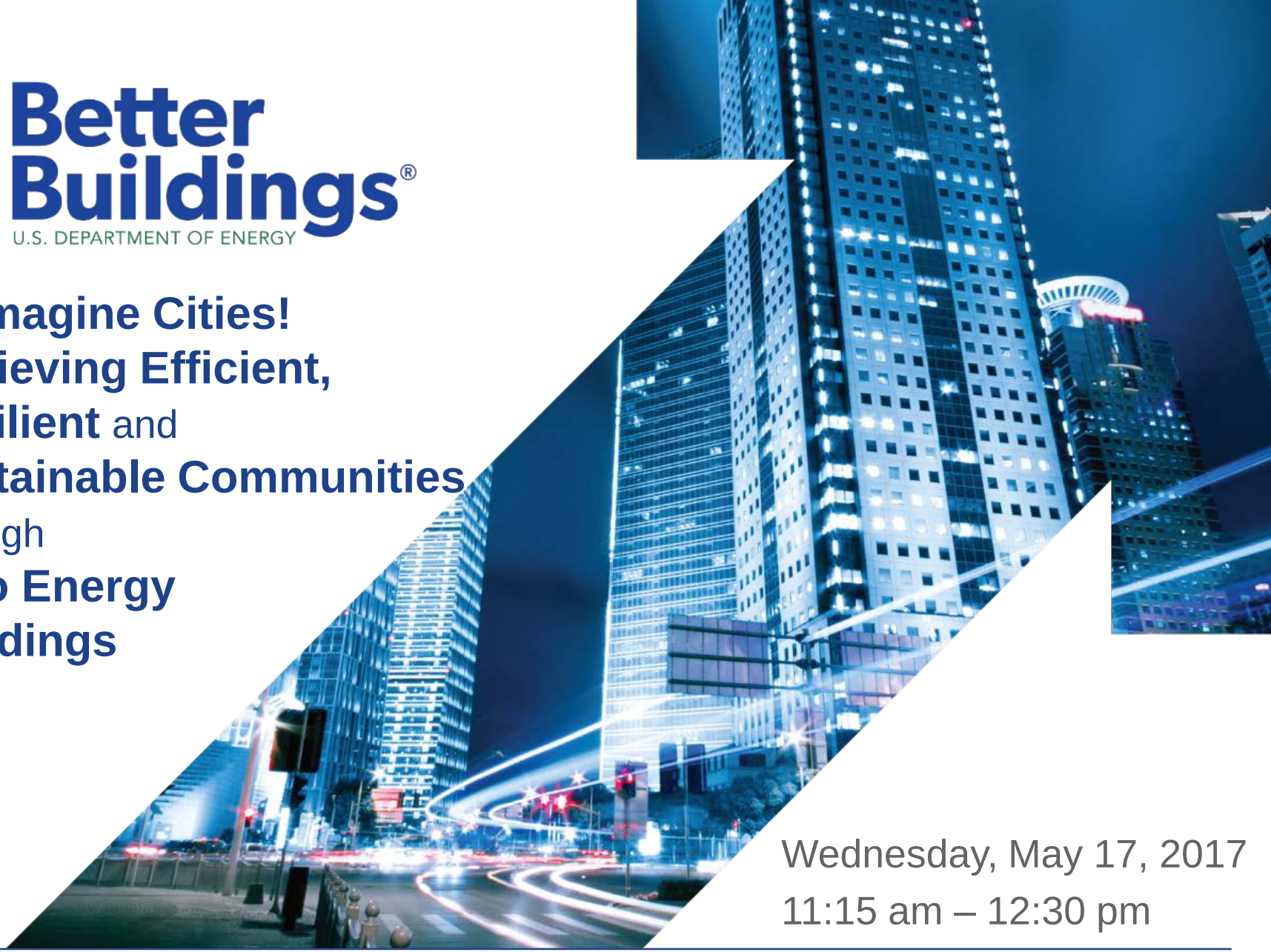
Better Buildings®
U.S. DEPARTMENT OF ENERGY

Reimagine Cities! Achieving Efficient, Resilient and Sustainable Communities through Zero Energy Buildings



Wednesday, May 17, 2017
11:15 am – 12:30 pm

U.S. DEPARTMENT OF ENERGY

Panelists

- Kirk Myers, REI
- Holly Lennihan, Hickok Cole Architects
- Barbara Frommell, National Western Center
- Solome Girma, Department of Energy (moderator)

Kirk Myers

REI

U.S. DEPARTMENT OF ENERGY

REI Goodyear, AZ Distribution Center

REI
RECREATIONAL
EQUIPMENT, INC.
EASTLAKE AVE E

IT ALL STARTED
WITH AN ICE AXE
Recreational Equipment, Inc. (REI) traces its roots to the 1930s when Seattle mountaineer Lloyd Anderson began his search for an ice axe. He wanted a reliable tool at a reasonable price but couldn't find one locally. Eventually he found a high-quality model in an Austrian alpine gear catalog for a mere $3.00, shipping included. Word about his find quickly spread among Seattle's climbing community, which led Lloyd and his wife, Mary, to convene with 21 fellow climbers to establish an outdoor gear co-op in 1938.
The Andersons began dispensing gear and products from their home, and later from shelves Lloyd built in a service station near Seattle's Pike Place Market. In the early days, Mary repaired members' tents and recommended camp recipes, and Lloyd hand-tooled ice axe shafts in their basement. In the many decades since, REI has grown to become the nation's largest consumer co-op, a recognized leader in outdoor recreation and a caretaker of shared natural spaces.

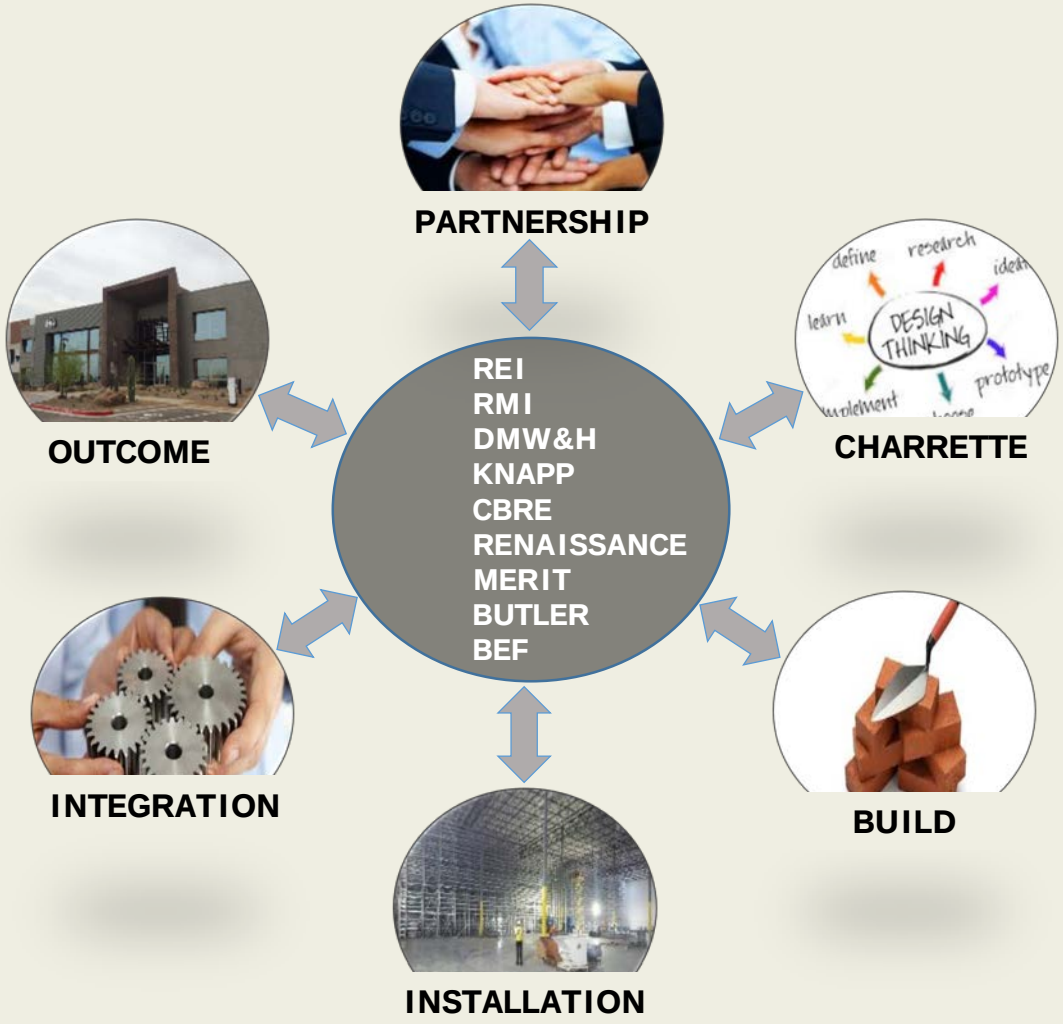
Sustainability

Technology

Water

People

Co-operative Design



- Integrated design approach
- Clear requirements of Net Zero Energy and long-term total cost of ownership
- Partners work in parallel, starting with charrette

Sustainability

- Net Zero Energy
- LEED Platinum
- Water Conservation

Efficiency Measures

- 57 measures were considered post-charrette
  - Optimized orientation, envelope and insulation through extensive energy modelling
  - Used all LED lighting
  - Included Air Turnover Units to de-stratify building; highest-efficiency mechanical cooling used
  - Focused on “vampire loads” for all material handling equipment
  - Hyperchairs are one cool example of innovation
- Reduced consumption over 50% below ASHRAE 90.1-2007
- Significantly downsized size of needed PV array
- Energy modelling for a production facility is difficult

Water Project

- Whole systems thinking
  - Intersection of energy and water: “embedded water” in energy
- Habitat restoration project in Verde Valley in partnership with Bonneville Environmental Foundation and The Nature Conservancy of Arizona
  - Putting water back in river
  - Supporting local farmers
  - Creating recreation economy
- Balanced facility’s annual water footprint over five years and earned two LEED points
- USGBC now recognizes Water Restoration Certificates for LEED points

REI

Holly Lennihan

Hickok Cole Architects

U.S. DEPARTMENT OF ENERGY

WHY ARE WE HERE TODAY?

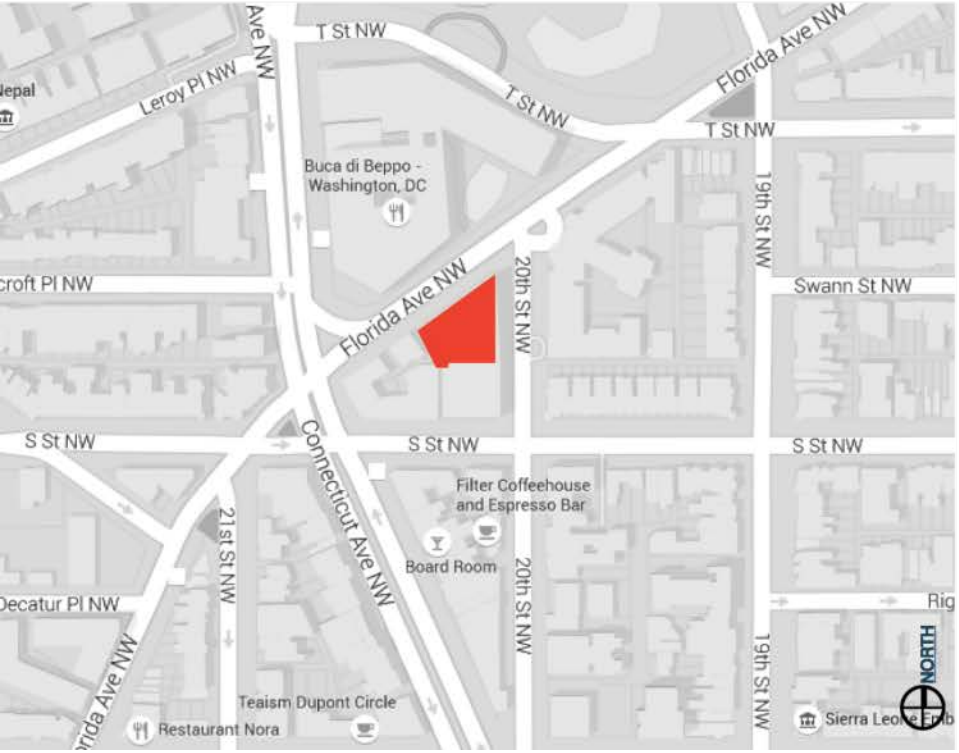
Organizations and companies seek to gain cost savings and productivity improvements while supporting their missions.

Cities are committed to creating a sustainable future for their residents.

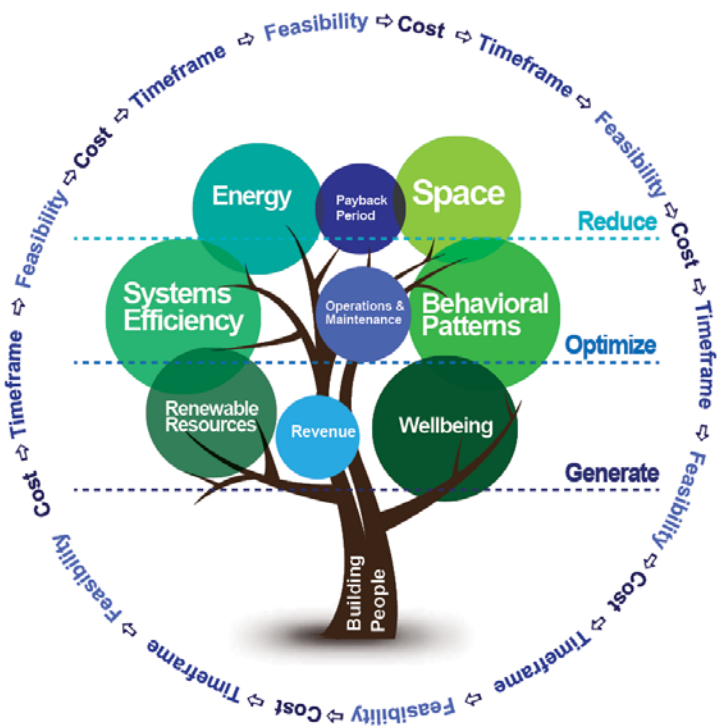
THE PROJECT: AGU

78,000 SF

DESIGNED IN 1992
NET ZERO ENERGY RENOVATION
OF THE INTERIOR AND EXTERIOR



AGU: DESIGNED FROM THE INSIDE OUT



+

- State of the art workplace environment
- Flexible and adaptable 21st century work environment - use Wellness principles
- Use the building as a research and educational tool: create building tour to showcase sustainable strategies
- Showcase contributions of earth and space science - exhibit space at the ground floor
- Push the limits of building energy and water performance using innovative technologies
- Raise AGU's visibility

AGU STRATEGIES USED

Dynamic Glazing
10.45 kBtu/sf*

Solar PV Array
10.23 kBtu/sf*

Radiant Ceiling
11.1 kBtu/sf*

Municipal Heat Extraction
9.0 kBtu/sf*

Material Re-use

Behavior Modification

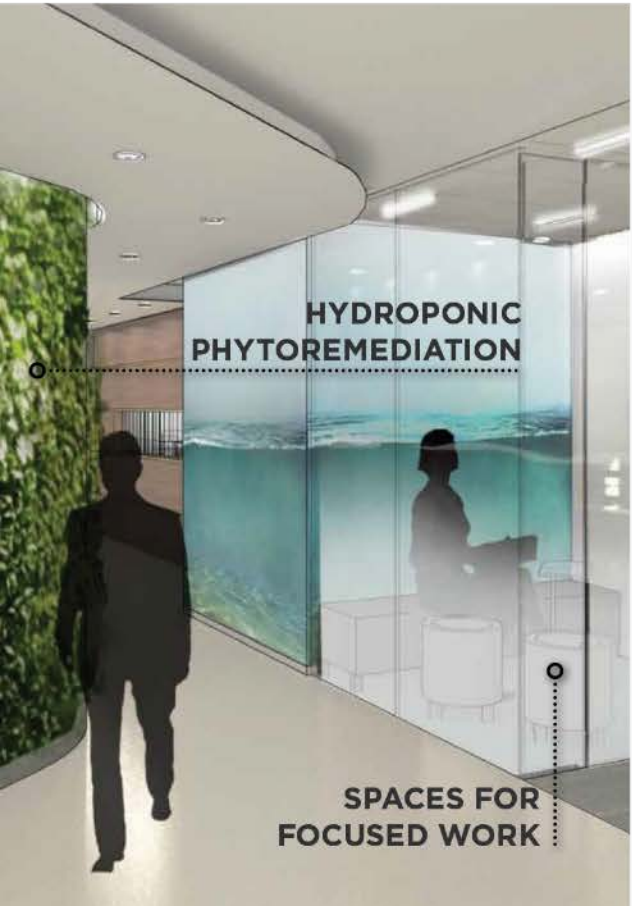
Greywater Reclamation

Hydroponic Phytoremediation

*per year contribution

AGU ACTIVATED GROUND FLOOR

AGU HEALTHY, HIGH-PERFORMANCE INTERIOR



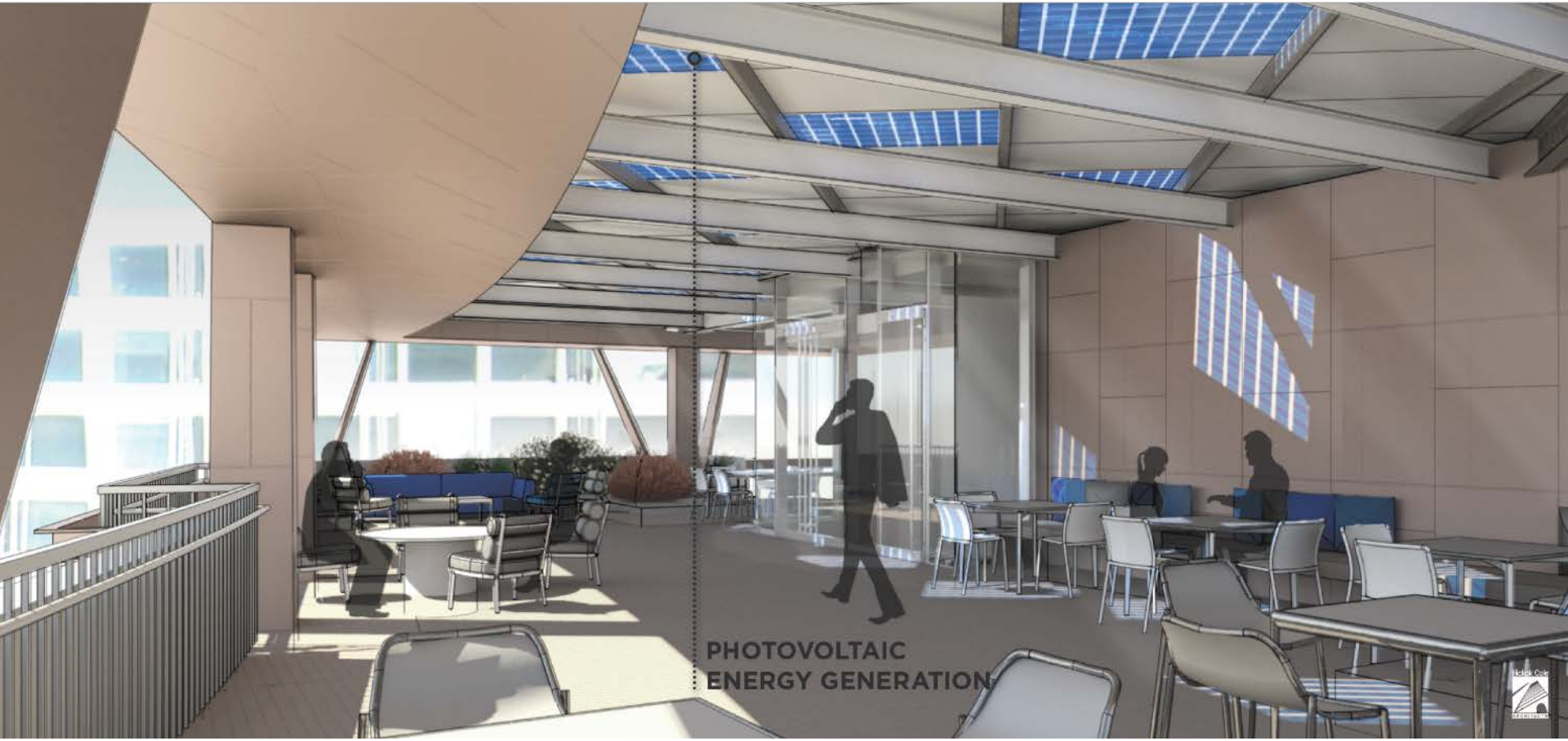
FLOOR PLAN TYPICAL WORK LEVEL

LEVEL 03

LEVEL 04

LEVEL 05

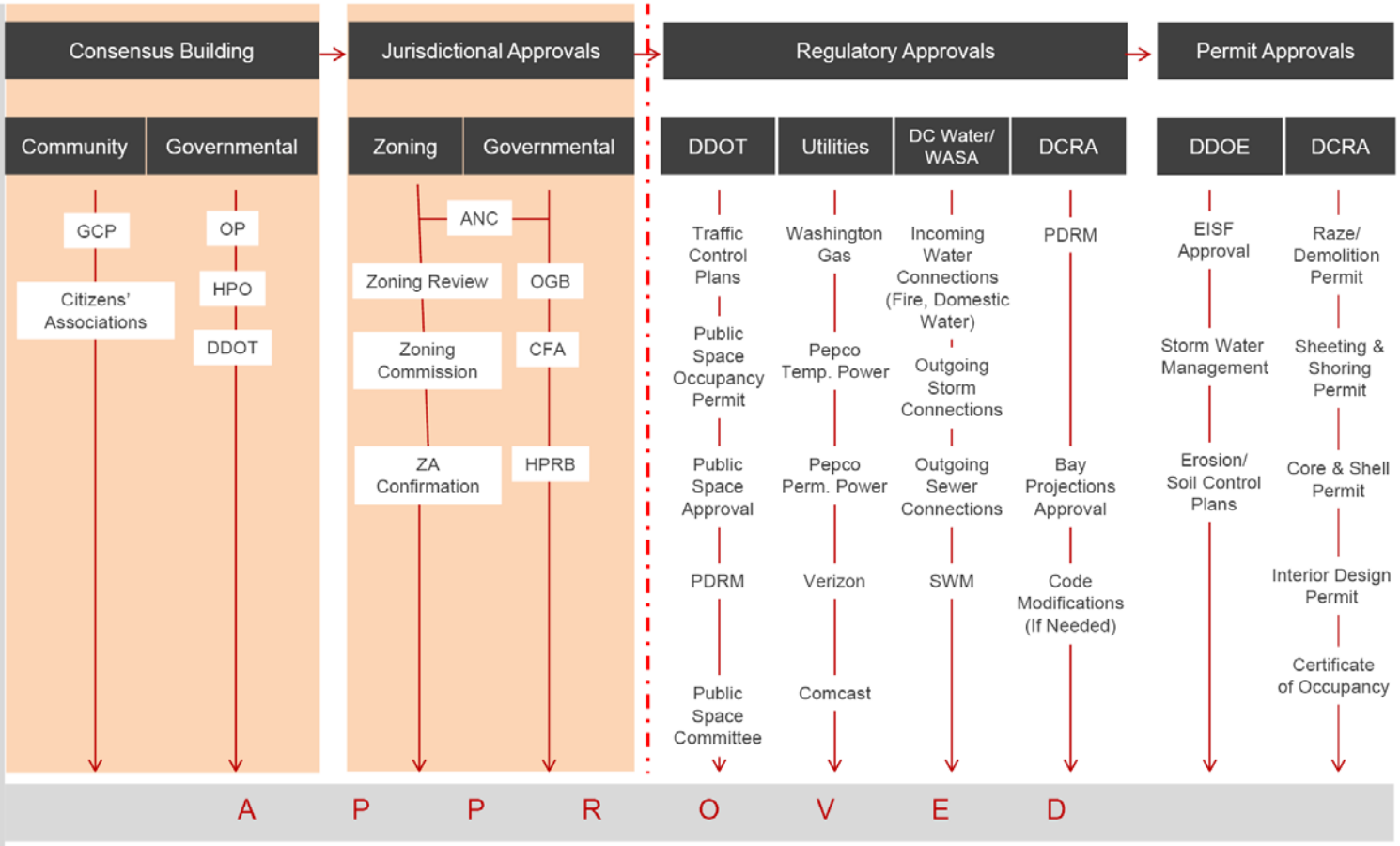
AGU FUNCTIONAL, ENERGY-PRODUCING ROOF



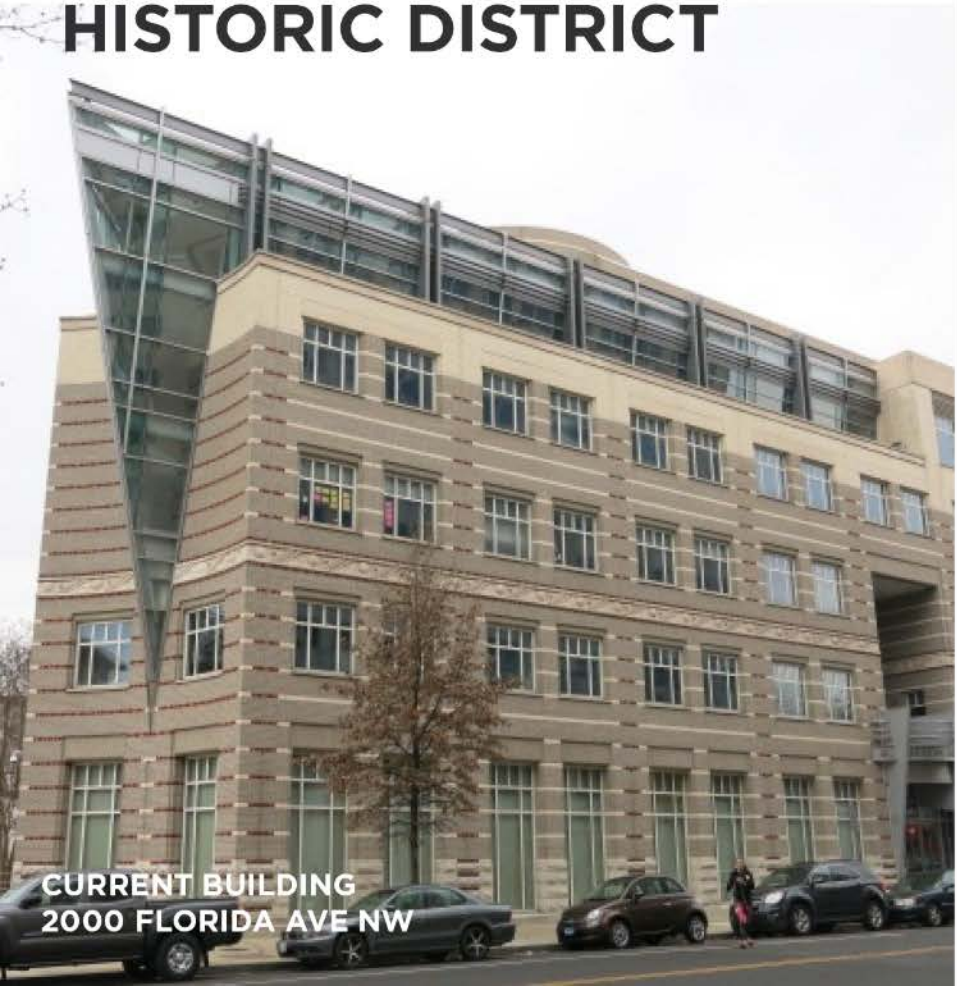
THE PLACE: WASHINGTON, DC

- DC goal is 50-50-50 (new construction)
- New Philosophy for DC: buildings as generators not consumers
- DC DOEE just released the Climate Action Plan and a Comprehensive Energy Plan
- ICC Green Construction Code 2012 adopted
- Stringent stormwater requirements
- GSA goal of all new construction to be Net Zero Energy by 2030
- The proposed DC Green Bank would utilize an initial investment of public funds and significantly leverage private capital

JURISDICTIONAL APPROVALS



HISTORIC PRESERVATION: HISTORIC DISTRICT

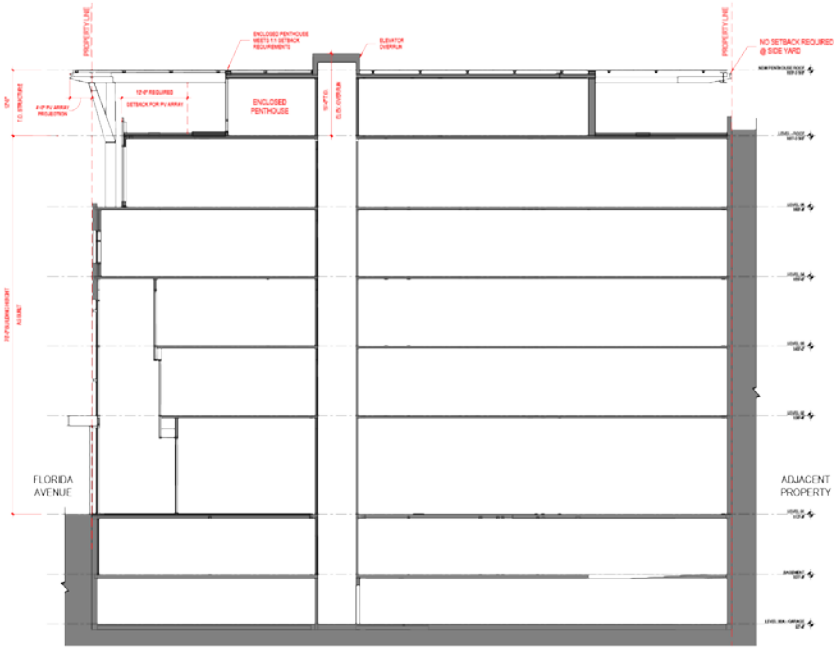


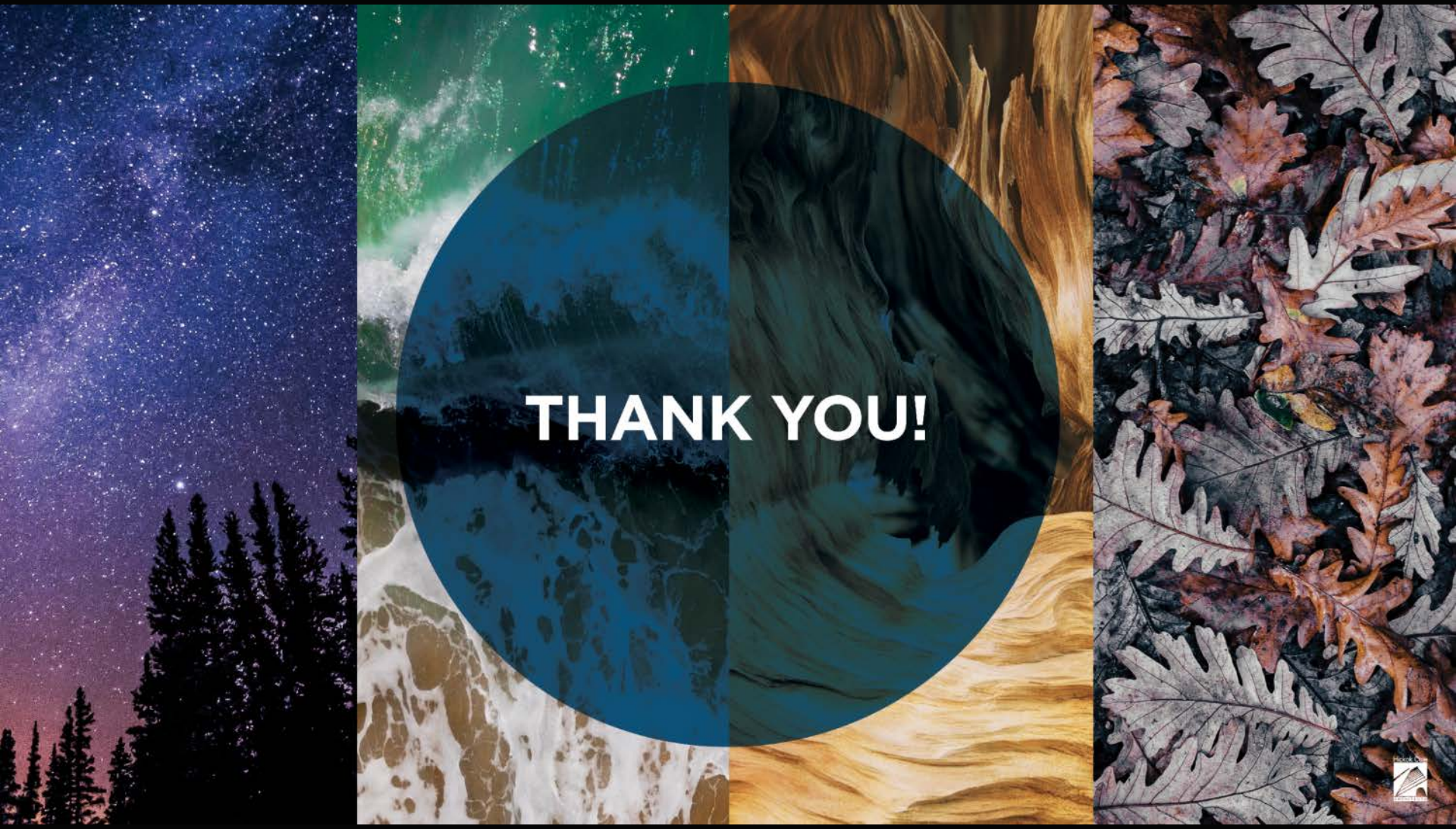
HISTORIC PRESERVATION

EXISTING CONDITIONS

PROPOSED FLORIDA AVENUE STOREFRONT

ZONING: PV ARRAY DOES NOT MEET SETBACK




THANK YOU!

Barb Frommell

National Western Center,
City & County of Denver

U.S. DEPARTMENT OF
ENERGY

NATIONAL WESTERN CENTER

LOCAL IMPACT ✵ GLOBAL REACH

Reimagining Cities! Achieving Efficient, Resilient and Sustainable Communities through Zero Energy Buildings

National Western Center

Denver, Colorado

Barb Frommell

May 17, 2017

- 2 miles from Downtown Denver
- Easy access from I-25 and I-70
- 1 stop from Denver Union Station
- 20 min to Denver Int'l Airport (DEN)
- South Platte River Greenway Trail
- Visibility from I-70 (150,000 vehicles / day)

NATIONAL WESTERN® Stock Show

111 Years of History

NATIONAL WESTERN CENTER

LOCAL IMPACT ✹ GLOBAL REACH

A bold vision:

Create *the* Global Destination for Agricultural Heritage and Innovation.

A bold mission:

Convene the world to create, educate, entertain, inspire, lead and deliver global food solutions.

Colorado State University

Flying B Bar Ranch

RJ Sangosti | The Denver Post

How will we feed 9 billion people?

National Western Center – Five Founding Partners

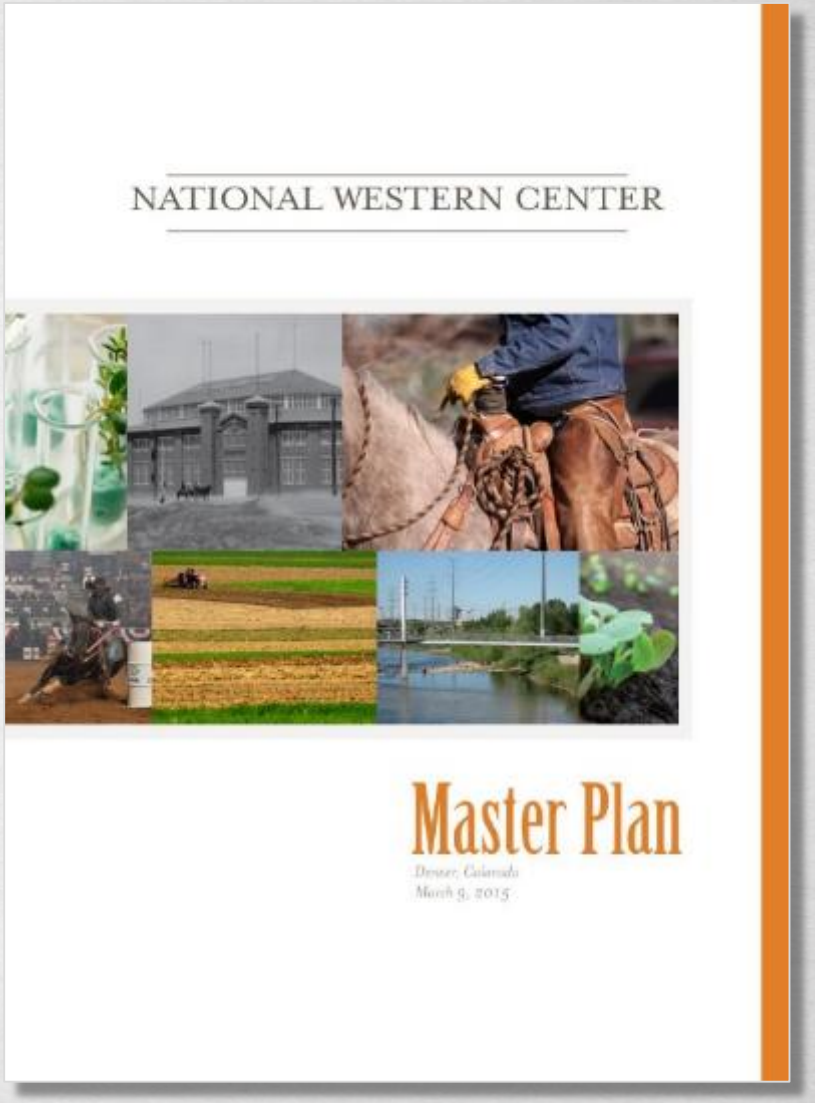
DENVER
THE MILE HIGH CITY

NATIONAL WESTERN Stock Show

Colorado State University

HISTORY Colorado

DENVER MUSEUM OF NATURE & SCIENCE



Adopted March 2015

Key Site Elements

Phase 1

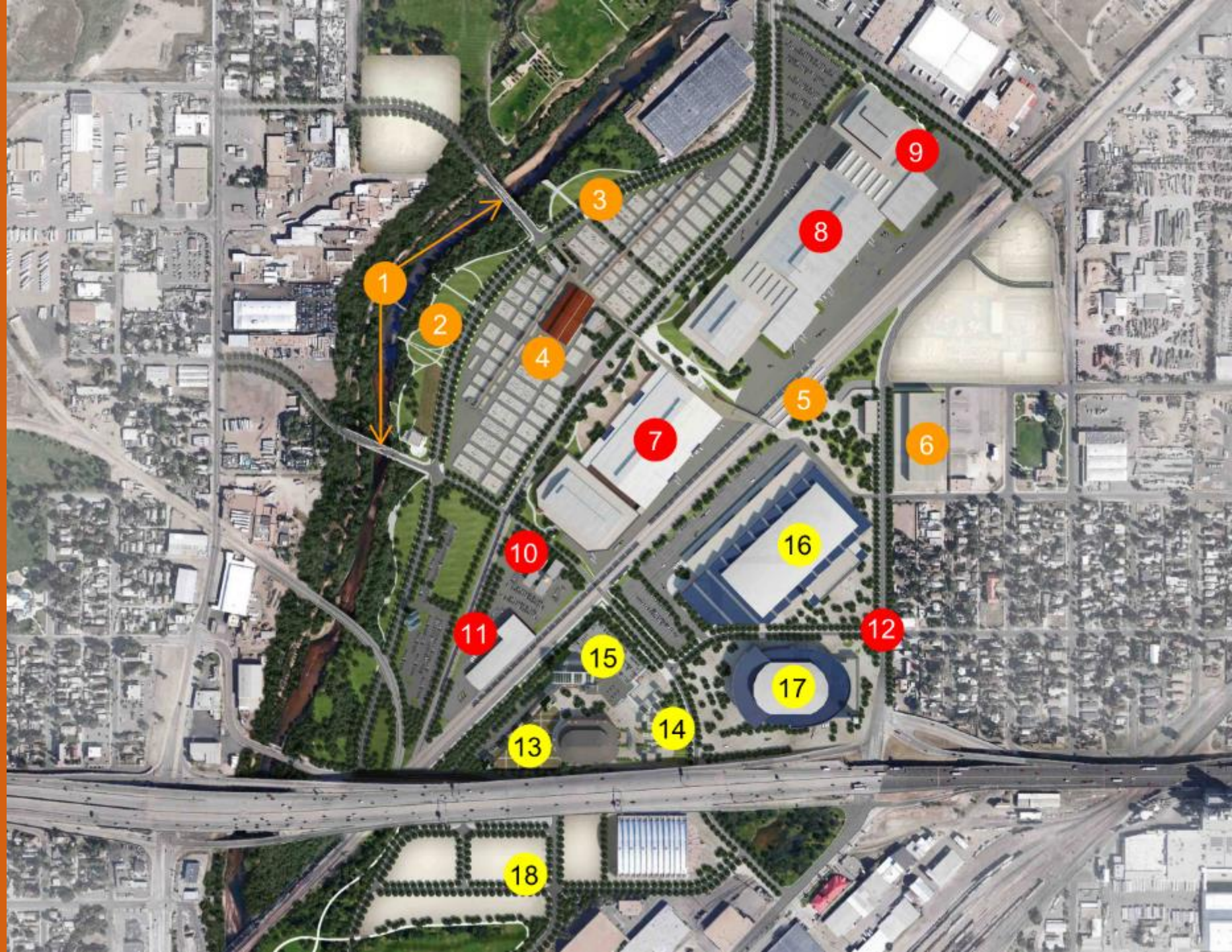
1. New bridges at 49th and 51st Streets
2. CSU Water Resources Center & S Platte Riverfront
3. Relocated National Western Drive
4. Stock Yards & Stock Yards Events Center
5. NWC Transit Station
6. Shared Use/TOD Parking Structure

Phase 2

7. Livestock Center
8. Equestrian Center
9. CSU Equine Sports Medicine Clinic
10. Livestock Exchange Building/Flex Space
11. NWSS Maintenance Facility
12. Brighton Boulevard

Phase 3-8

13. Stadium Arena Market
14. Colorado Commons
15. CSU Center
16. Trade Show/Exposition Hall
17. New Arena
18. Coliseum Site Redevelopment



Funding Secured!

CO House Bill 15-1344

Bi-partisan, statewide support

Denver Ballot Measure 2C

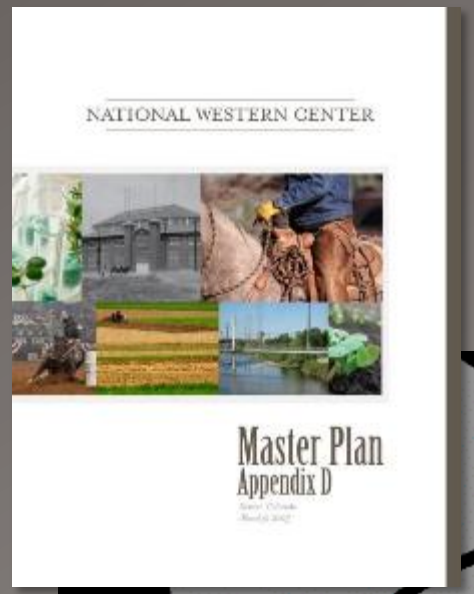
Tourism Tax

65.5% voter support

Regional Tourism Act Grant

Master Plan Guiding Principals

Sustainability and Regeneration Framework



- 9 Categories
- 63 Goals

Master Plan Energy & GHG Goals:

- Create a Net Zero Energy district, prioritizing technical and behavioral strategies to increase efficiency and using on-site renewable energy sources (by 5 years after build-out)

- Maintain or reduce greenhouse gas emissions (GHG) levels, including transportation, at or below 2016 GHG emissions; and strive for continuous reduction over time, aiming for alignment with City and County GHG and climate goals.

NWC ENERGY TEAM

Better Buildings®
U.S. DEPARTMENT OF ENERGY

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Colorado State University

DENVER
THE MILE HIGH CITY

ENERGY INSTITUTE

URBAN WATER CENTER

DENVER WATER

ch2m

brendle GROUP

METRO WASTEWATER RECLAMATION DISTRICT

CENTER FOR THE NEW ENERGY ECONOMY
Colorado State University

INSTITUTE FOR THE BUILT ENVIRONMENT

CENTER FOR ENERGY WATER SUSTAINABILITY

Xcel Energy®
PARTNERS IN ENERGY
An Xcel Energy Community Collaboration

NRDC
NATURAL RESOURCES DEFENSE COUNCIL

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TICKETS ON SALE
MON - FRI 9-4
COLO ATHLETES
FOR CHRIST

Current Energy Use by Premise

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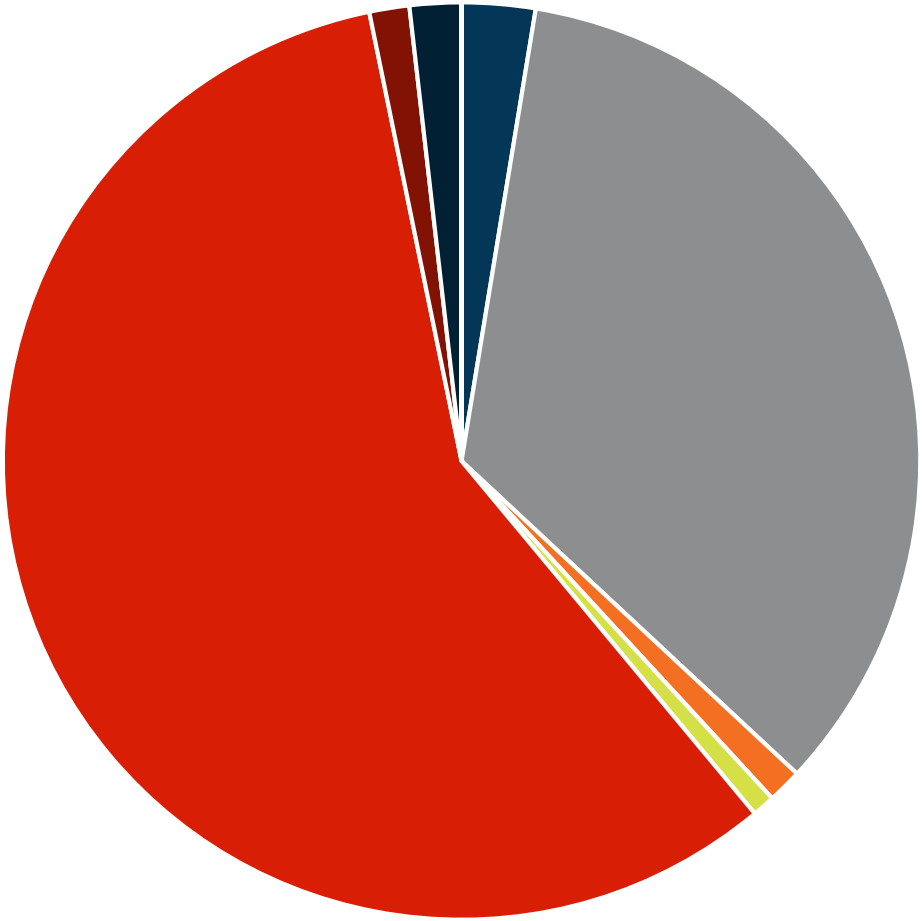
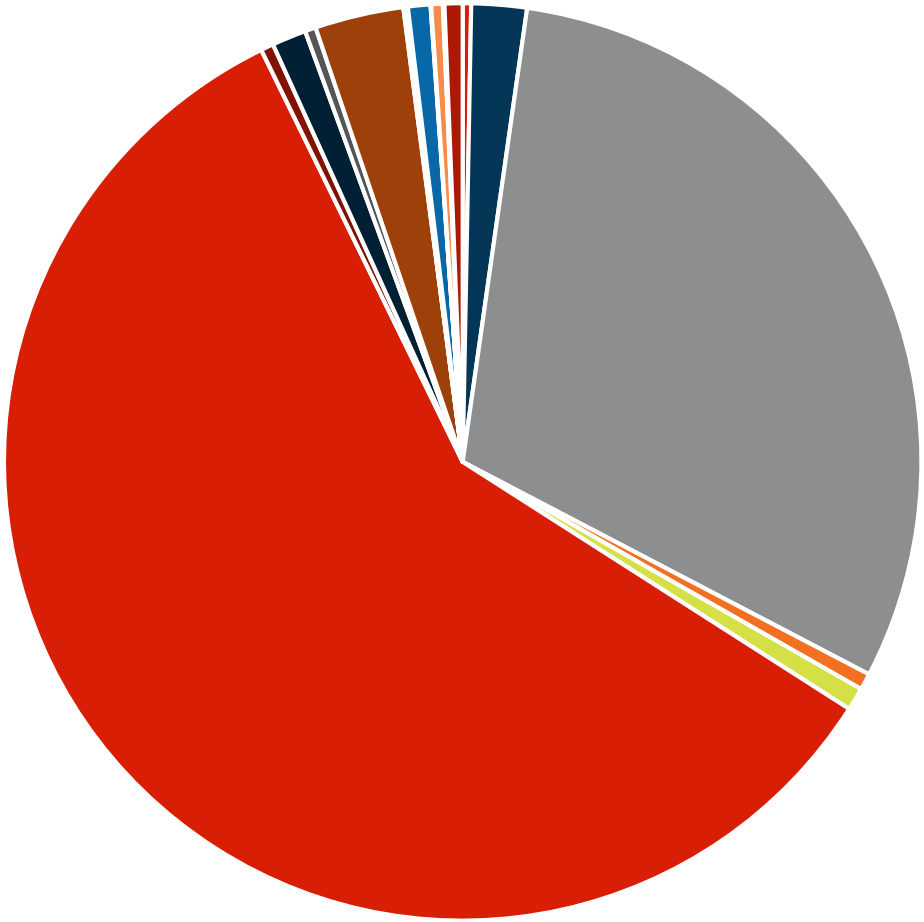
Natural Gas

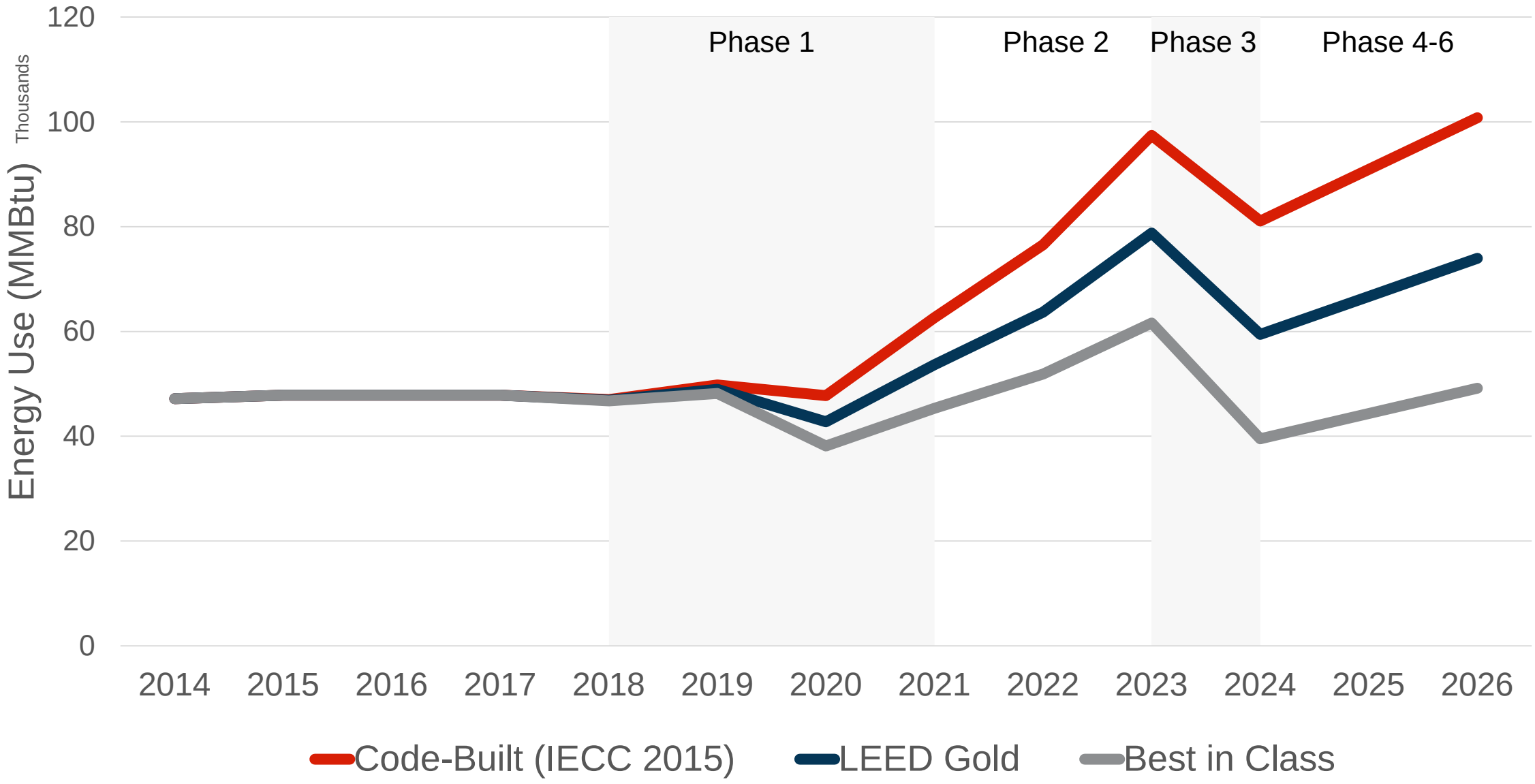


Electricity



- Activities Pavilion
- Etna Building
- Events Center
- Residential Boarding Home
- Security and Employment Building
- Stadium Arena Complex
- Stock Yards Arena
- Stock Yards Auction Arena
- Stockyards
- Coliseum Parking
- Gold Buckle Parking Lot
- Parking Lot A
- Parking Lot B
- Parking Lot C
- Parking Lot D
- Parking Lot H
- Parking Lot I
- Parking Lot N
- Unknown

NWC Energy Forecast by Development Phase



Snapshot of NWC Energy Use Today vs. Build-Out Scenarios*

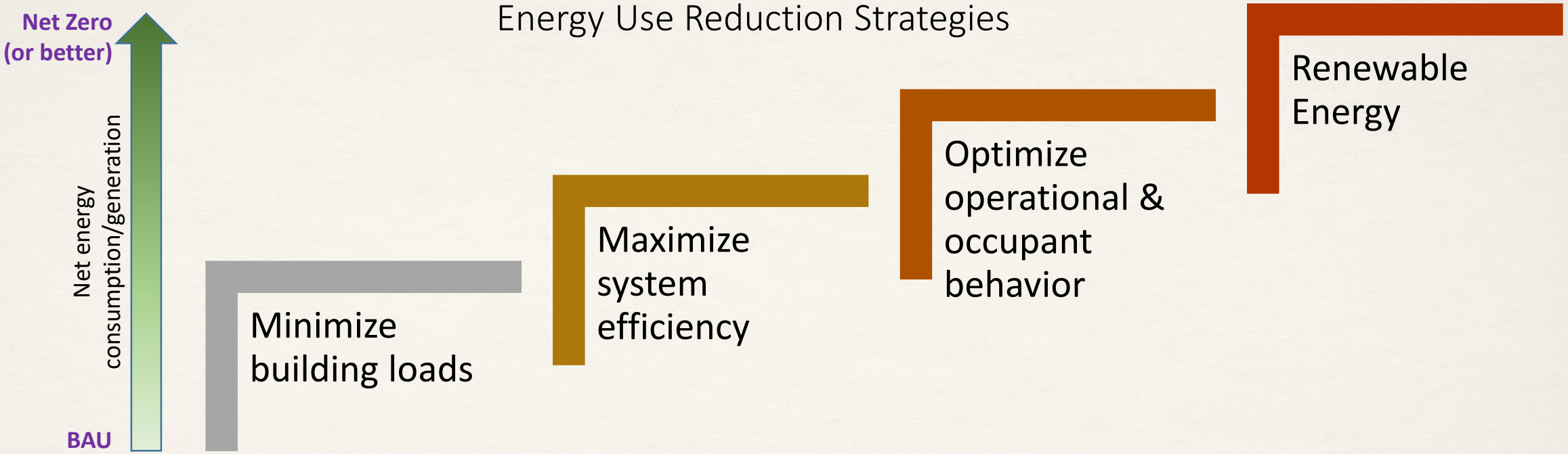
		Today	Redeveloped (In 2032)		
			Code-Built	LEED Gold	Best-in-Class
Square Footage		700,000	2,900,000		
Electricity/Natural Gas Split		40%/60%	TBD		
Electricity	Kwh	5,800,000	11,000,000	8,000,000	6,000,000
	Cost	$522,000	$990,000	$750,000	$520,000
Natural Gas	Therms	300,000	590,000	440,000	290,000
	Cost	$150,000	$300,000	$220,000	$150,000
Greenhouse Gas Emissions (MTCO2e)		5,400	8,300	6,300	4,300
GHG Split (Electricity/Natural Gas)		72%/28%	TBD		
Incremental Cost[1]		-	-	$5,500,000	$11,000,000

PRE-DESIGN SNAPSHOT

* Do not include renewables or district energy

Energy Ladder

Energy Use Reduction Strategies



How?	• Program right-sizing • Building orientation • Building design • Building materials	• District systems • High efficiency heating & cooling • Low energy fixtures	• Building automation systems • Lighting controls • Governance/ operational guidelines	• Solar • Wind • Geothermal • Sewer heat recovery • Waste to energy
When?	• Design/build	• Design • Procurement guidelines • Operations & maintenance	• Design • Governance • Operations & maintenance	• Design • After the three prior steps are resolved!

OPPORTUNITIES

- Campus Scale
- Partners: University, Utilities, DOE/NREL
- Fully Integrated Design
- City 2020 Goals
- Potential Sewer Heat recovery
- Modernizing infrastructure and more stringent building codes
- Public Private Partnerships
- Renewable Sources: Solar and Sewer Heat

OPPORTUNITY: ROOFTOP SOLAR

OPPORTUNITY: SEWER HEAT RECOVERY

45 MILLION GPD

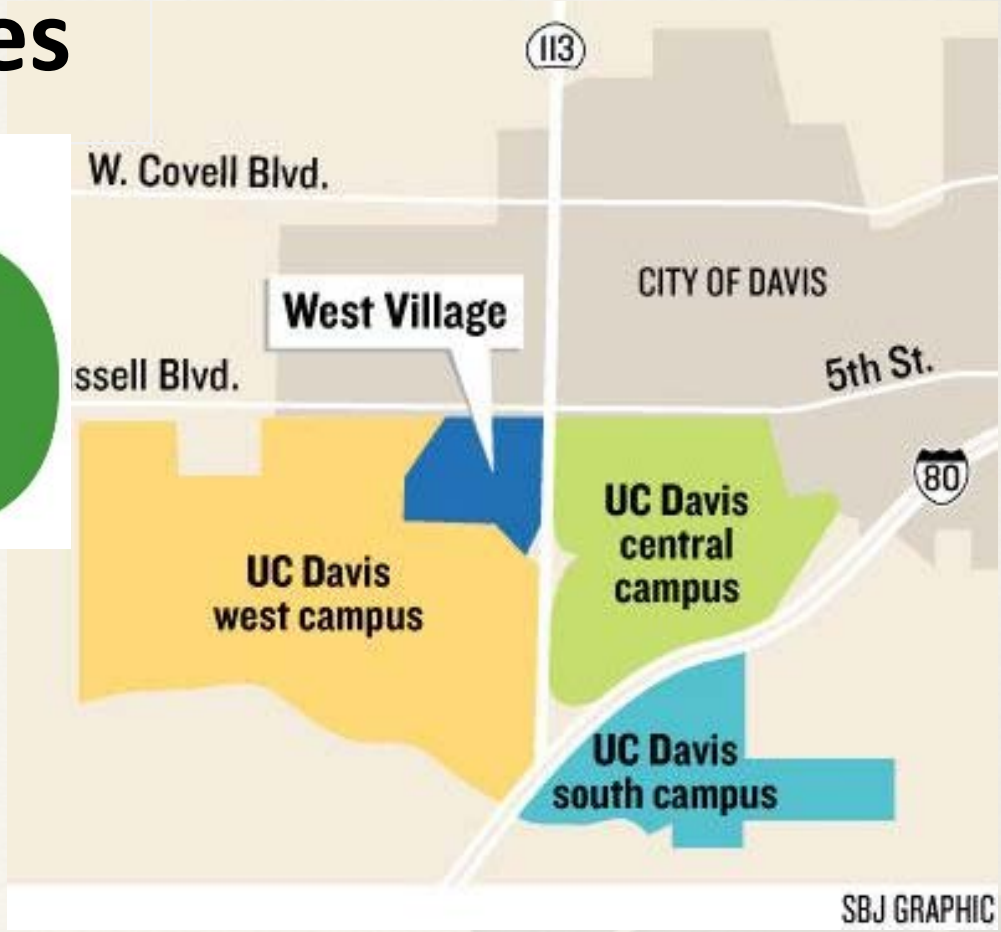
4°C EFFLUENT TEMPERATURE PROBLEM

CHALLENGES

- Time
- Phasing
- Funding/Financing
- Governance
- Tenant Controls

Zero Energy District Case Studies

FORT ZED



PEÑA STATION NEXT
NATIONAL WESTERN CENTER

Snapshot: Where are we in the development process?

2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022

- Land Acquisition *
- Rail Consolidation *
- Environmental Investigation & Remediation - Site
- Preliminary Planning/Studies
- Infrastructure Planning, Design & Construction
- Vertical Planning, Design & Construction

- Xcel Partners in Energy
- DOE ZED Accelerator

** Design and construction timelines will depend completely on the trajectory and schedule of the Land Acquisition and Rail Consolidation programs.*

Immediate Next Steps:

- Xcel Partners in Energy:
  - Finalize Goals, KPIs and ZED “boundaries”
  - Finalize Energy Plan
- DOE ZED Accelerator Program
  - Develop Business Case / Life Cycle Analysis
  - Operational Plan / Governance
  - Assess Procurement Strategies
- Incorporate into larger NWC Development Program, Design Standards
- Build Partnerships to get it done

EQUESTRIAN CENTER

Q & A

NATIONAL WESTERN CENTER
EXPOSITION HALL

Thank You

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