAR COURTS
CLOSE BUILDING SPACING
SPACE LESS THAN OR EQUAL TO HEIGHT
SHADED WEST FACADES
NO ON-SITE COMBUSTION
GEOTHERMAL WELL FIELD
THERMAL LOOP
CONNECTED Grid ForZED
ENERGY STORAGE
SMART GRID Demand Response Energy Management
PV ROOFS
NEXT GENERATION ENERGY

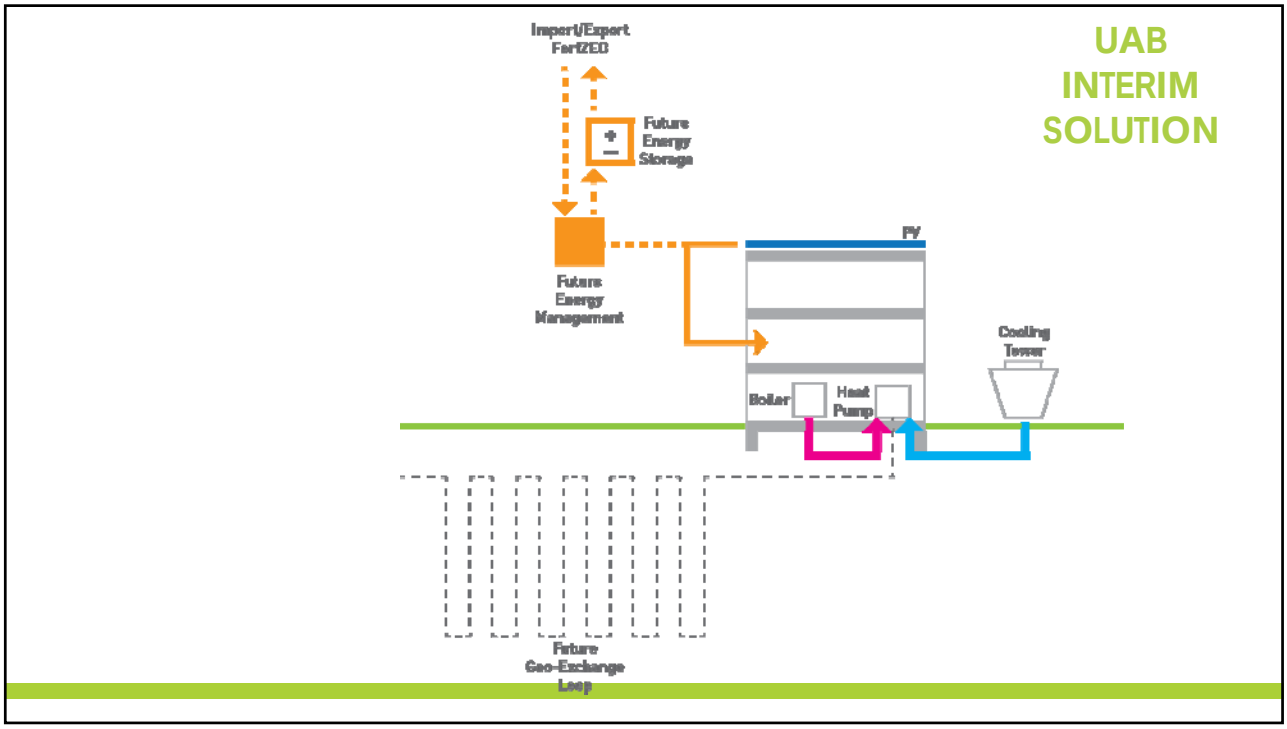

NET ZERO ENERGY EUI ANALYSIS
PV GENERATION
BASELINE
TARGET (2 STORY)
TARGET (3 STORY)
TARGET (4 STORY)
100 kBtu/sf
30 kBtu/sf
20 kBtu/sf
15 kBtu/sf
60 kBtu/sf

MASSING ENERGY COMPARISON

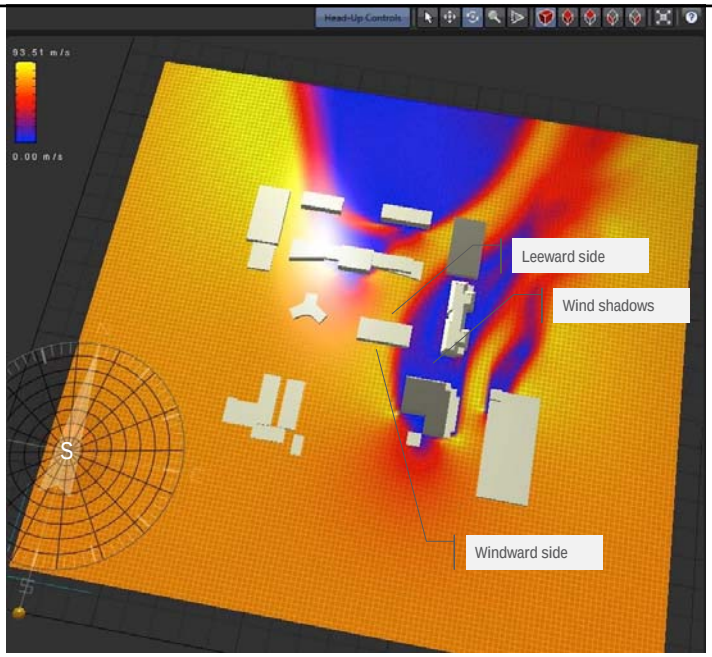




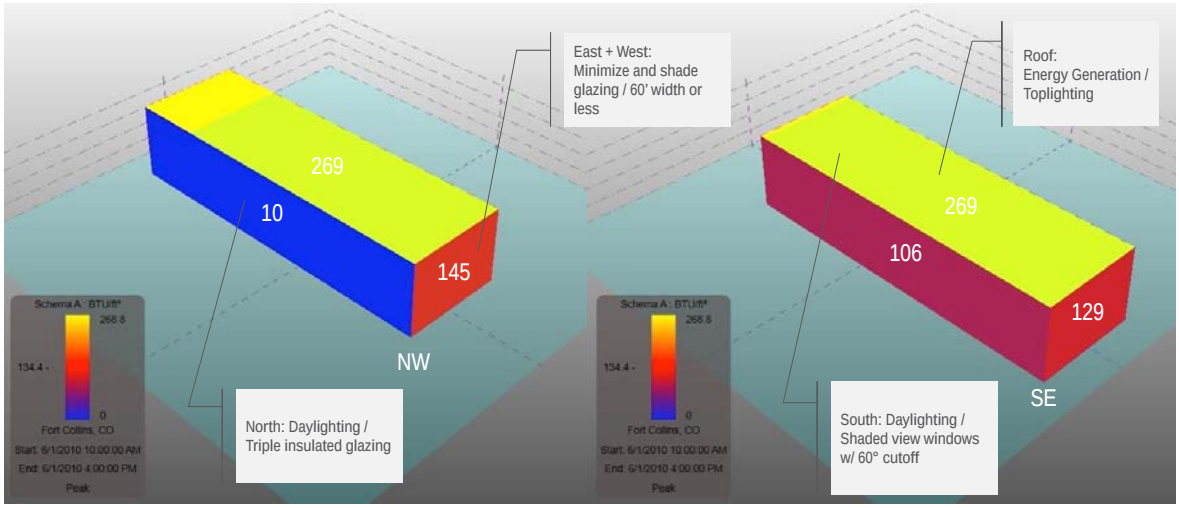

DISTRICT ENERGY CONCEPT
Import/Export FortZED
Energy Storage
Solar Thermal
PV
Energy Management
PV
Cooling Tower
Heat Pump
Heat Pump
Heating Recharge
Cooling Recharge
Geo-Exchange Loop

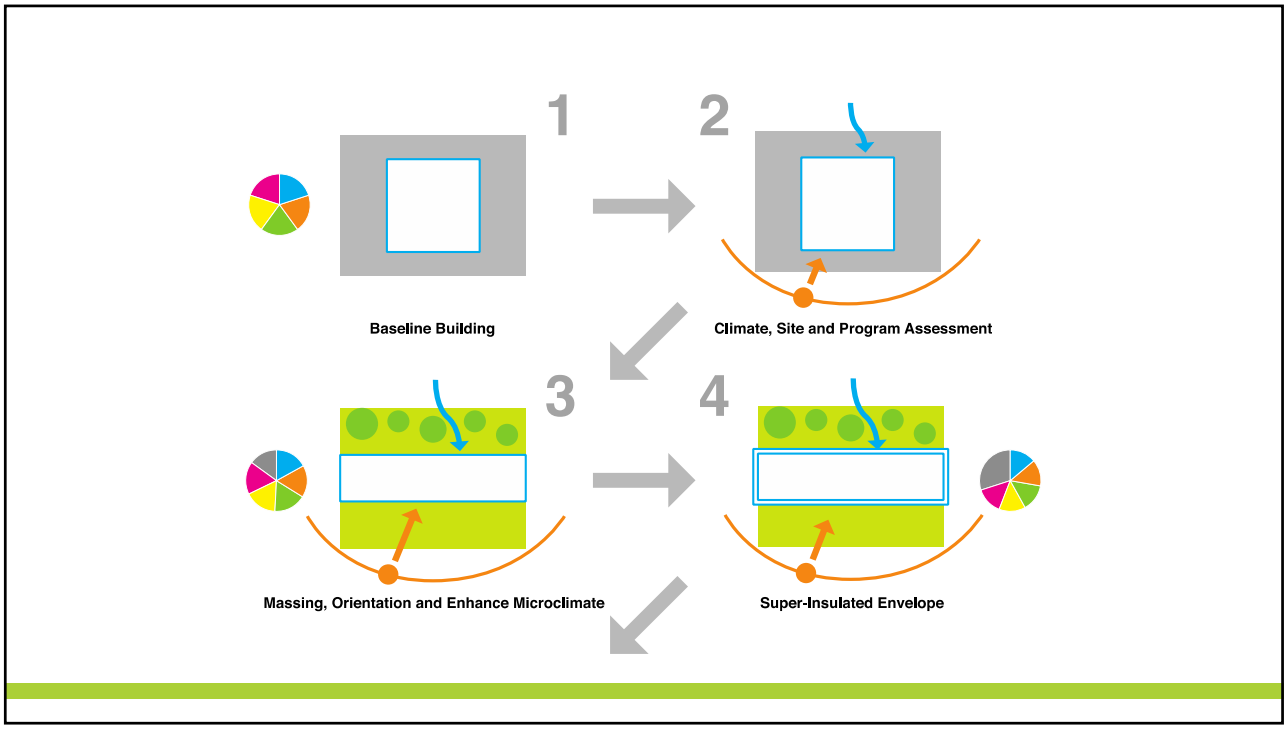

UAB INTERIM SOLUTION
Import/Export FortZED
Future Energy Storage
Future Energy Management
PV
Cooling Tower
Boiler
Heat Pump
Future Geo-Exchange Loop

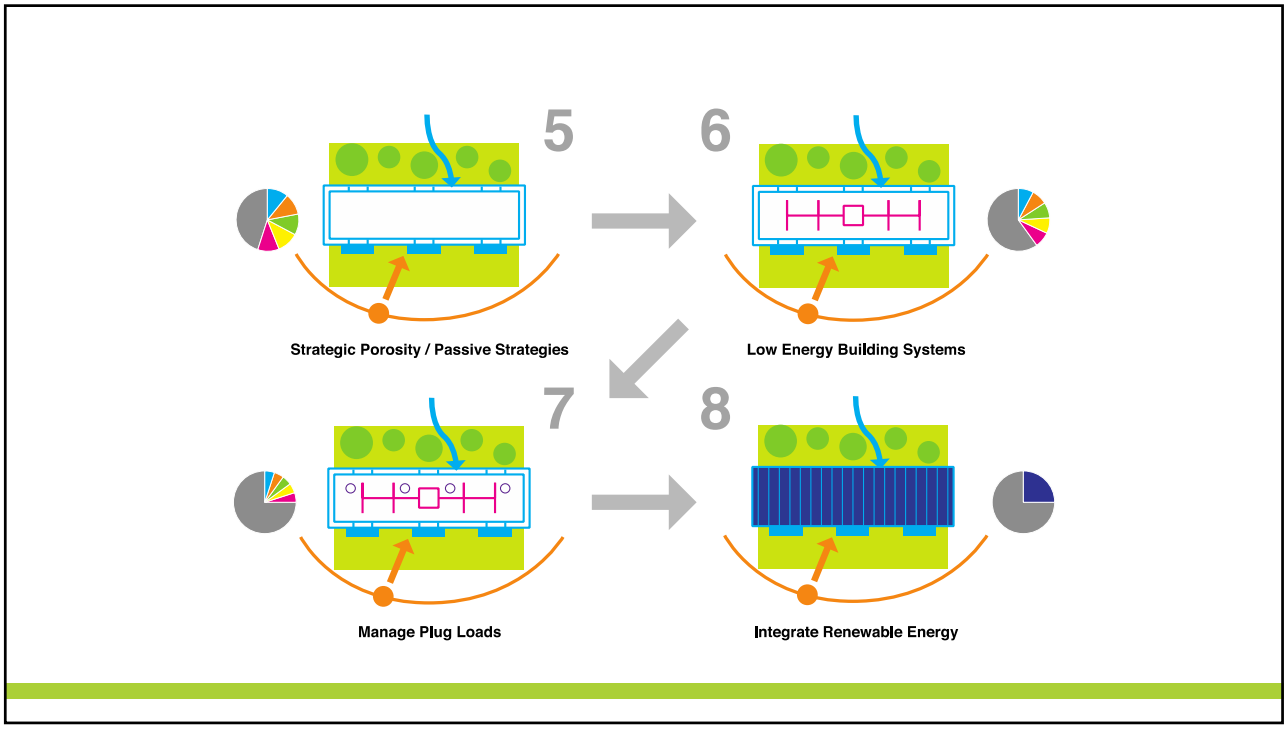
WIND ANALYSIS



SOLAR ANALYSIS




1
Baseline Building
2
Climate, Site and Program Assessment
3
Massing, Orientation and Enhance Microclimate
4
Super-Insulated Envelope

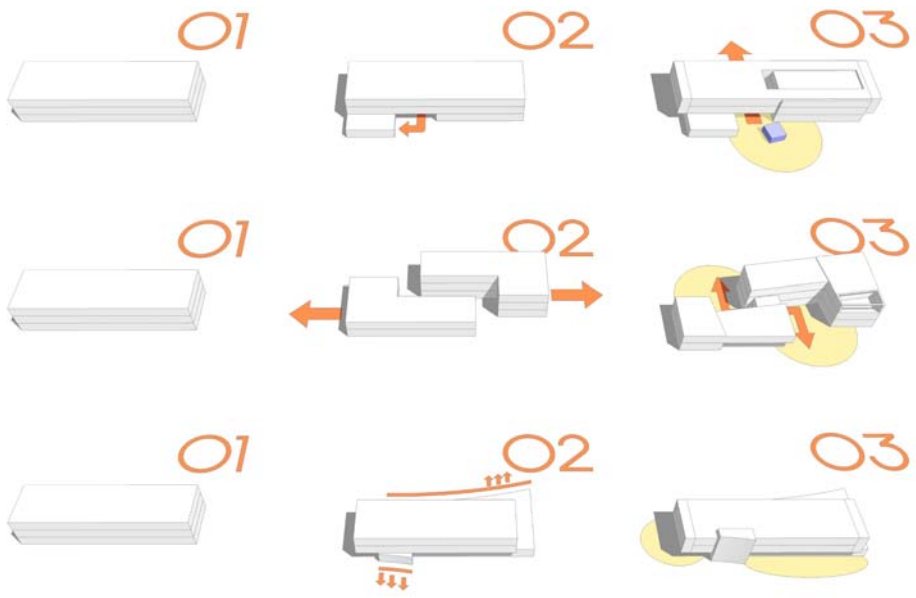

5
Strategic Porosity / Passive Strategies
6
Low Energy Building Systems
7
Manage Plug Loads
8
Integrate Renewable Energy

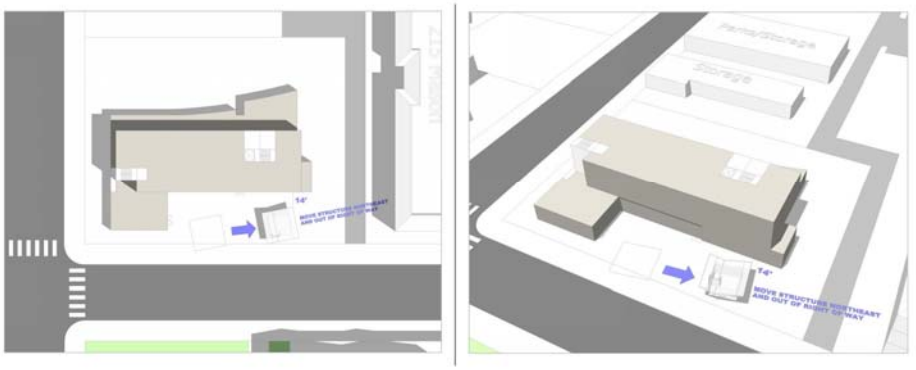
Guiding Principles

Block 32/42 - Civic Center
Vision Plan

- ***World Class Leadership:*** becomes a point of community pride in performance, innovation, and regenerative design that sets an example for the private sector in its reflection of Fort Collins' character and culture.
- ***Vibrant Community Spaces:*** contribute nature and ecology to the city while establishing places for public engagement that promote social and individual health.
- ***Resilient Design:*** lasting quality that is climate adaptive, accommodates growth, flexibility, and a universal community.
- ***Intuitive Organization:*** support and activate site connectivity externally and create a collaborative environment internally.
- ***Enhance the Civic Heart:*** physical embodiment of the city's mission and plan that meets immediate needs; establish a vision that can be invested in and realized.

Final Illustrative Plan


01
02
03
01
02
03
01
02
03


14'
MOVE STRUCTURE NORTHEAST AND OUT OF RIGHT OF WAY
14'
MOVE STRUCTURE NORTHEAST AND OUT OF RIGHT OF WAY


CooperSmith

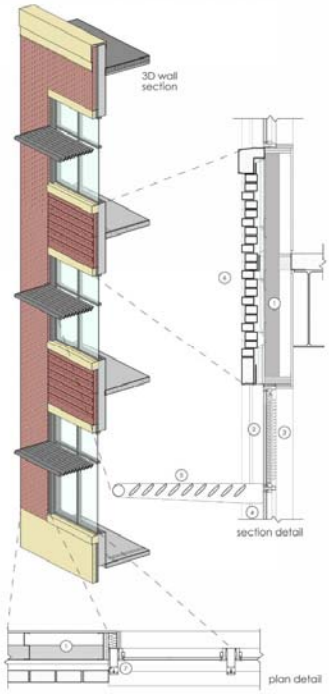

CAFE

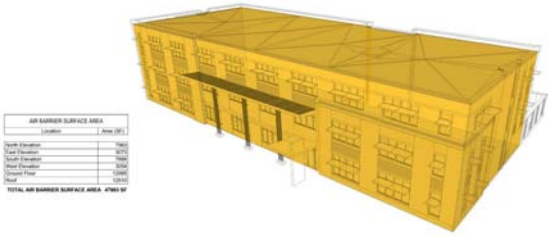
86% better
EUI than baseline

26.2 kbtu/sf

33% lower
Lighting Power Density than ASHRAE 90.1- 2010

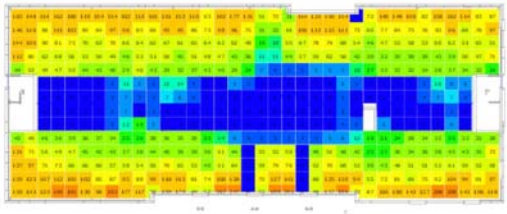
R-28/R-30
Overall Wall/Roof Assembly

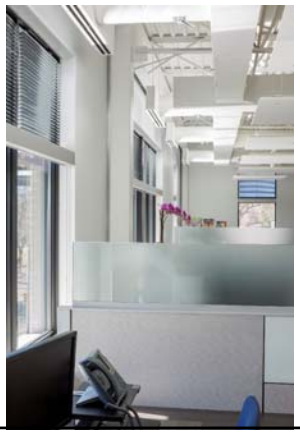


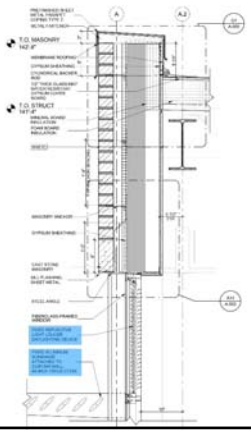


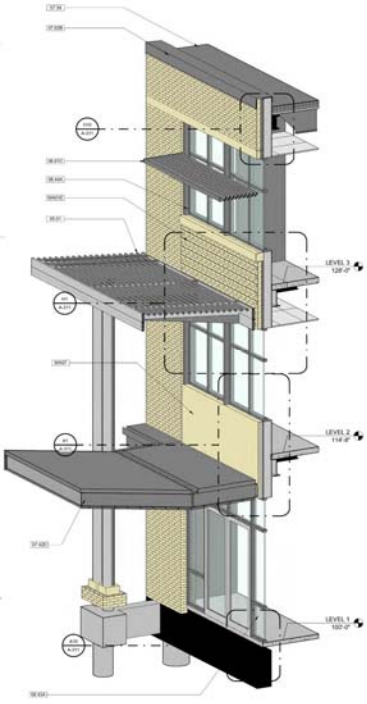
legend

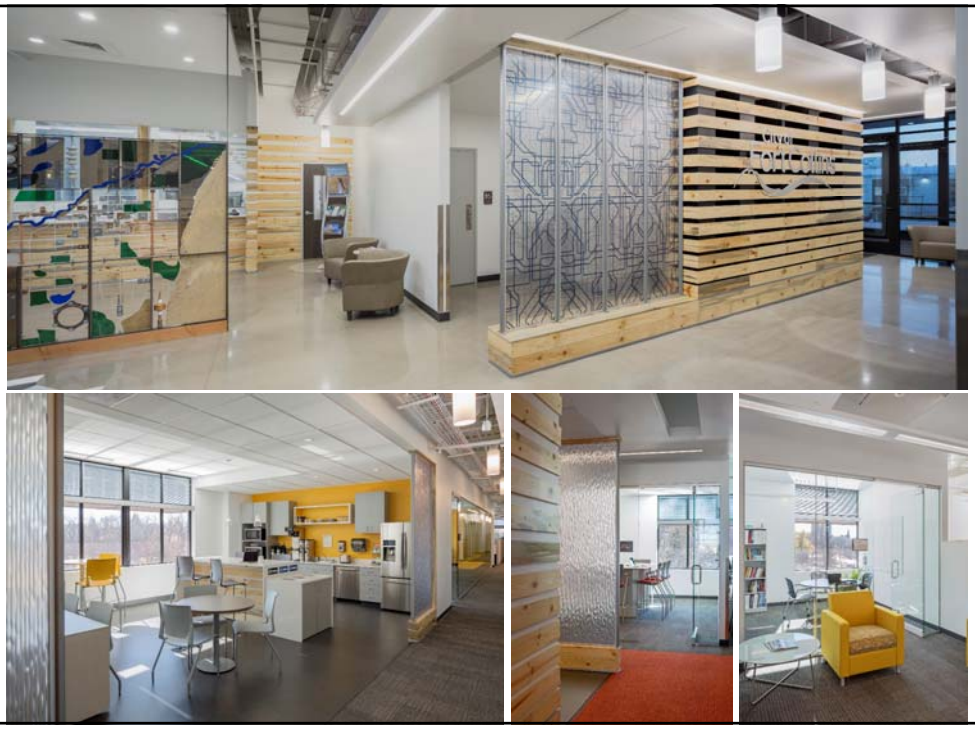
1: steel thermal efficient panel
2: daylight glazing panel
3: light louvers
4: vision glazing panel
5: exterior shade
6: recycled brick
7: curtain wall/fiberglass frame jamb





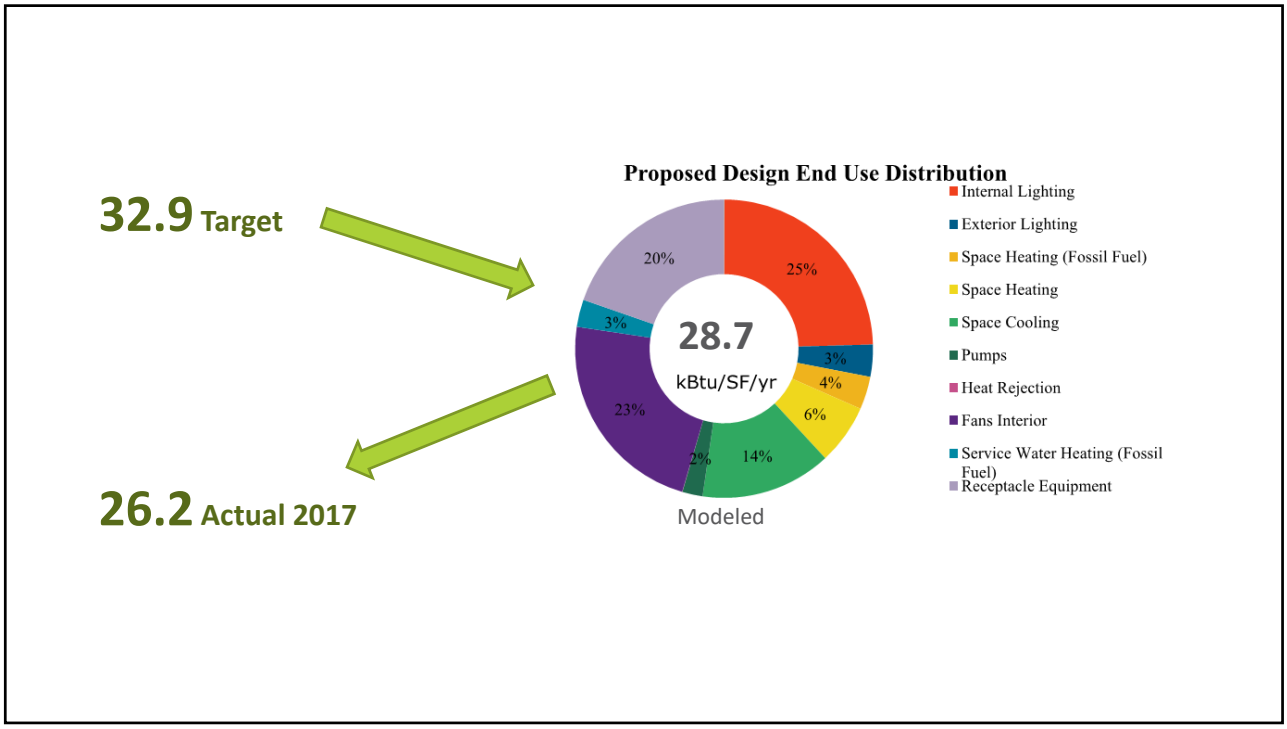







Occupant
Productivity and
Lessons Learned

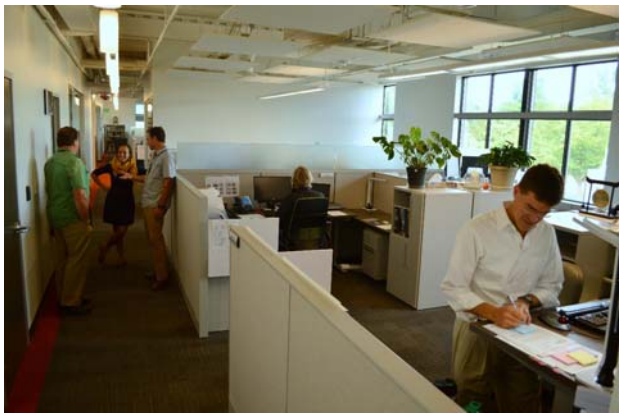

INSIGHTS From the New Fort Collins Utilities Office Building
COMFORT
Features:
• Year-round thermal comfort and indoor air quality
• 90% of occupant spaces with daylight and views
• Individualized, customizable workstations
• LED task lights, adjustable window shades, personal fans
• Collaboration and flex spaces
Change of Satisfaction: Building Features
Automatic Daylight Controls
Adjustable Furniture
Window Blinds
Thermostats
Project Summary
222 Laporte Ave.
37,500 sq. feet
$387/sq. foot
Integrated design & construction process
Completed 2016
Owner: City of Fort Collins
Architect: RNL Design, [au]workshop
Contractor: Adolfson + Peterson
EFFICIENCY
Targets & Performance:
✓ EUI: 32.9 kBtu/sf/yr & 30.8 actual
✓ LEED Platinum V4
✓ ENERGY STAR® score of 100
✓ Water use reduced indoor 45%/outdoor 65%
Features:
• Building shape & orientation optimizes daylighting
• High-performance envelope and windows
• Distributed heat pumps, energy recovery ventilation
• Daylighting & efficient LED lighting
• High-efficiency building transformers
• Detailed energy monitoring & continuous commissioning
• Low water use landscaping
• Low Impact Development rain gardens
Site Energy Breakdown (kBtu/sf/yr)
Net Electricity from Grid
Photovoltaics
Natural Gas
Building Demand and PV Production
CHARACTER
Art in Public Places – telling Utilities' story
Google "Butterfly Building" renovation
Repurposed bricks from creamery that once stood on the site
CAFE
49

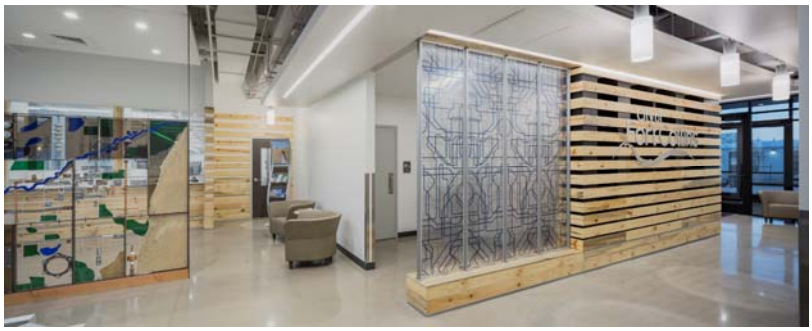

32.9 Target
26.2 Actual 2017
Proposed Design End Use Distribution
28.7
kBtu/SF/yr
25%
3%
4%
6%
14%
2%
23%
3%
20%
Internal Lighting
Exterior Lighting
Space Heating (Fossil Fuel)
Space Heating
Space Cooling
Pumps
Heat Rejection
Fans Interior
Service Water Heating (Fossil Fuel)
Receptacle Equipment
Modeled

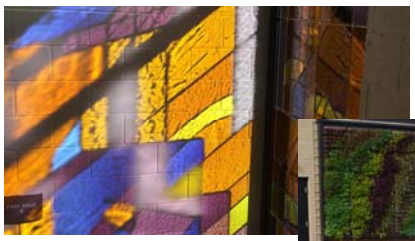
EUI with solar (kBtu/sf/yr)

14.3 predicted

15.5 actual








CAFE


Q & A

ARCH | NEXUS

ARCH | NEXUS SAC

LEED v4 Platinum Certified 4/20/17
LEED v4 Existing Buildings – Submitted
Living Building Challenge - Submitted
SEED Certification – Submitted
Energy Star Certification - Submitted
WELL Registered

Reveal Label
JUST Certified Employee-Owned Company

ENR Best Green Project of the Year 2017

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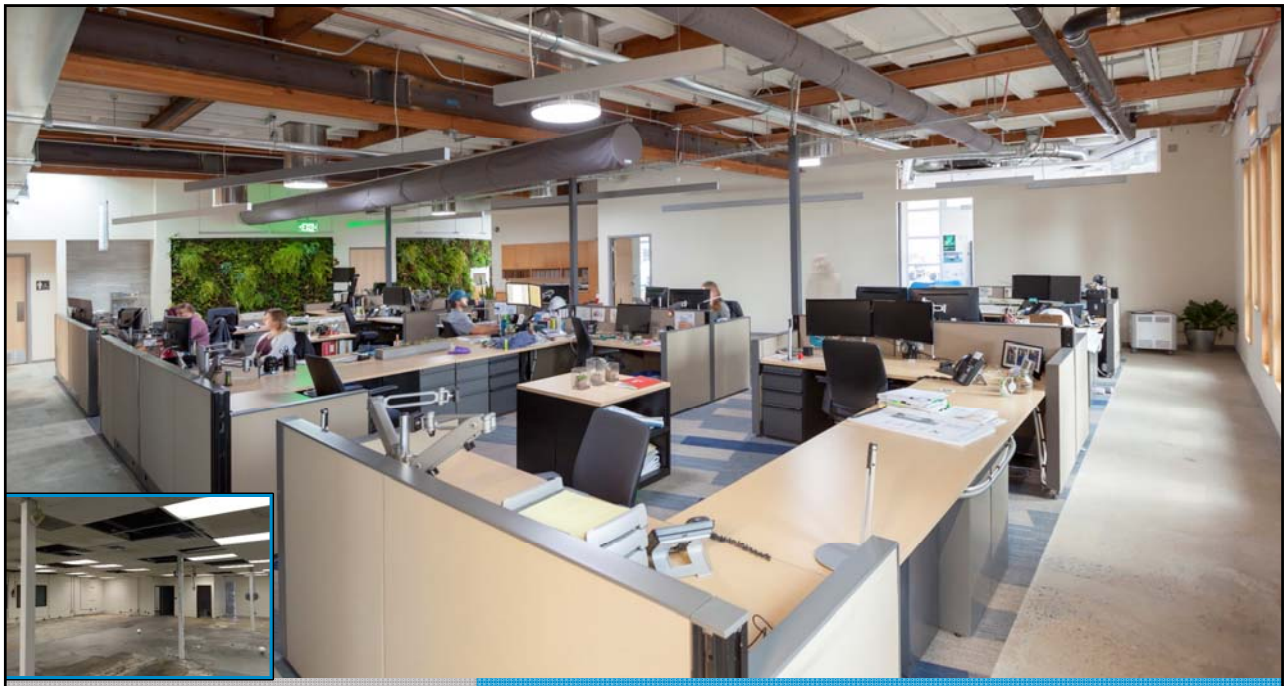

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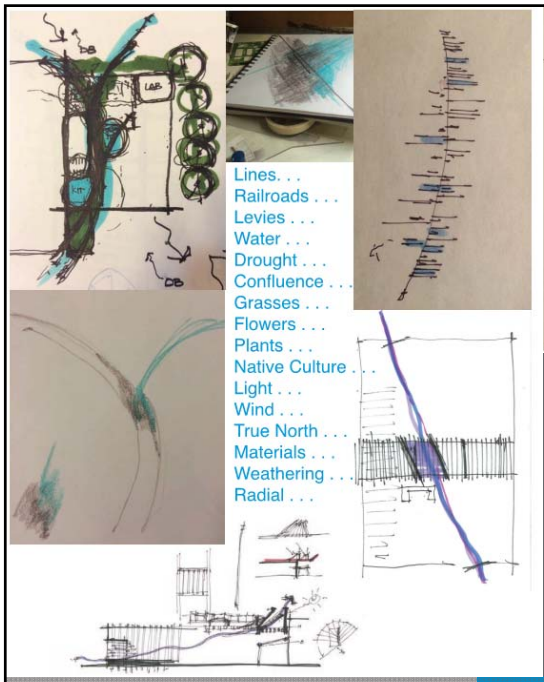
PROCESS

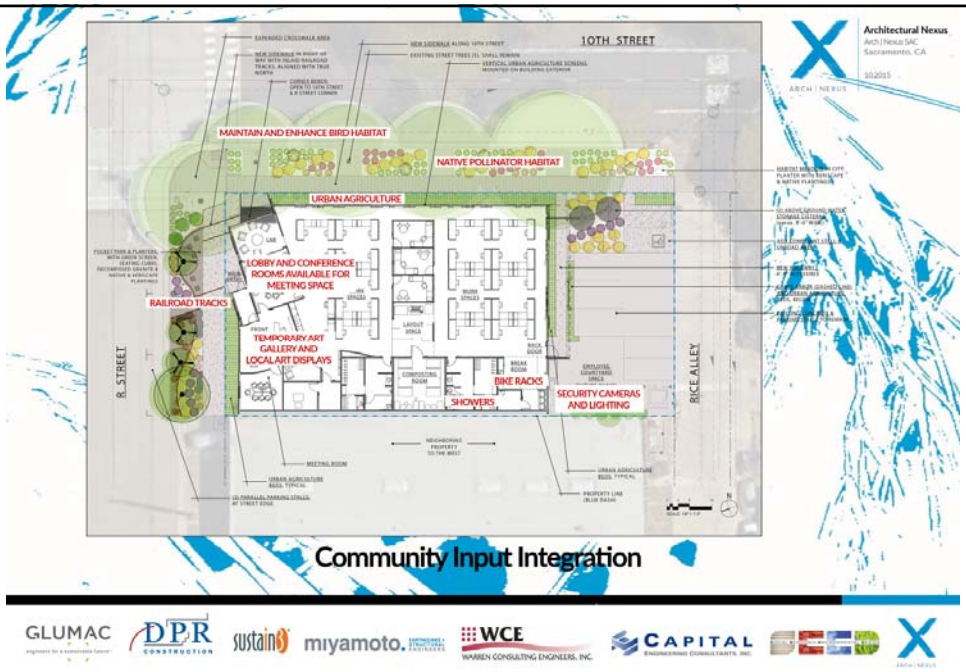
Choosing the Team
Design and Sustainability Charrettes
Community Engagement In Design
Daylight And Energy Modeling
Occupant Engagement - Inhabit

INTEGRATED TEAM

ARCH | NEXUS
WCE WARREN CONSULTING ENGINEERS, INC.
GLUMAC engineers for a sustainable future
miyamoto. EARTHQUAKE + STRUCTURAL ENGINEERS
SMUD
2020 ENGINEERING
CAPITAL ENGINEERING CONSULTANTS, INC.
City of SACRAMENTO
MarketOne BUILDERS Forward Together
sustain3
HUNT ELECTRIC, INC.
Habitat Horticulture



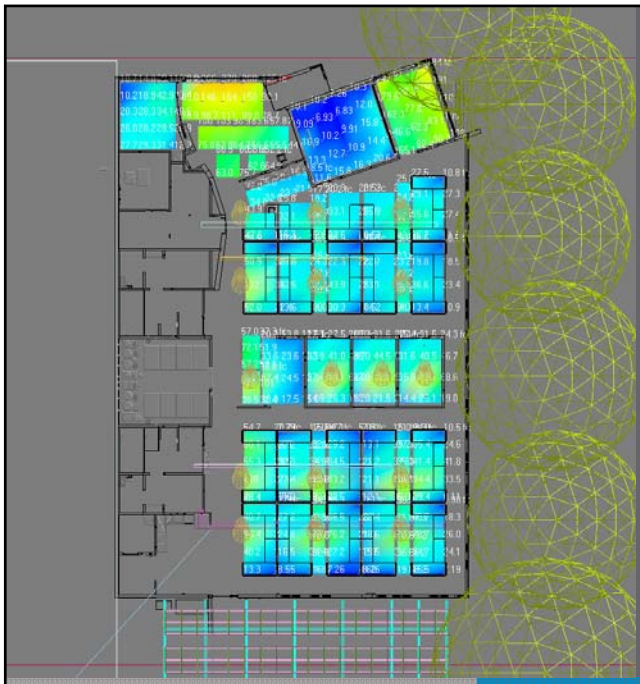
DESIGN CONCEPT



SCHEMATIC DESIGN NARRATIVE

06. NET POSITIVE ENERGY

Target EUI 35-40 kBtu/sf/year given HVAC systems currently budgeted for this project. High performance building envelope. Mechanical VRF system with a DOAS unit for ventilation, supplemented with operable windows tied to HVAC controls. Alternate strategies include geothermal heat pumps and radiant floors. Target 0.6 W/sf for the installed indoor lighting supplemented with natural daylight through the use of Solatubes.. All LED lighting indoors and out on sensor and/or daylight control. Solar hot water system and solar photovoltaic array. Sub-metering of energy end uses to enable verification of Net Positive Energy goal. Powerwall Tesla battery backs for back-up power. Natural ventilation strategies to conserve energy through thermal buoyancy with the use of solar chimneys is continuing to be studied through a CFD analysis.



DESIGN CONCEPT

NET POSITIVE ENERGY

EUI 25.1 [36.1] With PV -17.8
170% + [105%]
Carbon offsets

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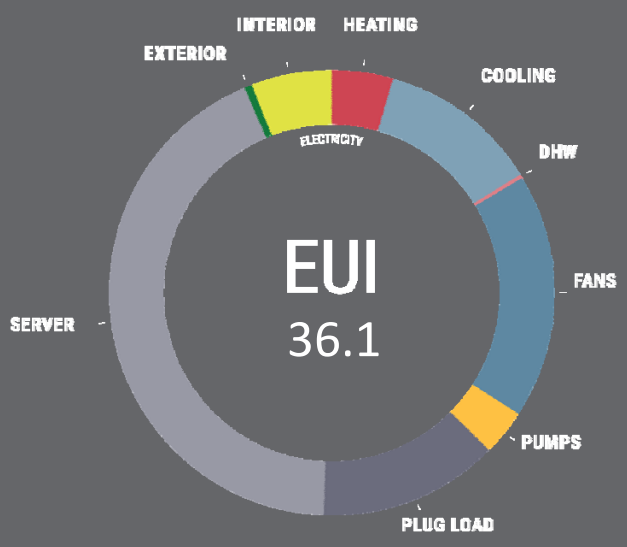
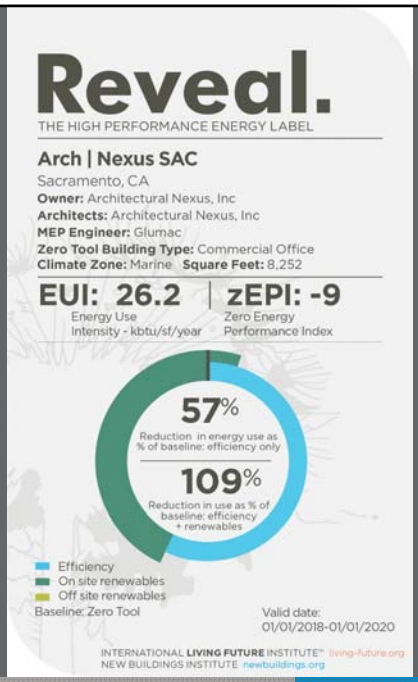


NET ZERO DESIGN

"Building reuse is the highest form of sustainability, yet the design constraints that come with reuse are very limiting in terms of energy use reduction…"

-Kenner Kingston

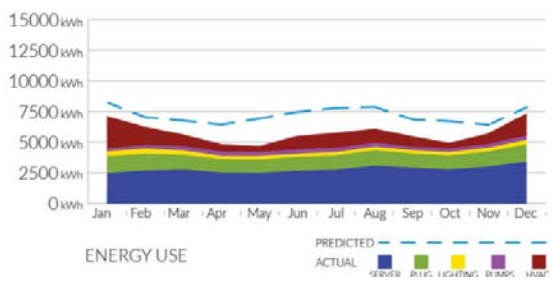


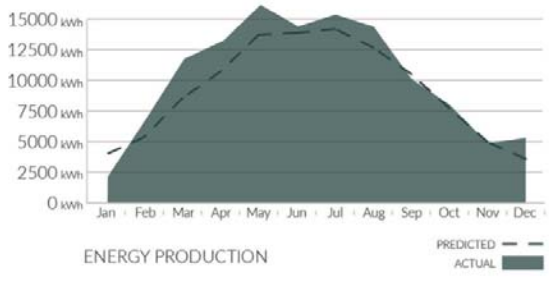
NET ZERO VERIFIED

"…the answer to the reuse/energy conundrum is the occupant; while most buildings underperform predicted performance, our occupants are driving energy use down monthly."

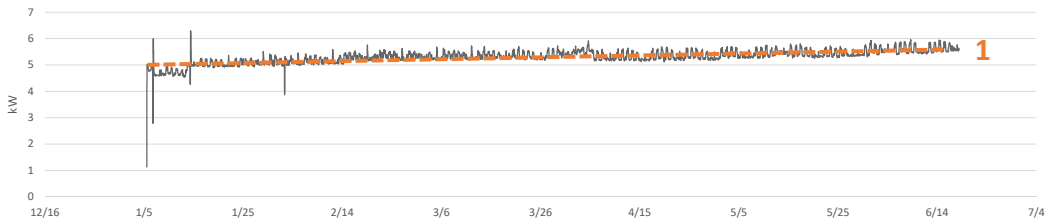
-Kenner Kingston

ARCH | NEXUS SAC **ENERGY PERFORMANCE**

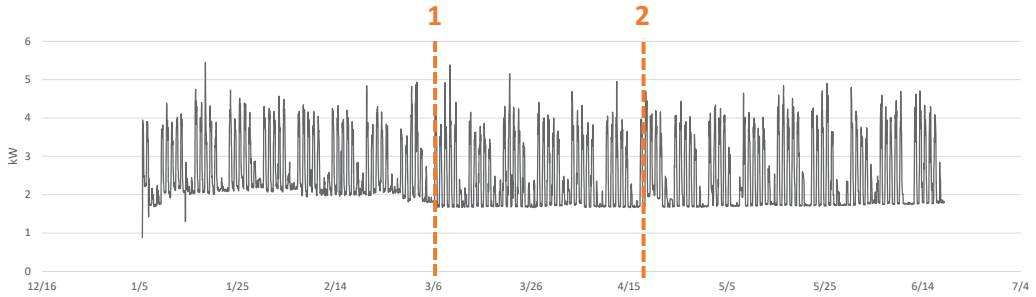




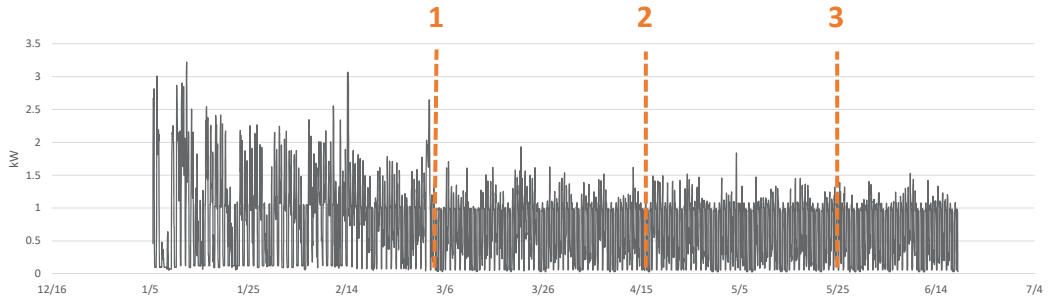
SERVER LOAD



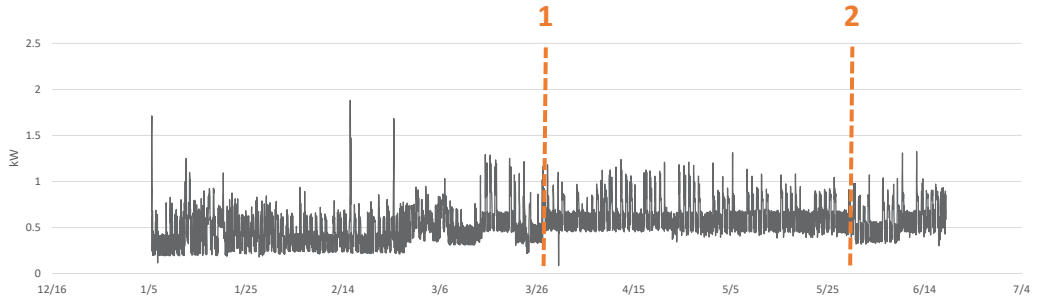
PLUG LOAD



LIGHTING LOAD



PUMP LOAD



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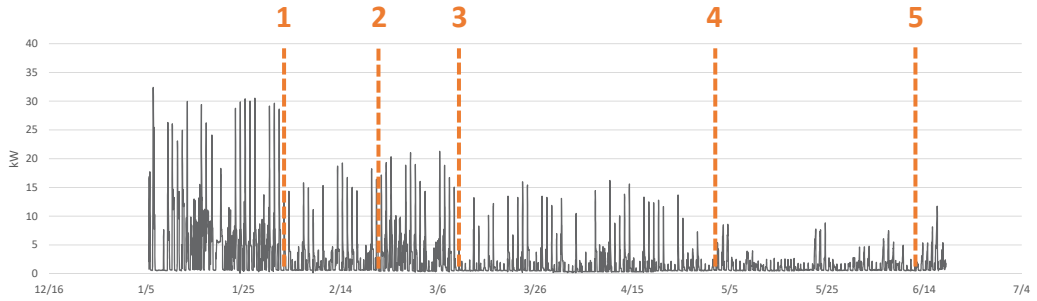
HVAC LOAD



OCCUPANT ENGAGEMENT

Engaged Occupants are using
26% Less Energy
Than Expected in an Already High Performance Building

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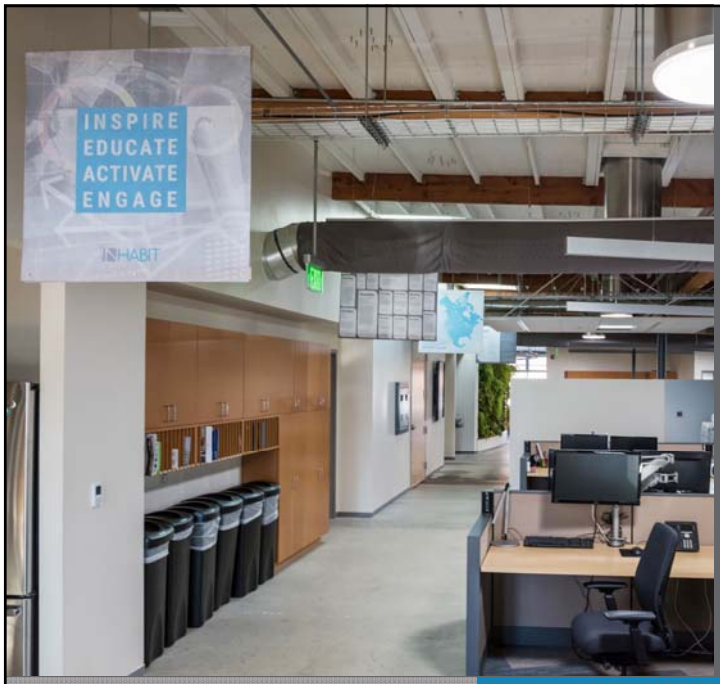

TRANSFORM

Occupants into Inhabitants

- Education
- Action
- Reward
- (repeat)

TRANSFORM

How it works:

- Episodic Competitions
- Weekly "Learn & Earns"
- Short Quiz
- **Unlock Actions**
- Earn Individual & Team Points
- Dashboard Metrics
  - Points
  - kWH Saved
  - CO2 Avoided
  - Pounds of Waste Diverted

NET ZERO WATER

Rainwater to Irrigation
Greywater Capture
Composting Toilets
Rainwater to Potable? - Waiting

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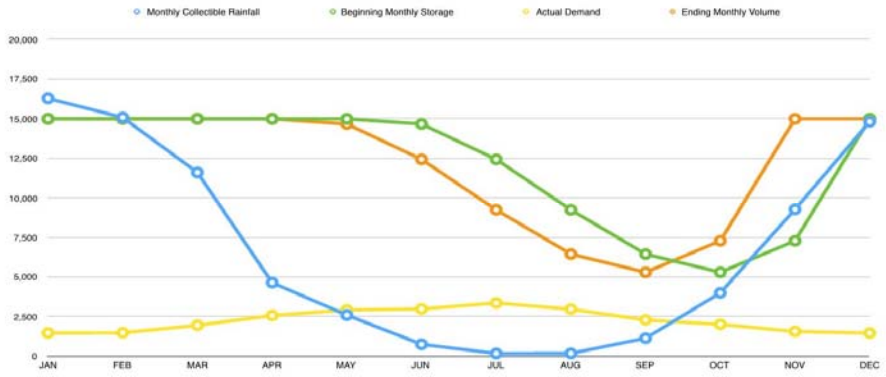
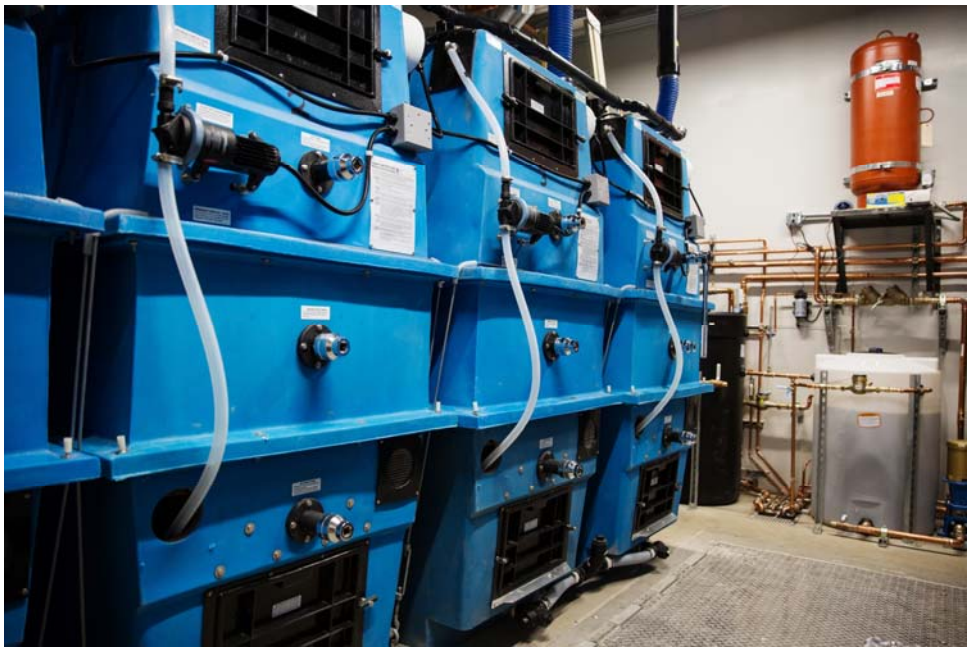
RAINWATER SUPPLY & WATER USAGE





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