

An Integrated Approach for a Carbon Neutral Laboratory for the University of Maryland



Speakers

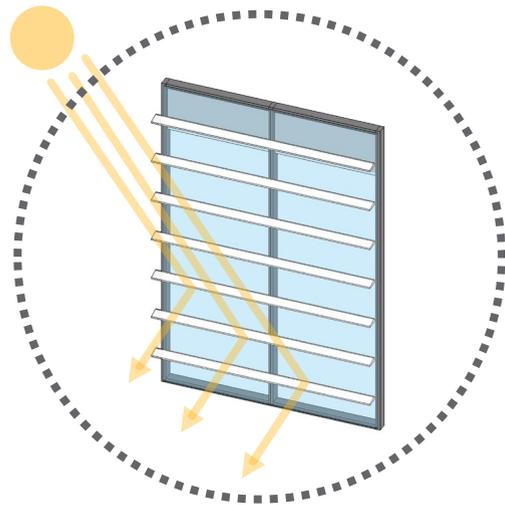
Bradford Crowley

Jason Ciotti-Niebish

Learning Objectives

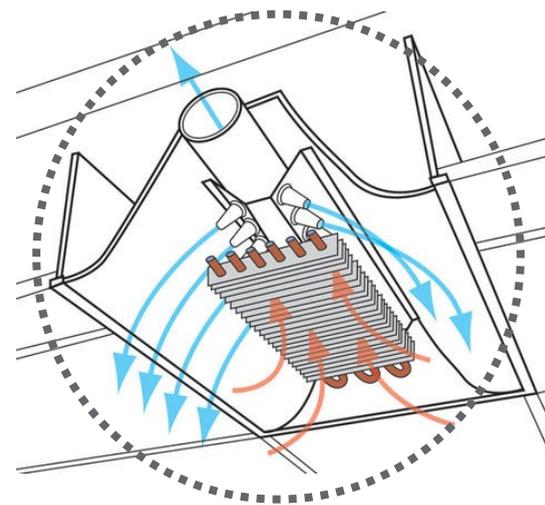
Passive Impact

Understand the impact of passive and active measures on a laboratory's carbon footprint



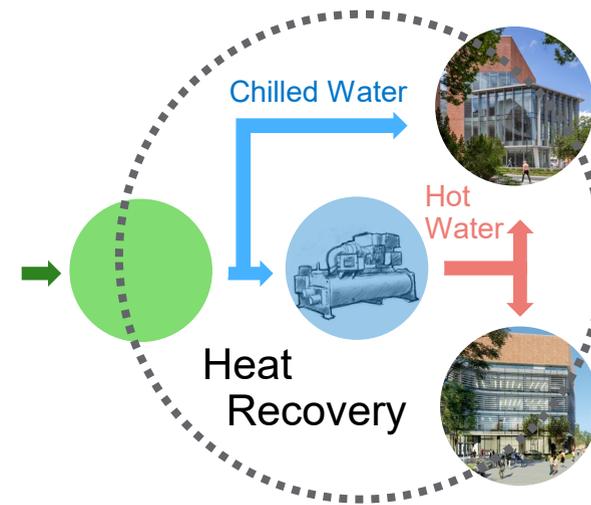
Innovative Systems

Demonstrate how low temperature hot water systems have changed the way we design laboratory MEP systems and what this means for future electrification efforts



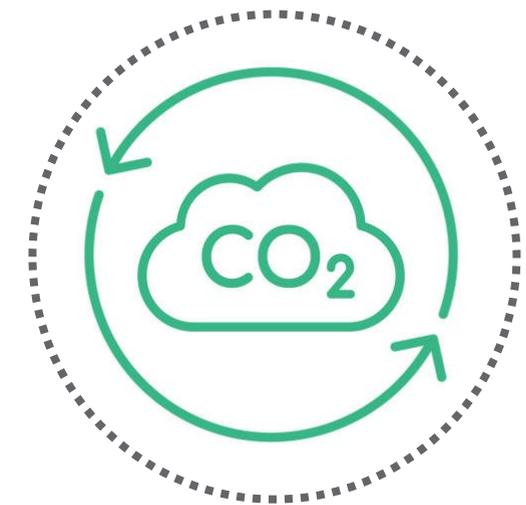
Electrifying Heat Production

Show how a district energy plant, run by a 3rd party, was used as an asset to create an innovative waste heat recovery system that provides hot water for two buildings



Carbon Neutrality

Identify key building elements that benefit from the integration of architecture and engineering with the goal of carbon neutrality



Formula

Passive Impact + **Active & Innovative Systems** + **Electrifying Heat Production** = **Carbon Neutrality**

Speakers

Engineering



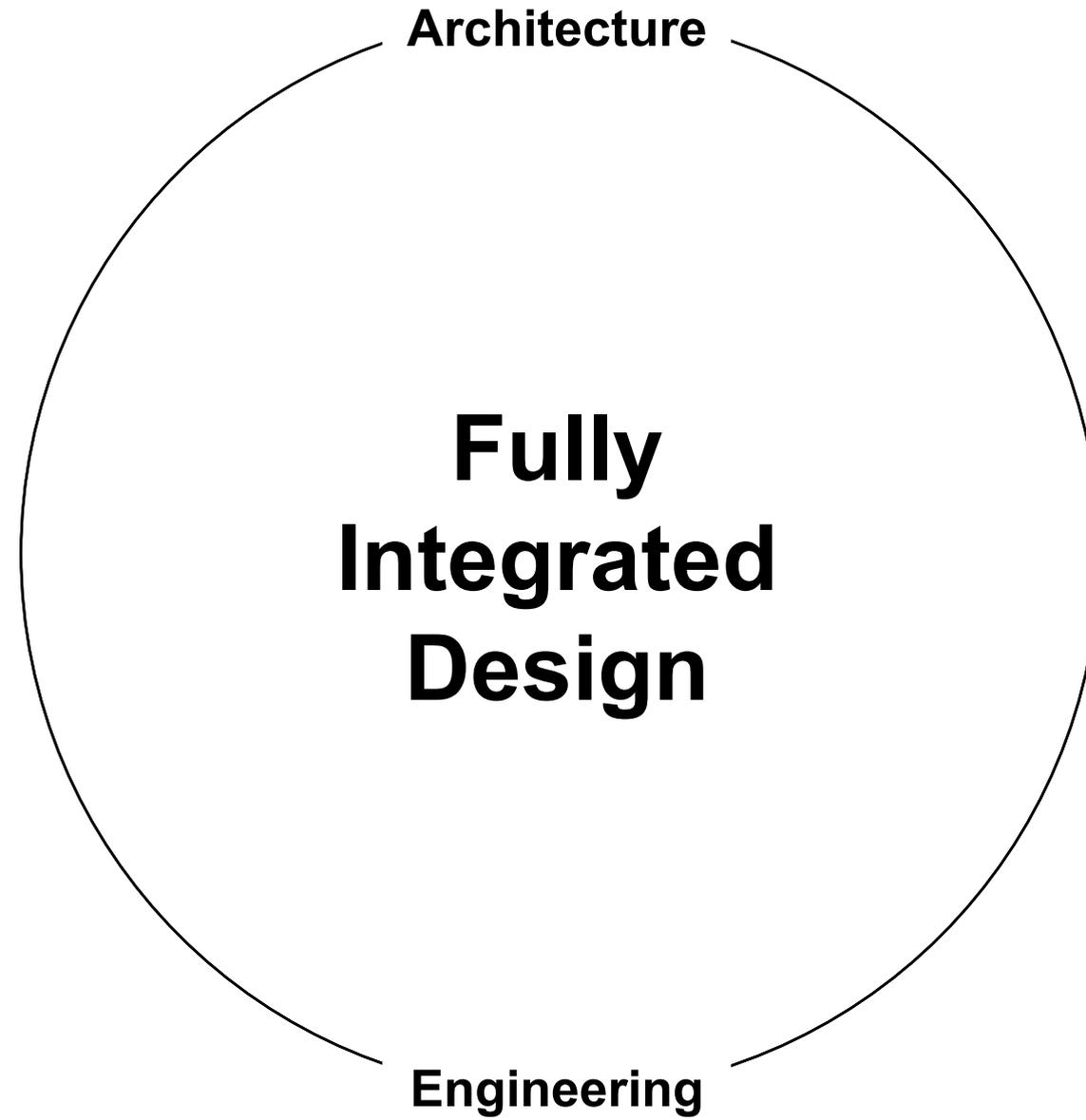
Brad Crowley PE, LEED AP
Principal, Ballinger

Architecture



Jason Ciotti-Niebish AIA, LEED GA
Associate Principal, Ballinger

Speakers



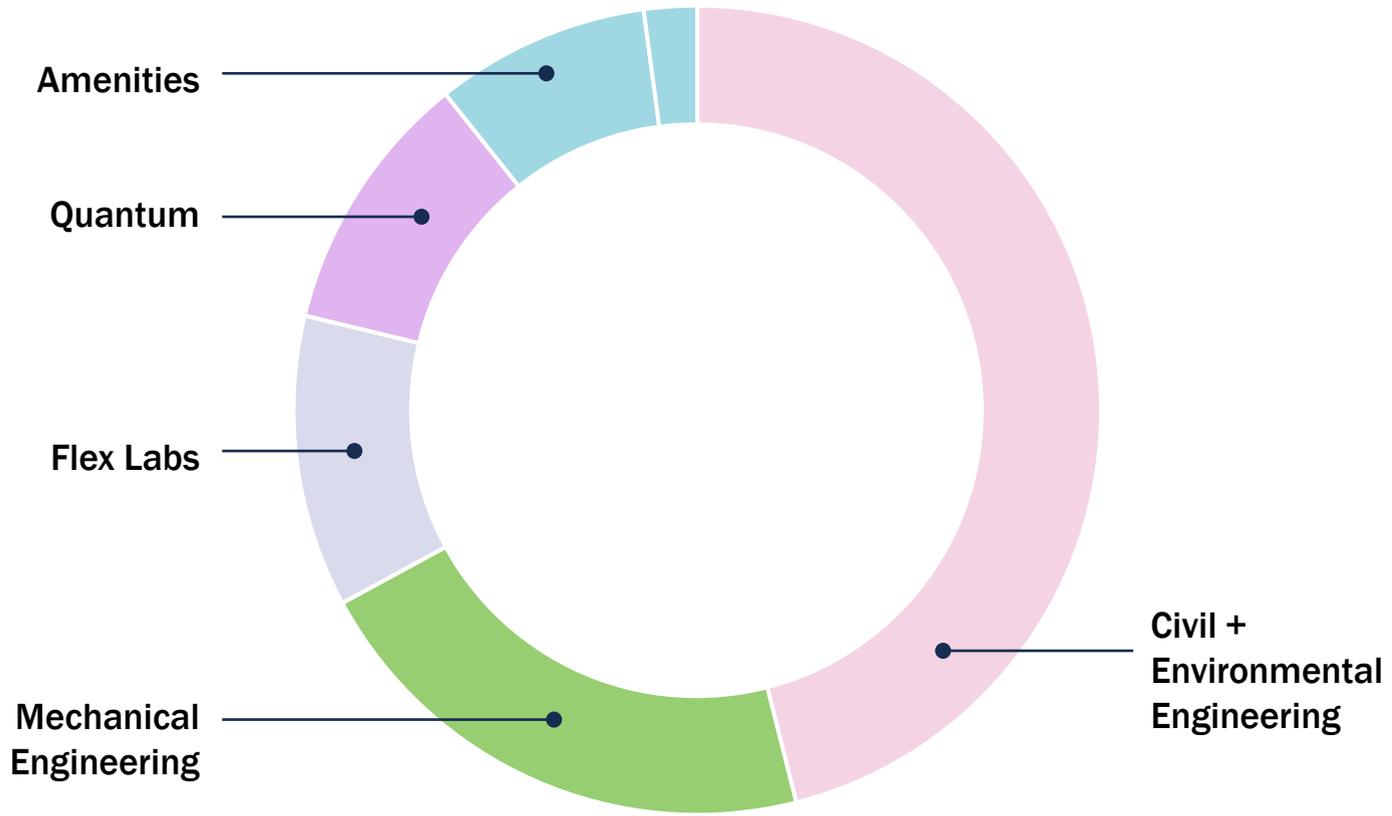
Client & Program

Stanley R. Zupnik Hall

Interdisciplinary Engineering Building, University of Maryland Collage Park



Project Understanding



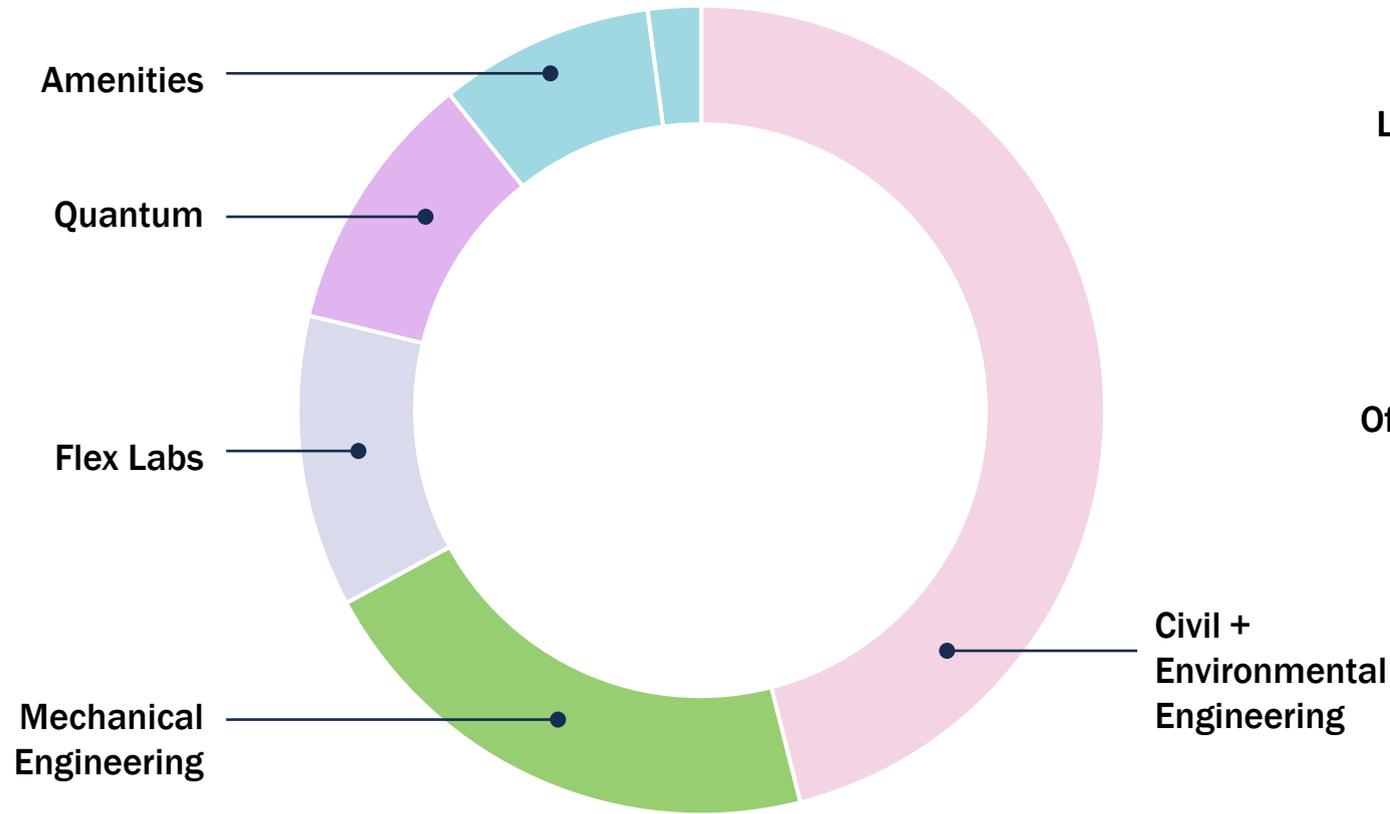
Program Summary

86,000 ASF / 164,000 GSF
54% Net / Gross

 Engineering Research +
Discovery



Project Understanding

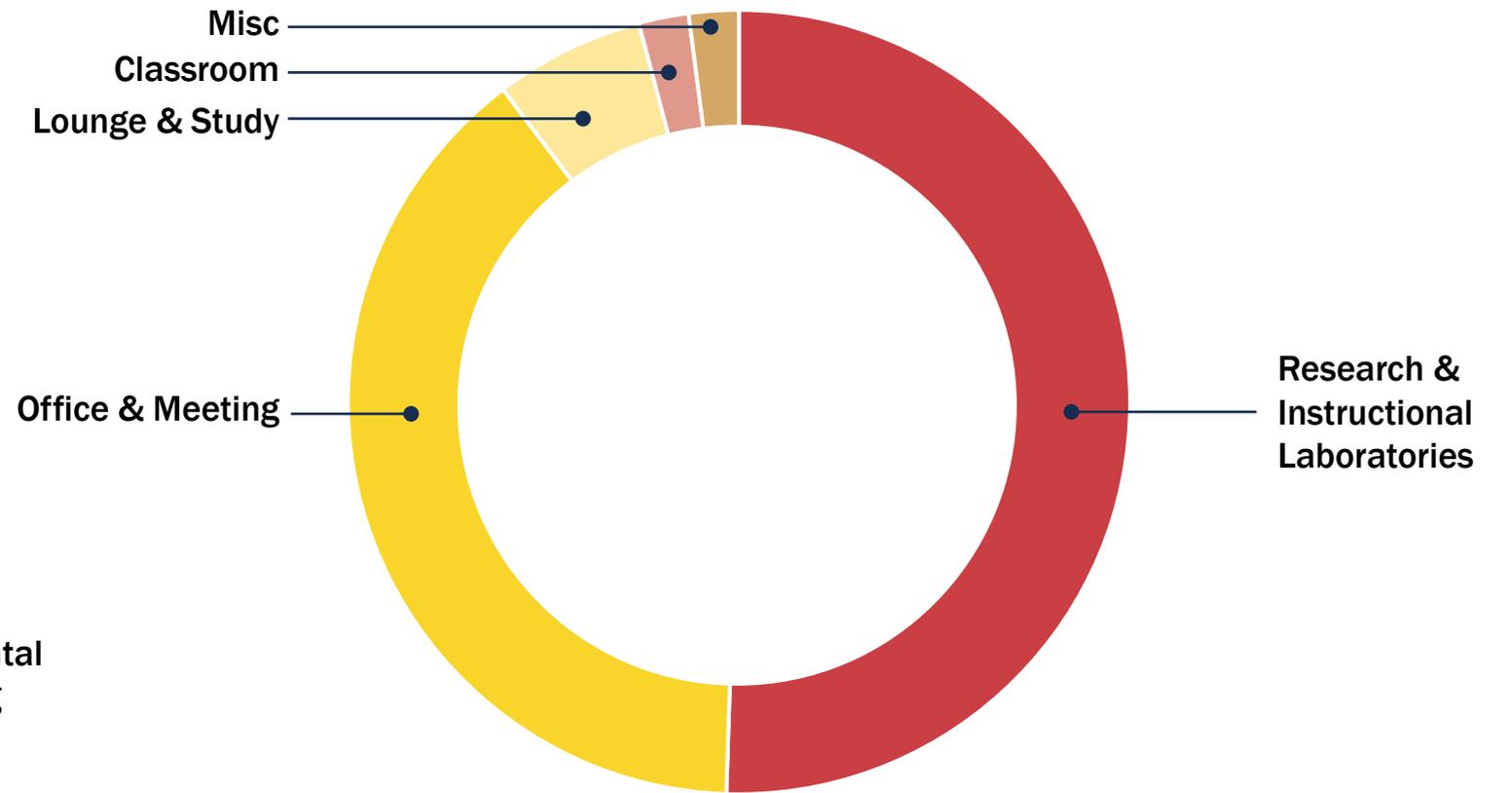


Program Summary

86,000 ASF / 164,000 GSF
54% Net / Gross



Engineering Research +
Discovery



Space Type Summary

42% Wet Capable
54 Fume Hoods



Site Improvement +
Integration

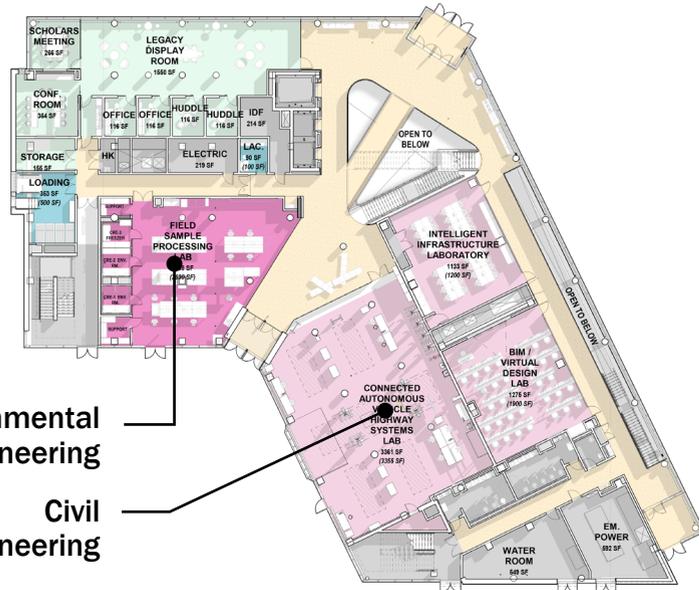
Exterior Overview | North & East Facades



Exterior Overview | South & East Facades



Floor Plan Overview | Program Distribution



Ground Floor

Environmental Engineering
Civil Engineering



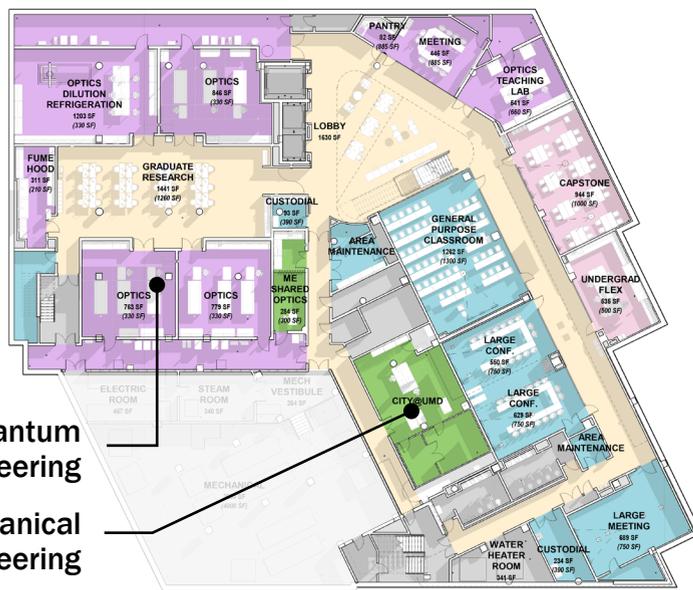
Second Floor

Mechanical Engineering
Civil Engineering



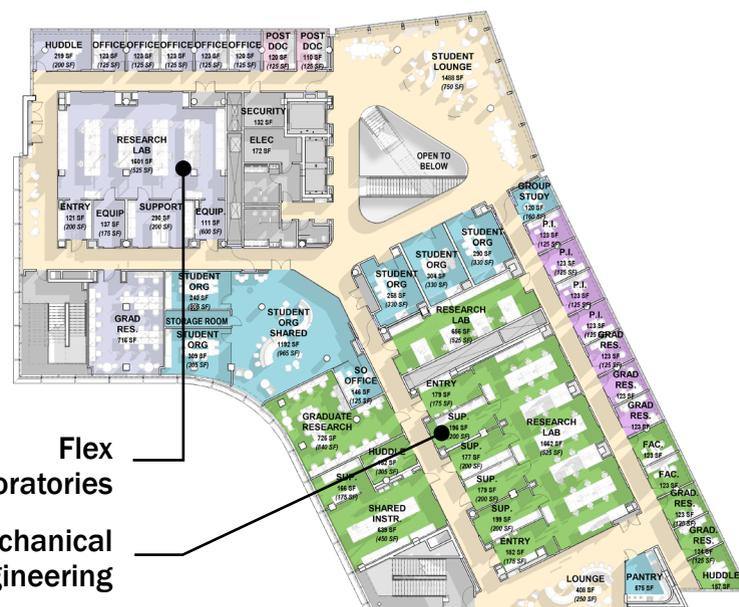
Fourth Floor

Civil & Environmental Engineering
Administration



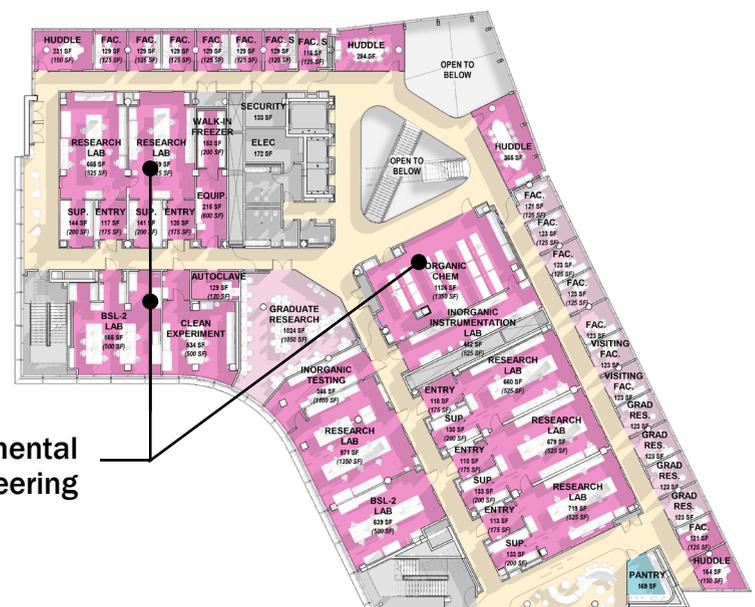
Basement

Quantum Engineering
Mechanical Engineering



First Floor

Flex Laboratories
Mechanical Engineering



Third Floor

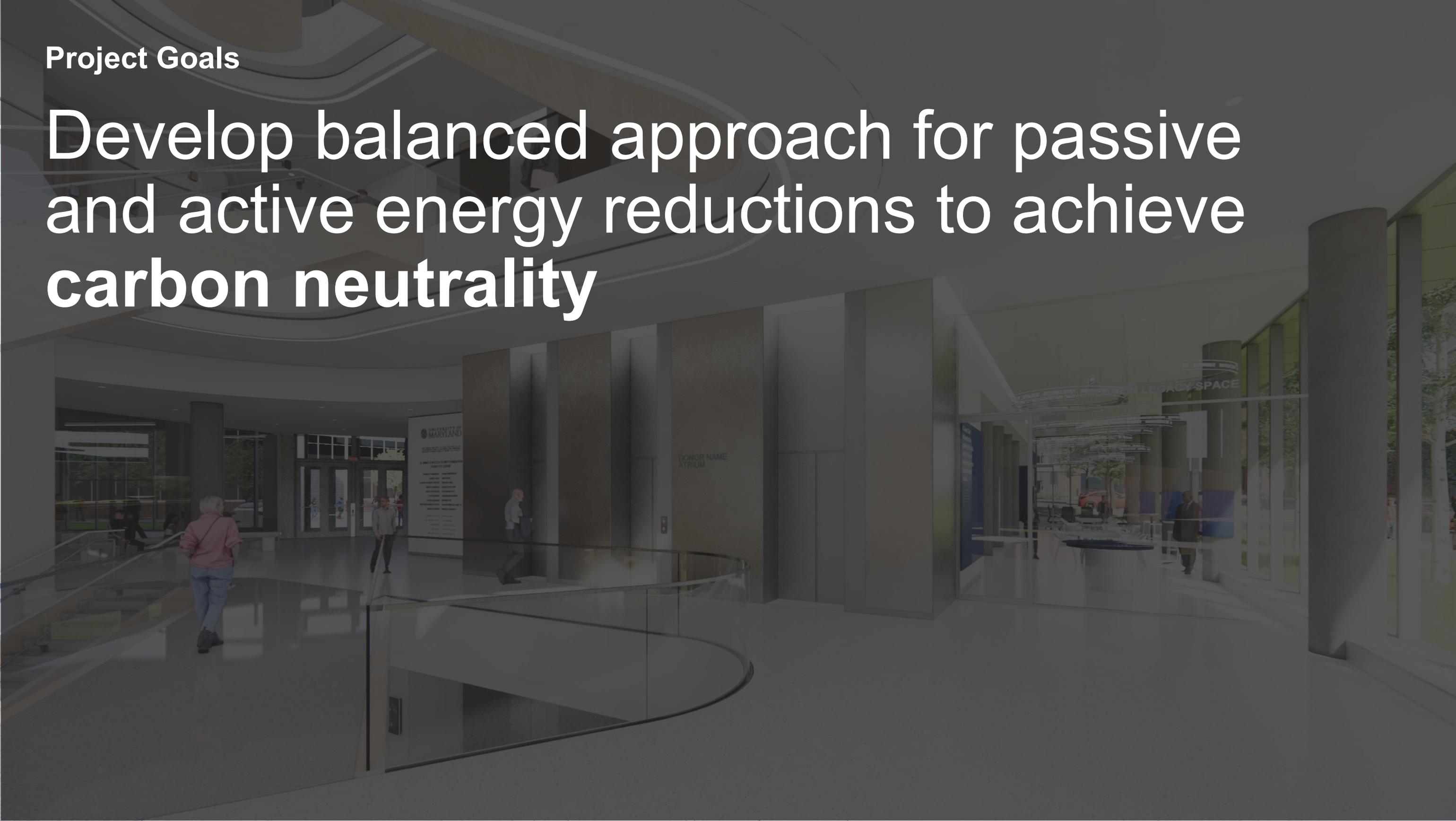
Environmental Engineering

Atrium | Facilitating Connections & Air Exchange



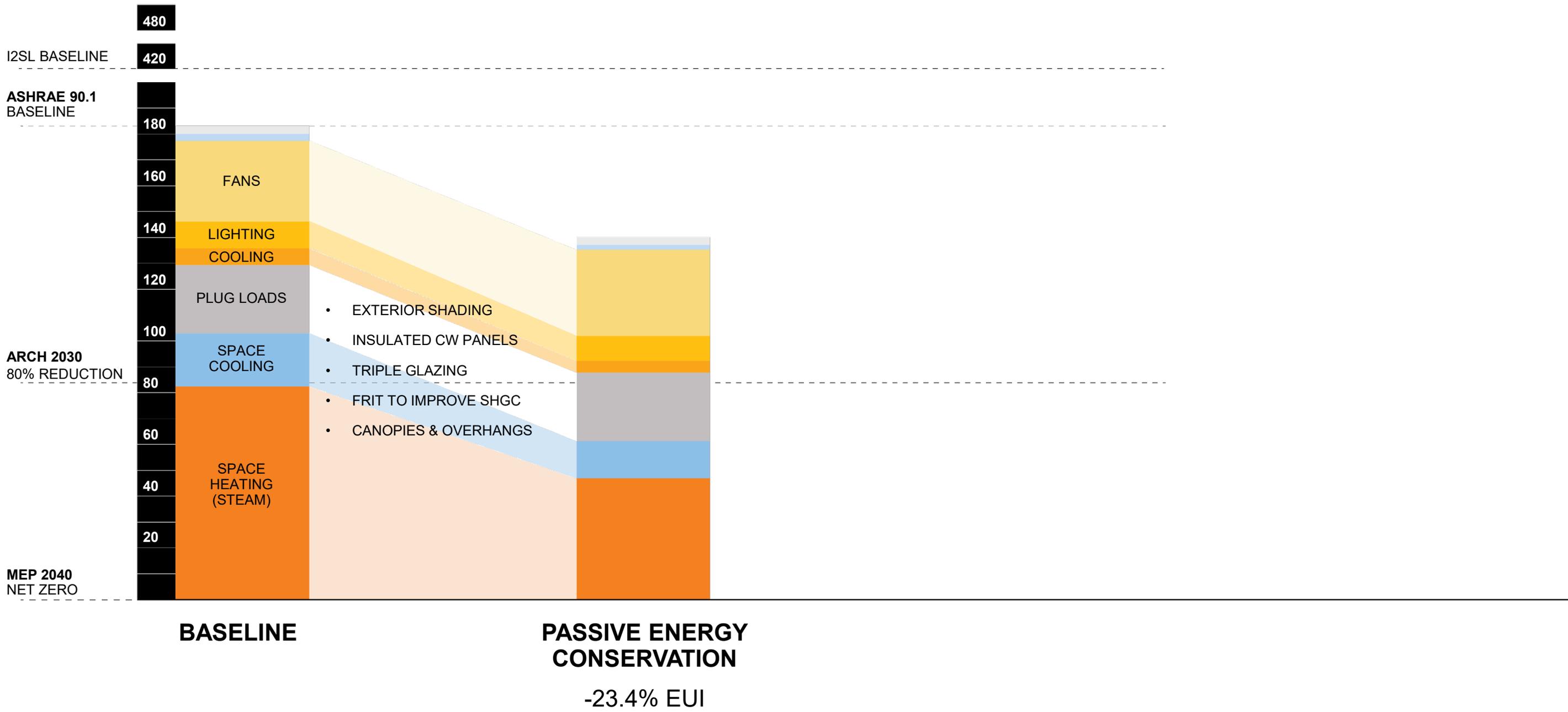
Project Goals

Develop balanced approach for passive and active energy reductions to achieve **carbon neutrality**



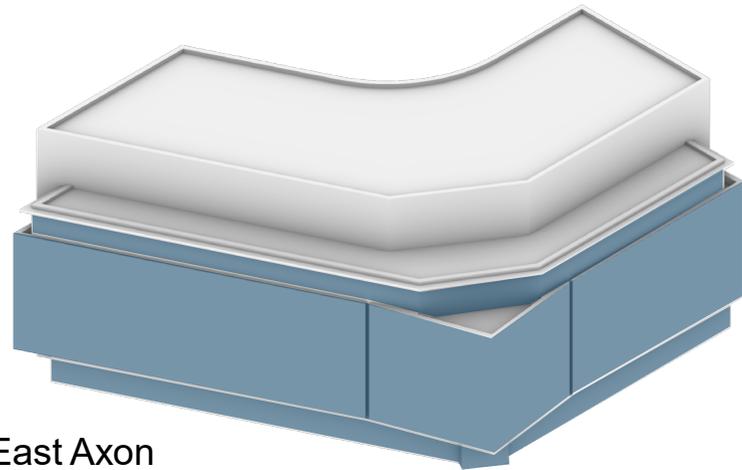


Building Energy Conservation | I2SL Building Baseline

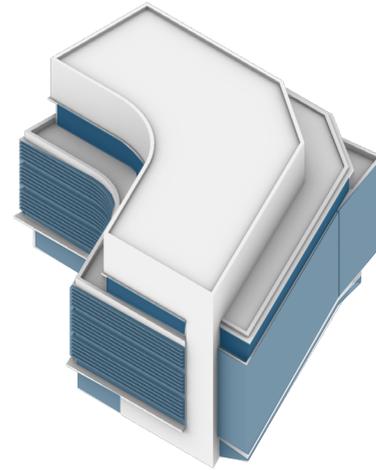


Building Energy Conservation | Passive Systems

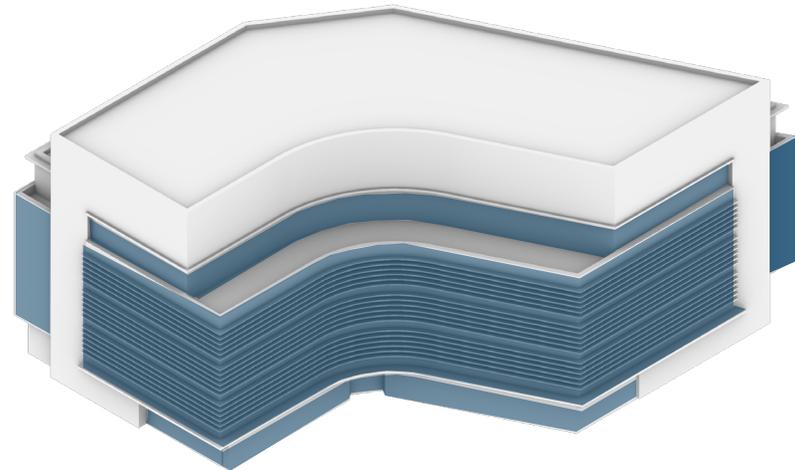
Passive Energy Reductions | Orientation-Specific Envelope Design



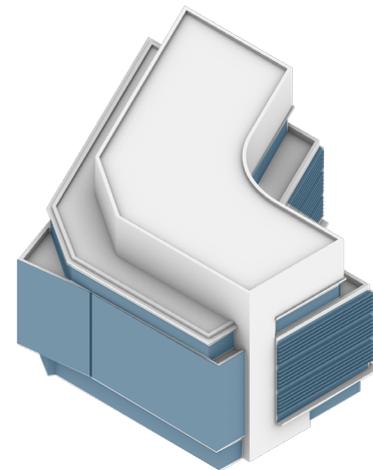
North-East Axon



South-East Axon



South-West Axon

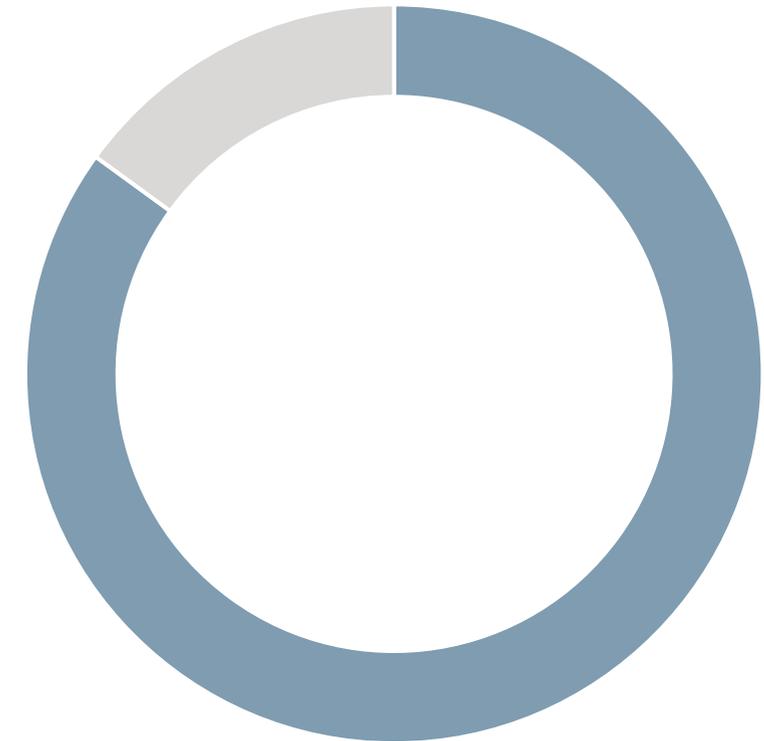


North-West Axon

Exterior Wall Systems:

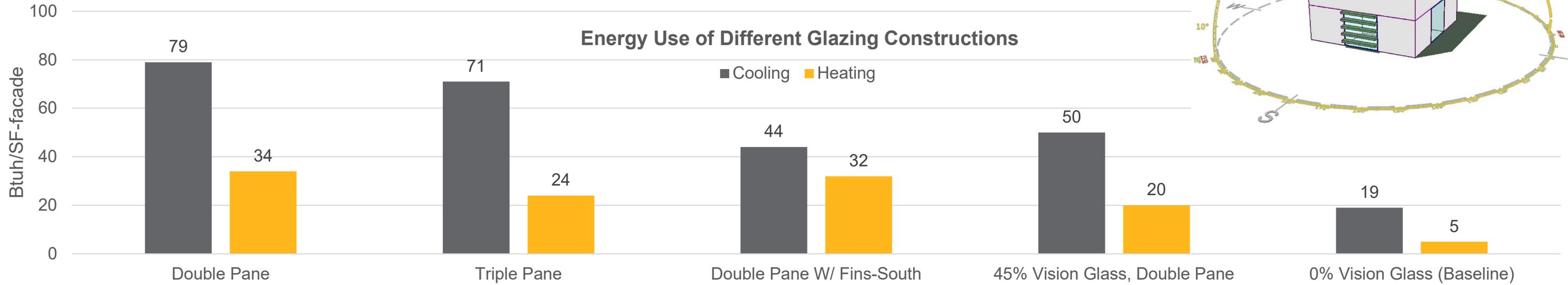
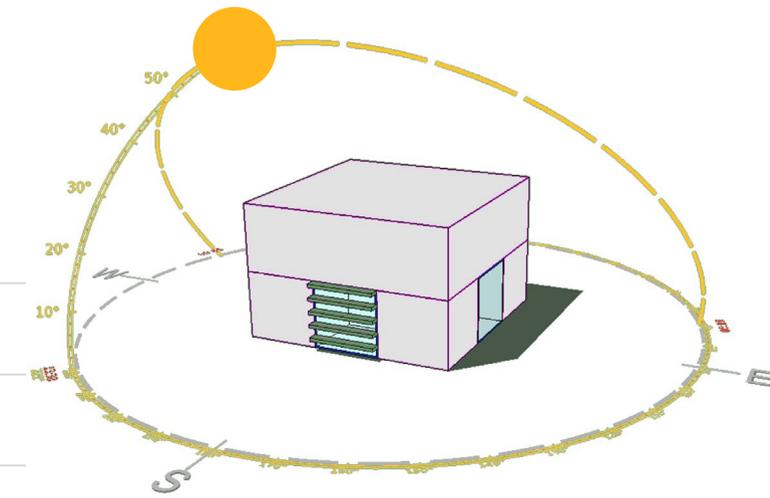
Curtain Wall = 85%

Masonry Wall = 15%



■ CURTAIN WALL ■ SOLID WALL

Passive Energy Reductions | Glazing Sensitivity Analysis – South Façade



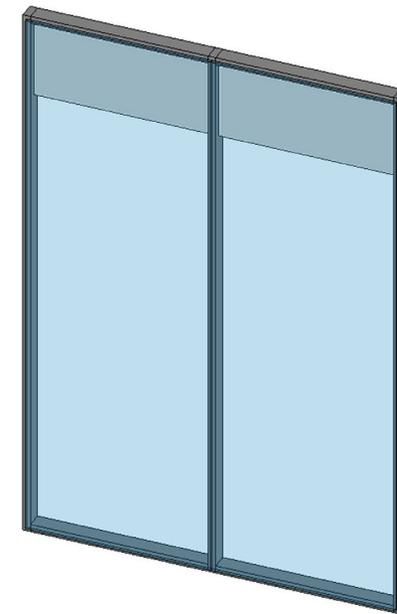
Glazing Option No.	Glazing Option Description	Thermal Comfort (PPD) (Summer/Winter)	Cooling Load (Btuh/SF-facade)	Heating Load (Btuh/SF-facade)
1.	Double Pane, Low-e (surface 2 (s2))	31% / 10%	79	34
2.	Triple Pane, Low-e (s2)	28% / 9%	71	24
3.	Double Pane, Low-e (s2), Fins - South	20% / 10%	44	32
4.	45% Vision Glass, Double Pane, Low-e (s2)	22% / 8%	50	20
5.	0% transparent (baseline)	15% / 7%	19	5

Passive Energy Reductions | Curtain Wall System Assemblies



Equivalent performance

Equivalent performance, refers to achieving the same level of functionality or desired outcome using different design approaches, materials, systems, or strategies. It's about ensuring a building or system still meets its intended goals even with changes in its underlying components or configurations.



SYSTEM 01:

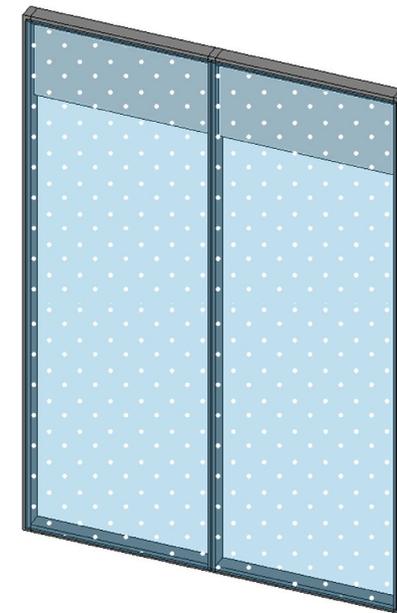
- Triple Glazing - Low-E Coating
- Shading via Building Overhang

Passive Energy Reductions | Curtain Wall System Assemblies



Equivalent performance

Equivalent performance, refers to achieving the same level of functionality or desired outcome using different design approaches, materials, systems, or strategies. It's about ensuring a building or system still meets its intended goals even with changes in its underlying components or configurations.



SYSTEM 02:

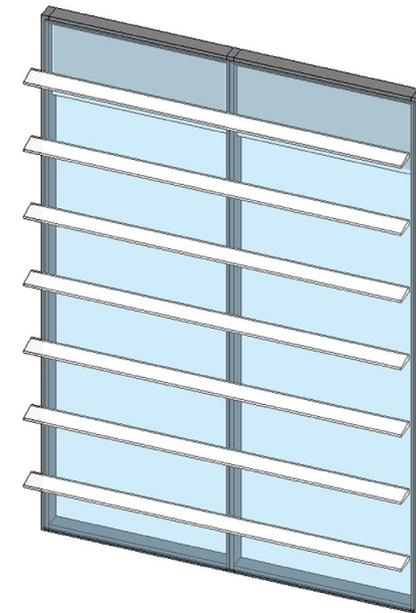
- Triple Glazing - Low-E Coating
- 30% Uniform Frit (SHGC)

Passive Energy Reductions | Curtain Wall System Assemblies



Equivalent performance

Equivalent performance, refers to achieving the same level of functionality or desired outcome using different design approaches, materials, systems, or strategies. It's about ensuring a building or system still meets its intended goals even with changes in its underlying components or configurations.



SYSTEM 03:

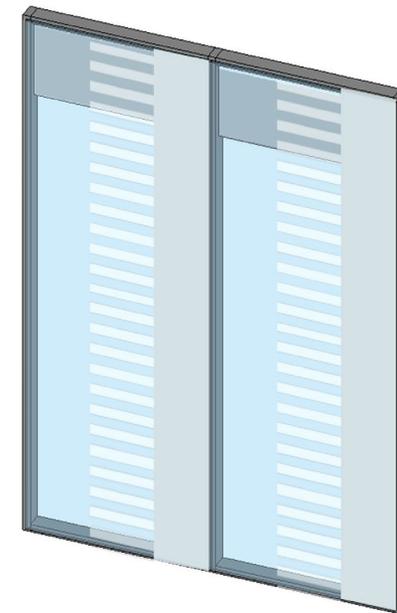
- Double Glazing - Low-E Coating
- Continuous Exterior Shading

Passive Energy Reductions | Curtain Wall System Assemblies



Equivalent performance

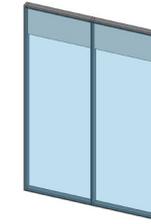
Equivalent performance, refers to achieving the same level of functionality or desired outcome using different design approaches, materials, systems, or strategies. It's about ensuring a building or system still meets its intended goals even with changes in its underlying components or configurations.



SYSTEM 04:

- Double Glazing - Low-E Coating
- 33% Uniform Frit (SHGC)
- 33% Insulated Back Panel

Passive Energy Reductions | Curtain Wall System Assemblies



SYSTEM 01

 Triple Glazing - Low-E Coating
Shading via Building Overhang



SYSTEM 02:

 Triple Glazing – Low-E Coating
30% Uniform Frit (SHGC)



SYSTEM 03:

 Double Glazing – Low-E Coating
Continuous Exterior Shading



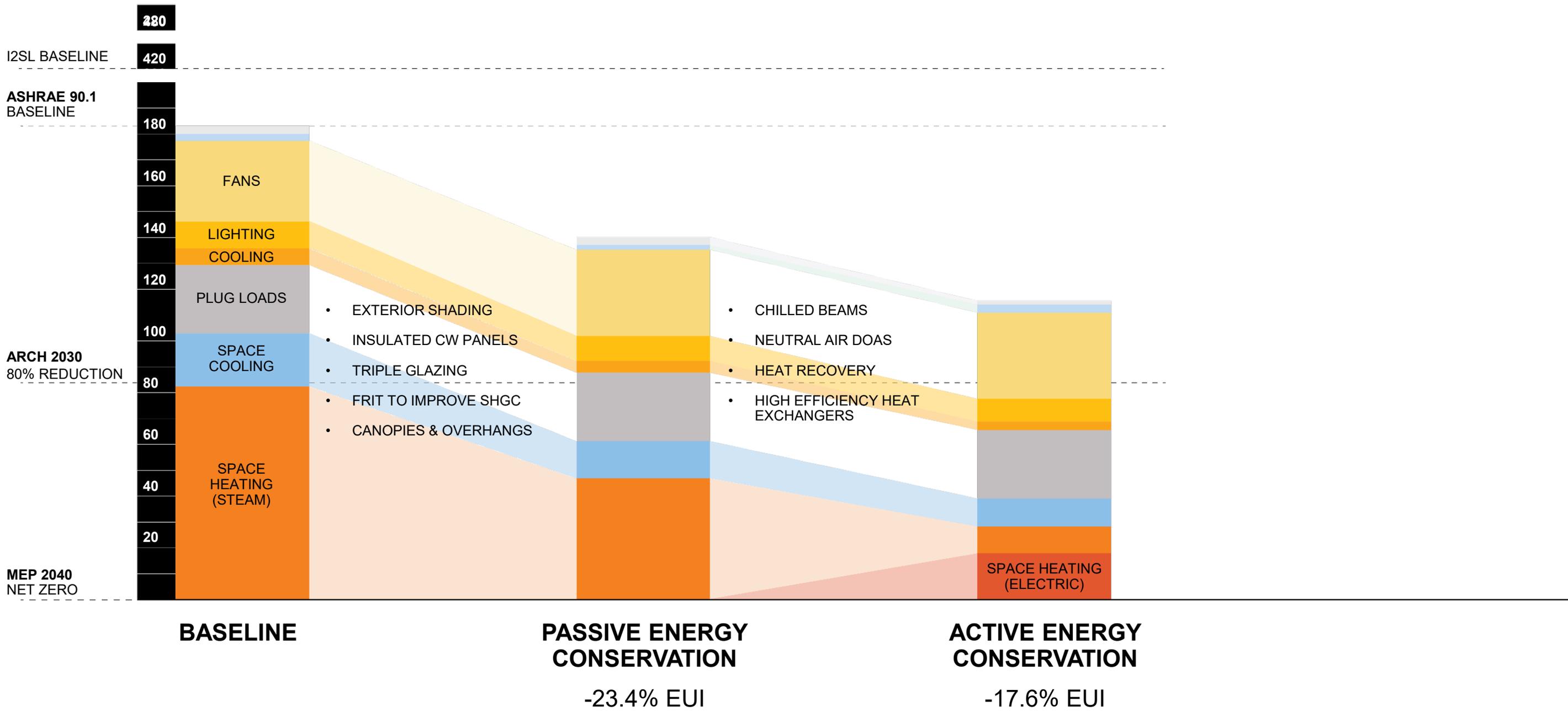
SYSTEM 04:

 Double Glazing – Low-E Coating
33% Uniform Frit (SHGC)
33% Insulated Back Panel (R-21)

Project Goals | Active Energy Conservation

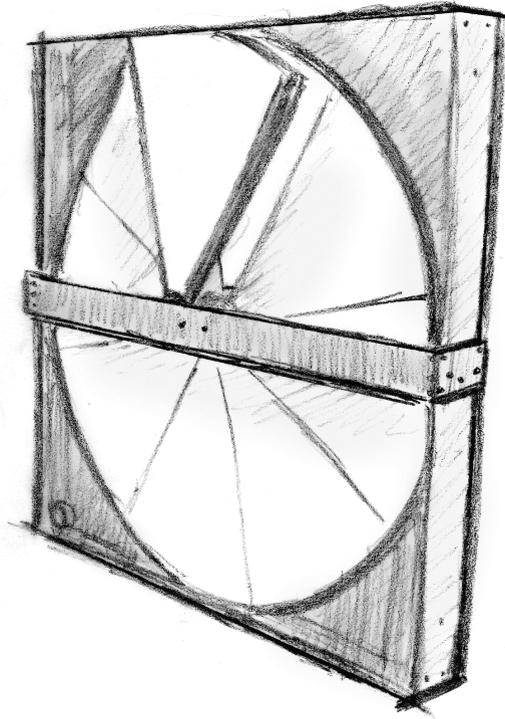
Innovative Systems Active Energy Conservation



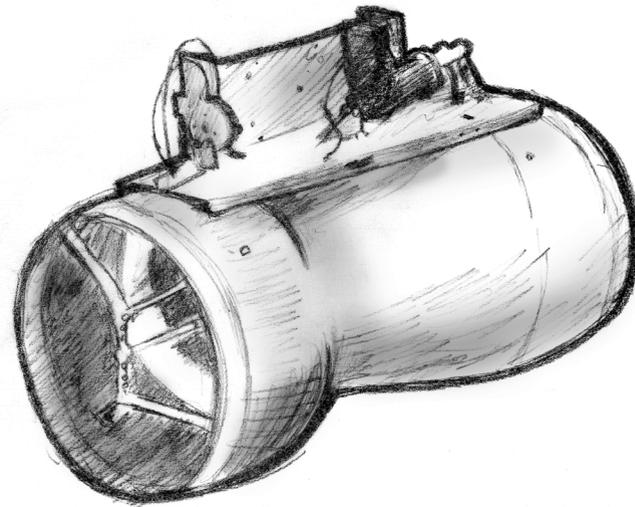


Building Energy Conservation | Active Systems

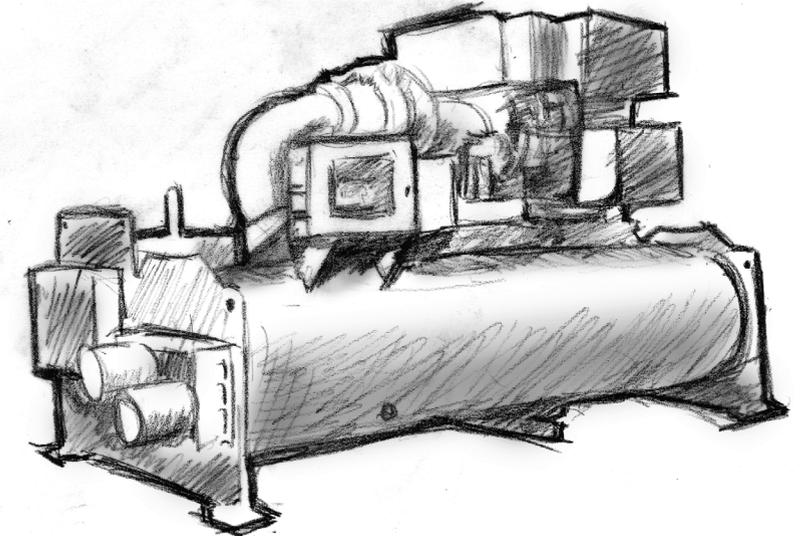
Electrification Informing System Design



Maximizing Energy
Recovery & Eliminating Reheat

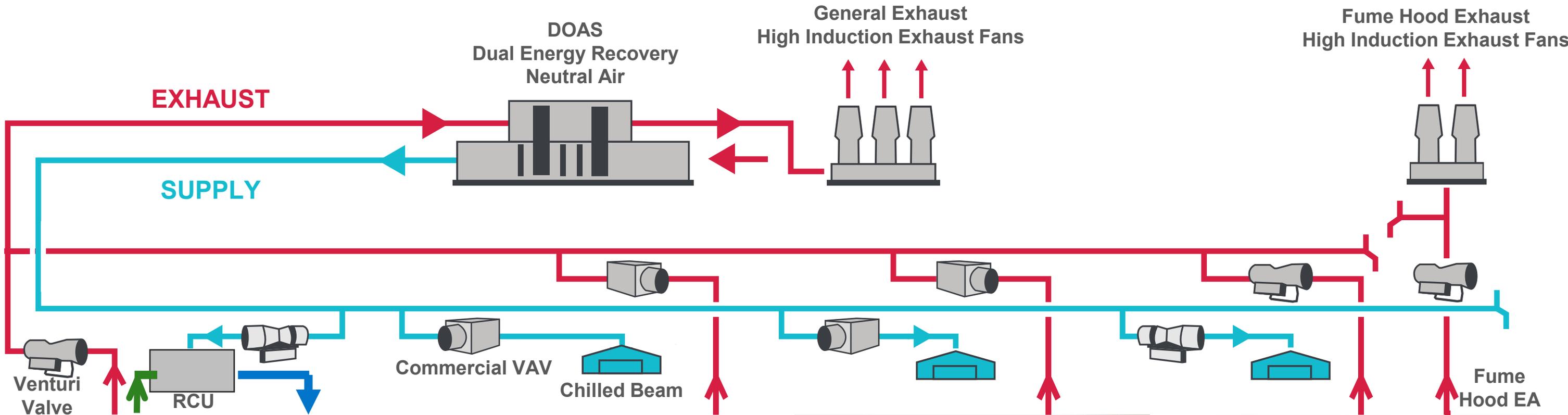


Optimizing
Ventilation



Electrifying Water Production
/ Low Temperature Water

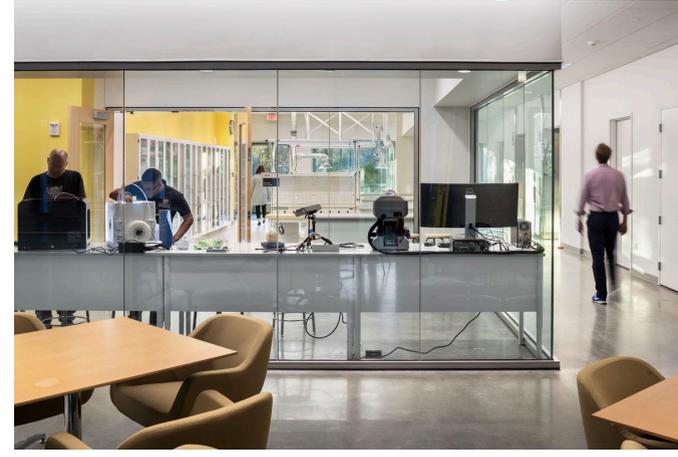
Active Energy Conservation | Neutral Air DOAS & Chilled Beams



**Quantum
Technology Center**



**Student
Lounge**

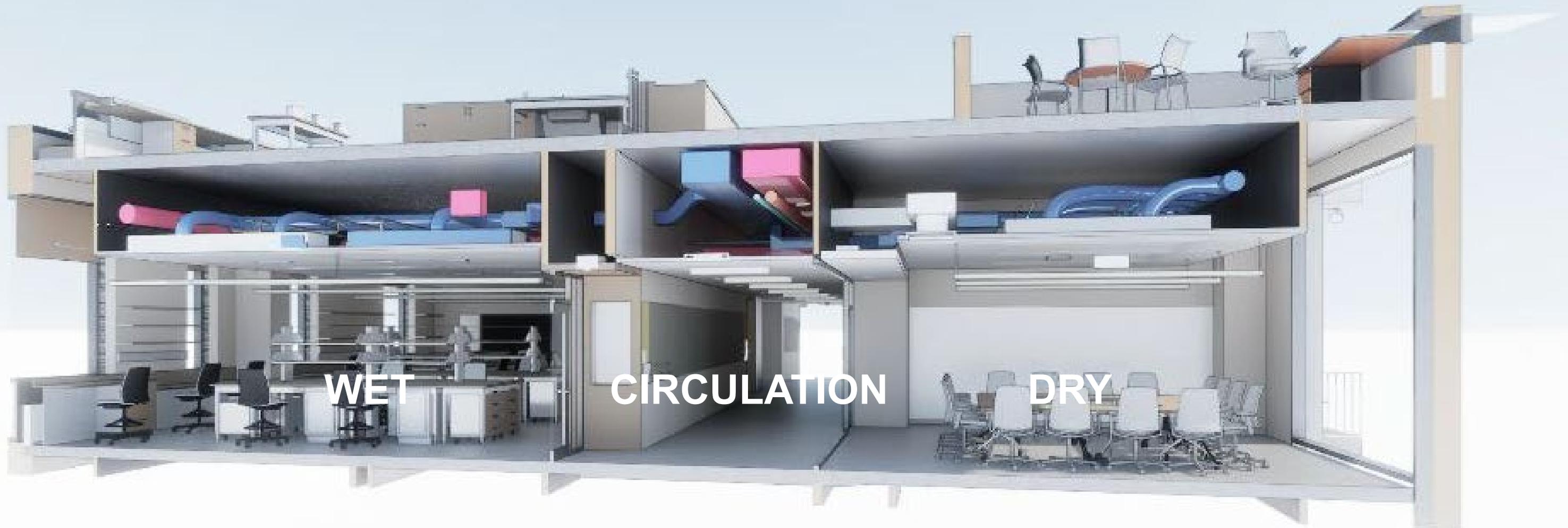


Dry Lab



Wet Lab

Active Energy Conservation | Air-share



WET

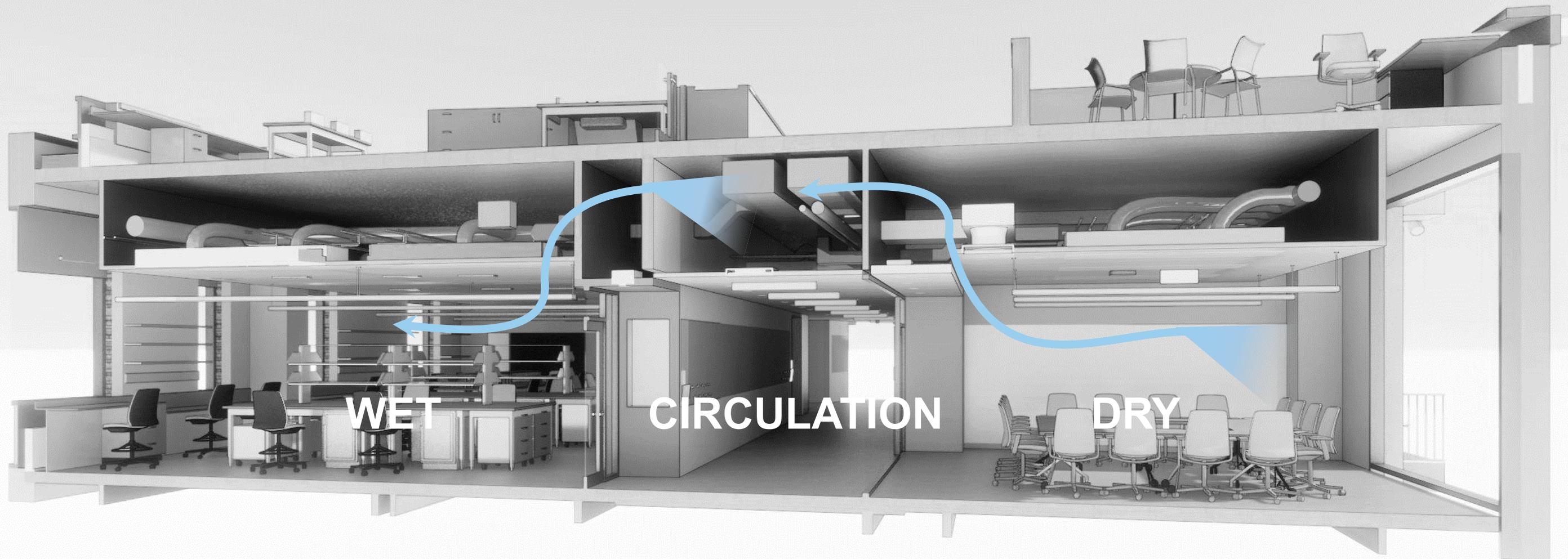
CIRCULATION

DRY

Laboratory Zone

Workplace Zone

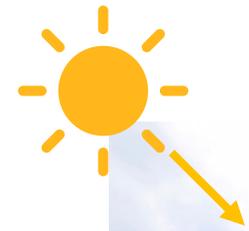
Active Energy Conservation | Air-share



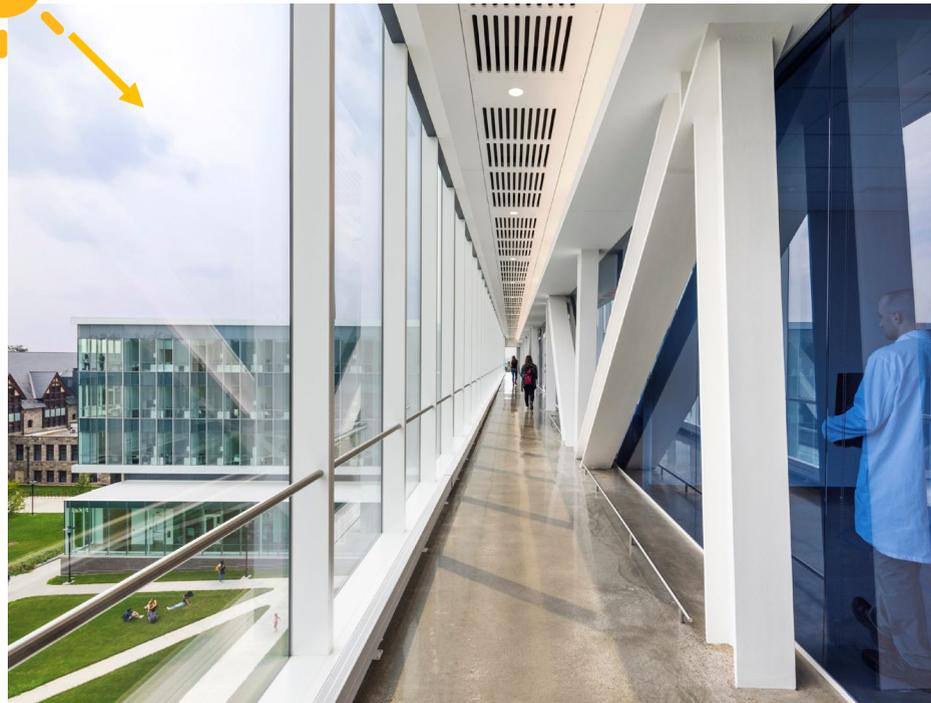
Laboratory Zone

Workplace Zone

Wintertime Chilled Water – Capturing Heat



South Facade



Use chilled water to capture heat

North Facade



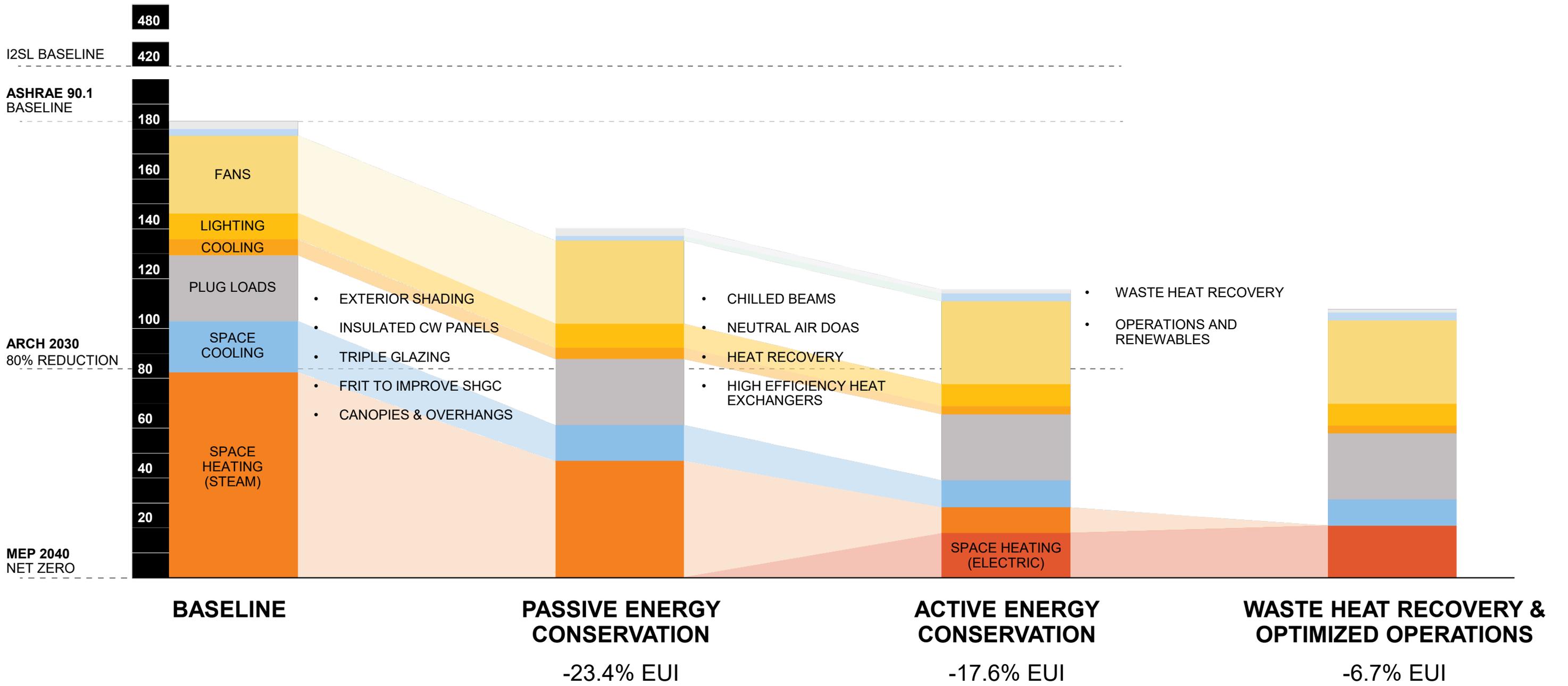
Deliver heat to where it is needed

Convert heat to higher temperature

Project Goals | Waste Heat Recovery

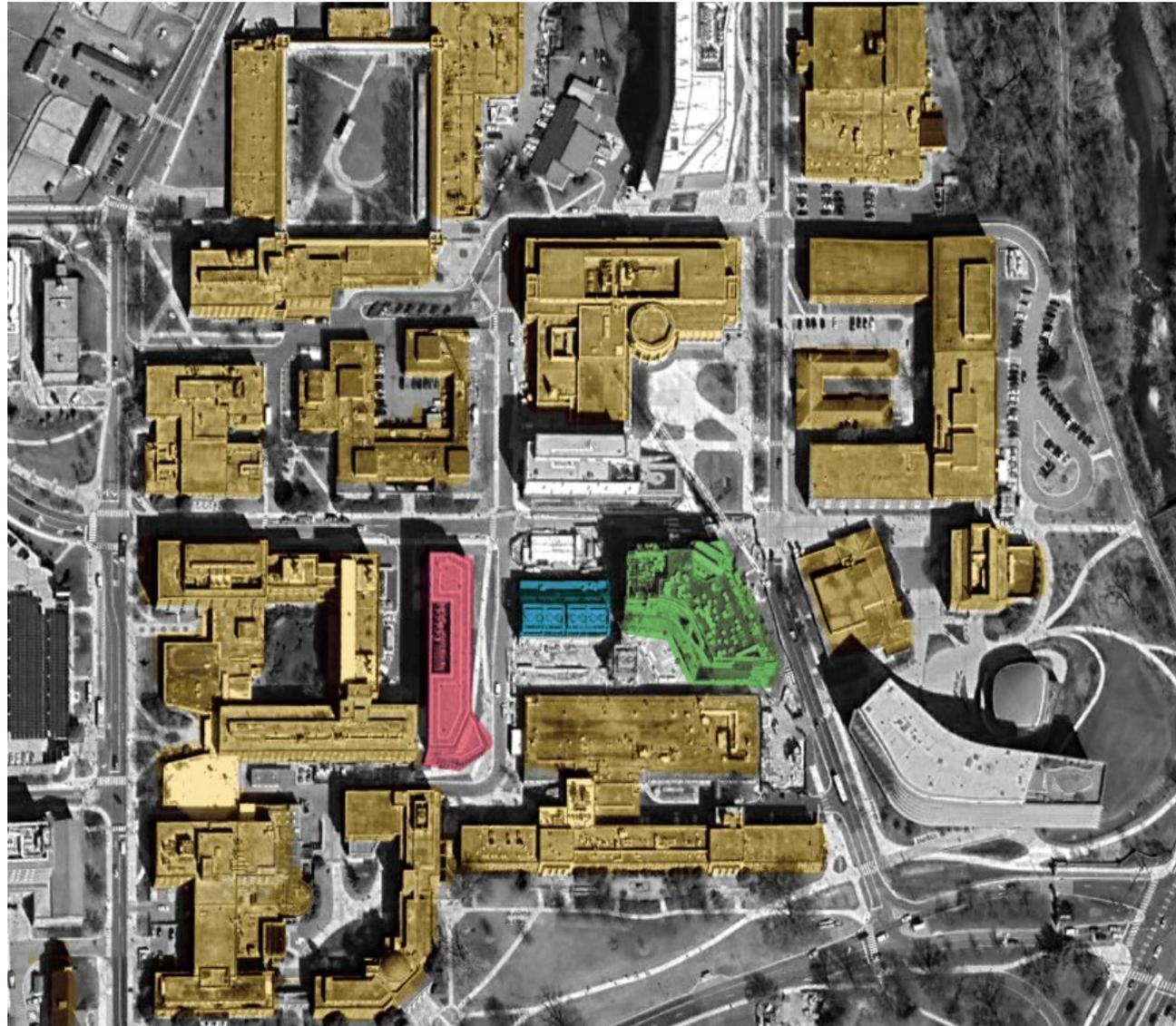
Waste Heat Recovery





Building Energy Conservation | Waste Heat Recovery

SCUB IV District Chilled Water Plant



- Buildings served by SCUB
- Stanley R. Zupnik Hall
- Chemistry Research Building
- SCUB



- SCUB IV – serves 2.5 million square feet
- ~6,400 nominal tons. Currently operates beyond firm capacity (a project to add additional capacity is in design).
- Operated by a 3rd party
- Creates chilled water year round

No CHW capacity available for Zupnik Hall



STANLEY R. ZUPNIK HALL

STANLEY R. ZUPNIK HALL



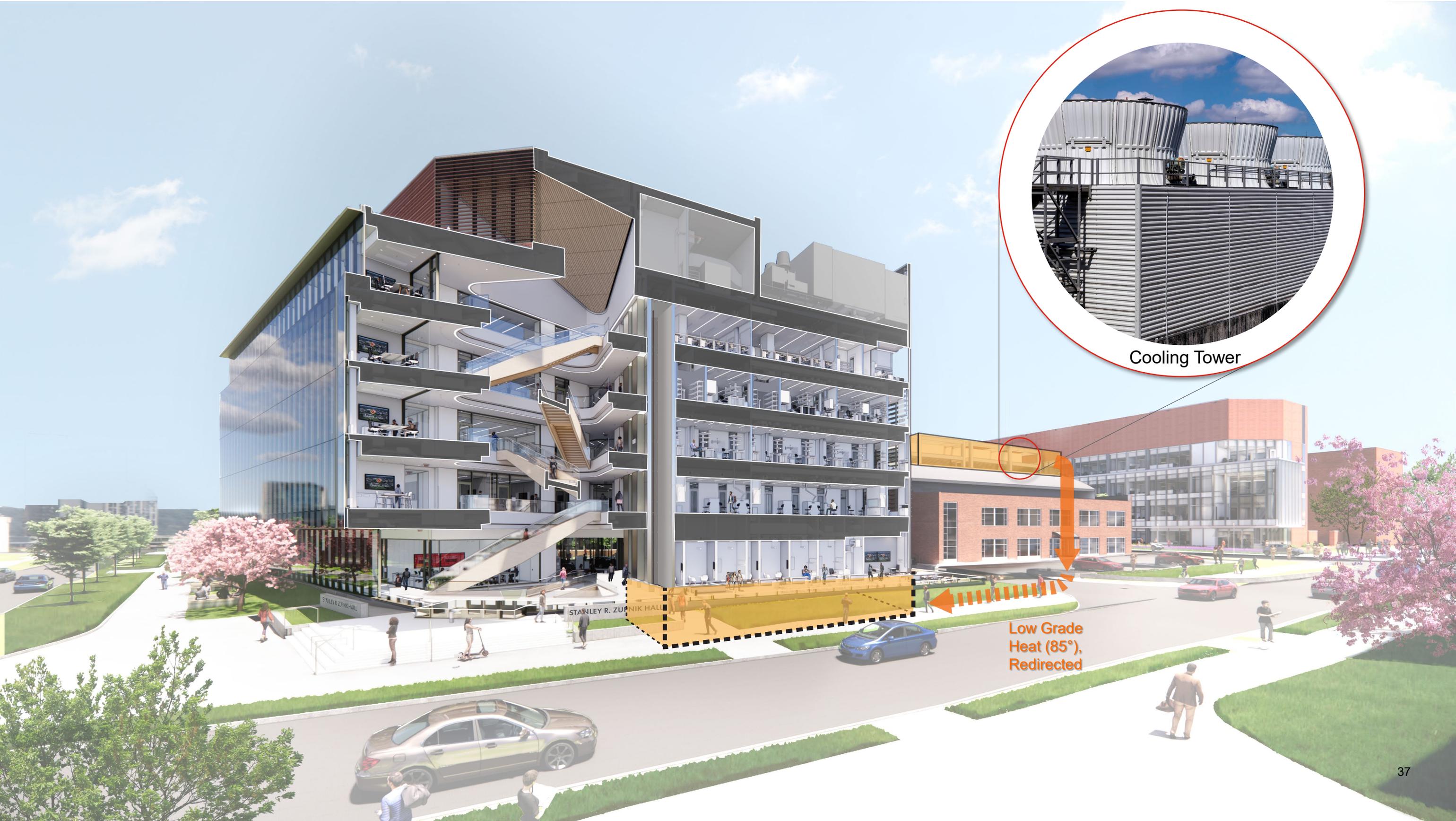
Cooling Tower



Low Grade Heat (85°)

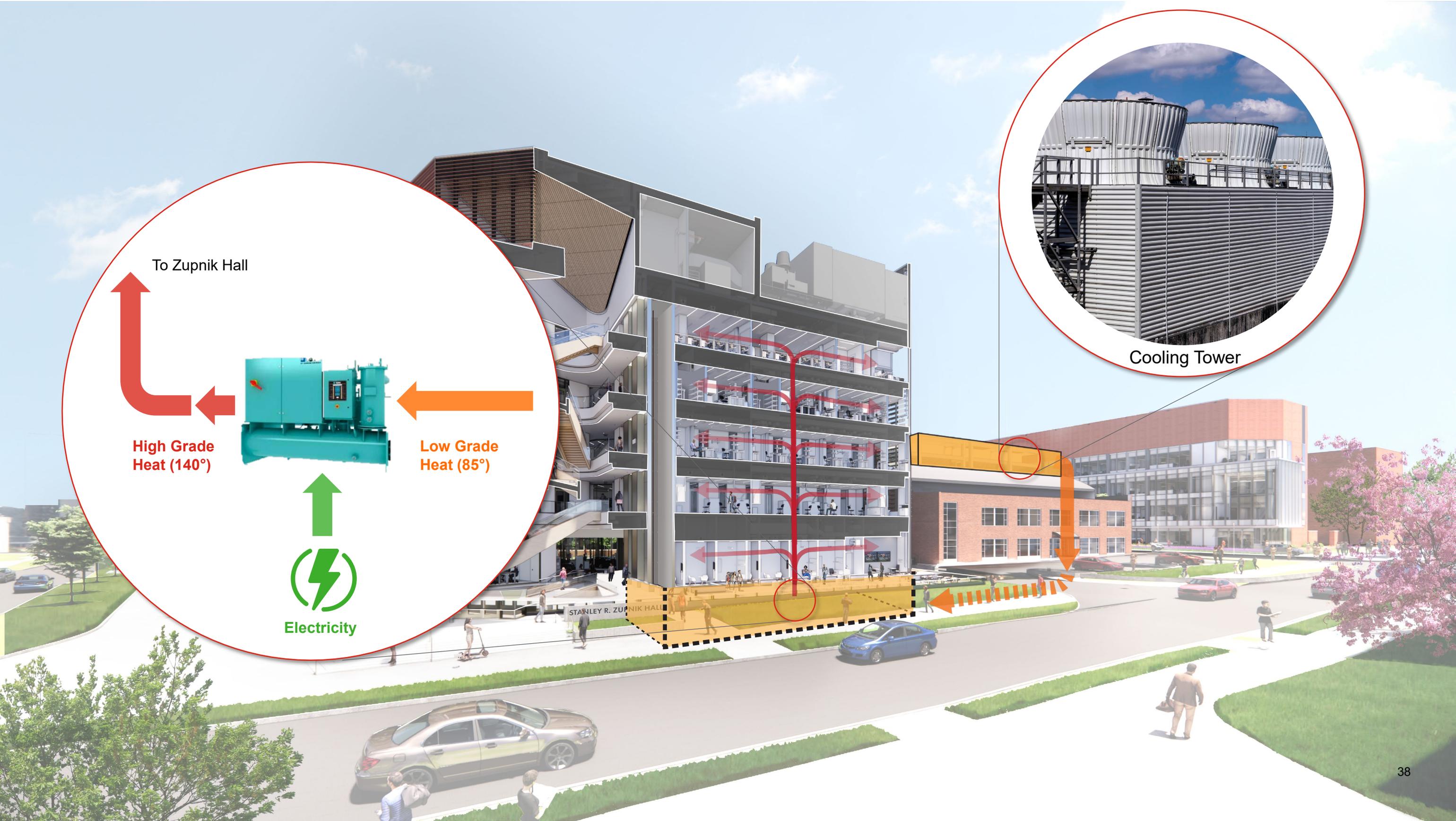
STANLEY R. ZUPNIK HALL

STANLEY R. ZUPNIK HALL



Cooling Tower

Low Grade Heat (85°), Redirected



To Zupnik Hall

High Grade Heat (140°)



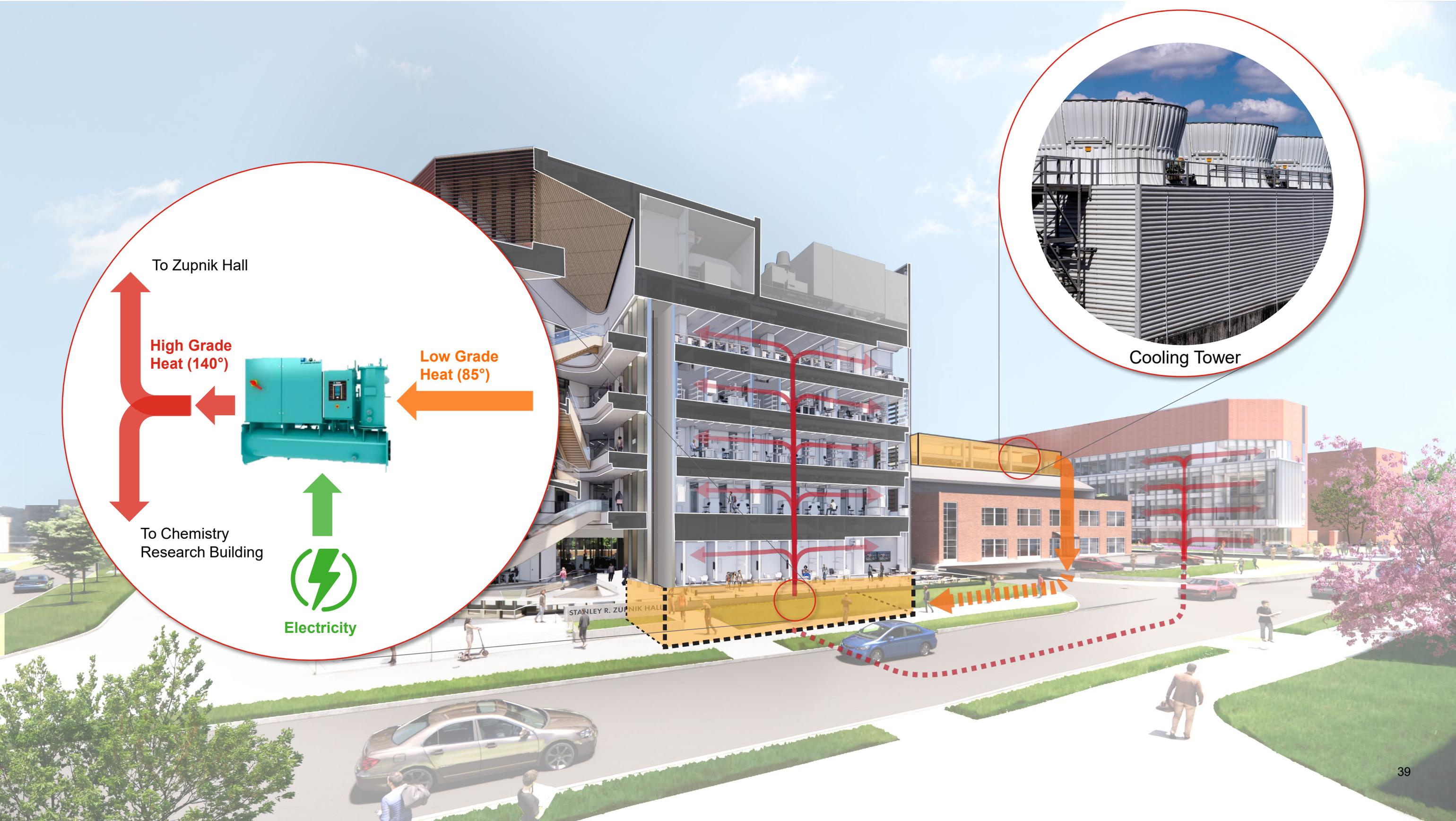
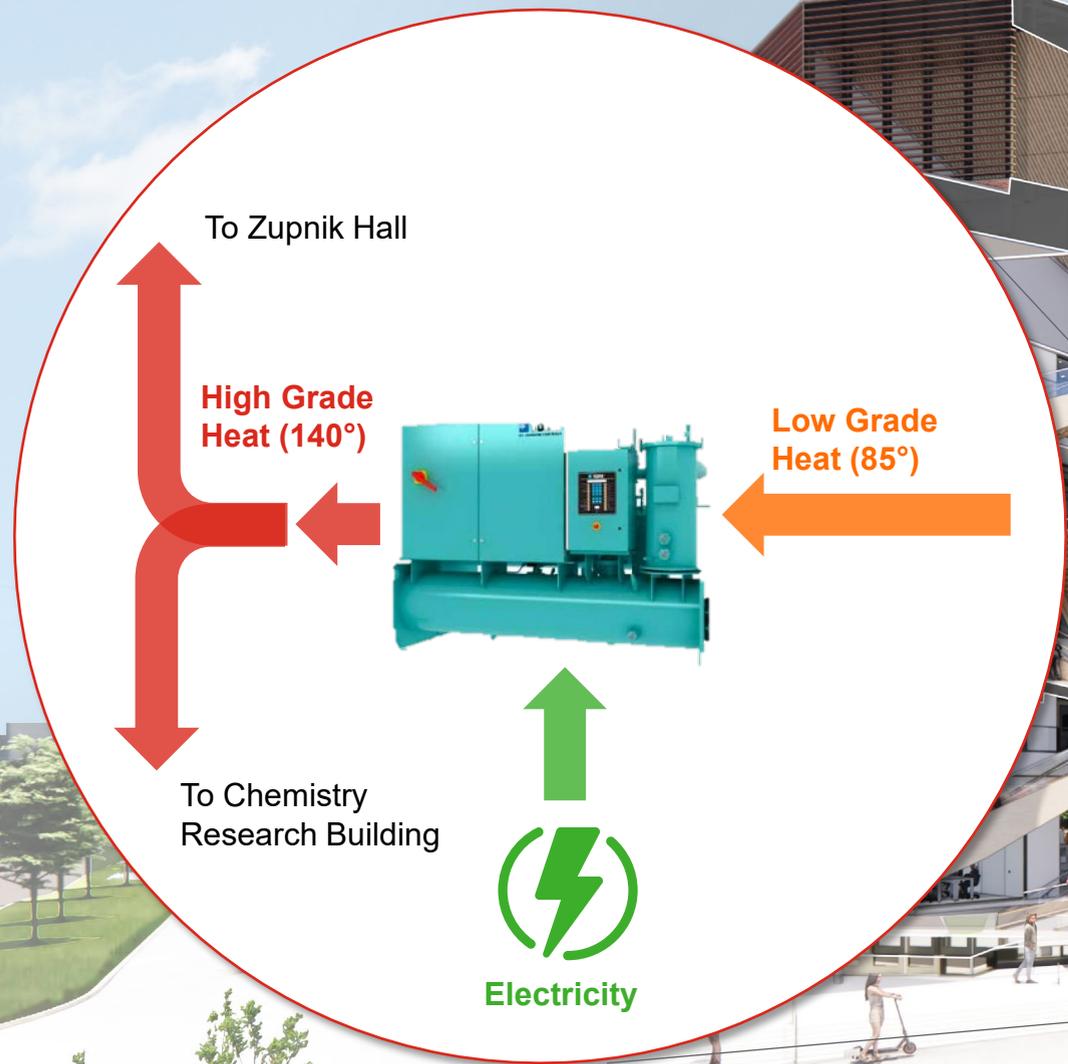
Low Grade Heat (85°)

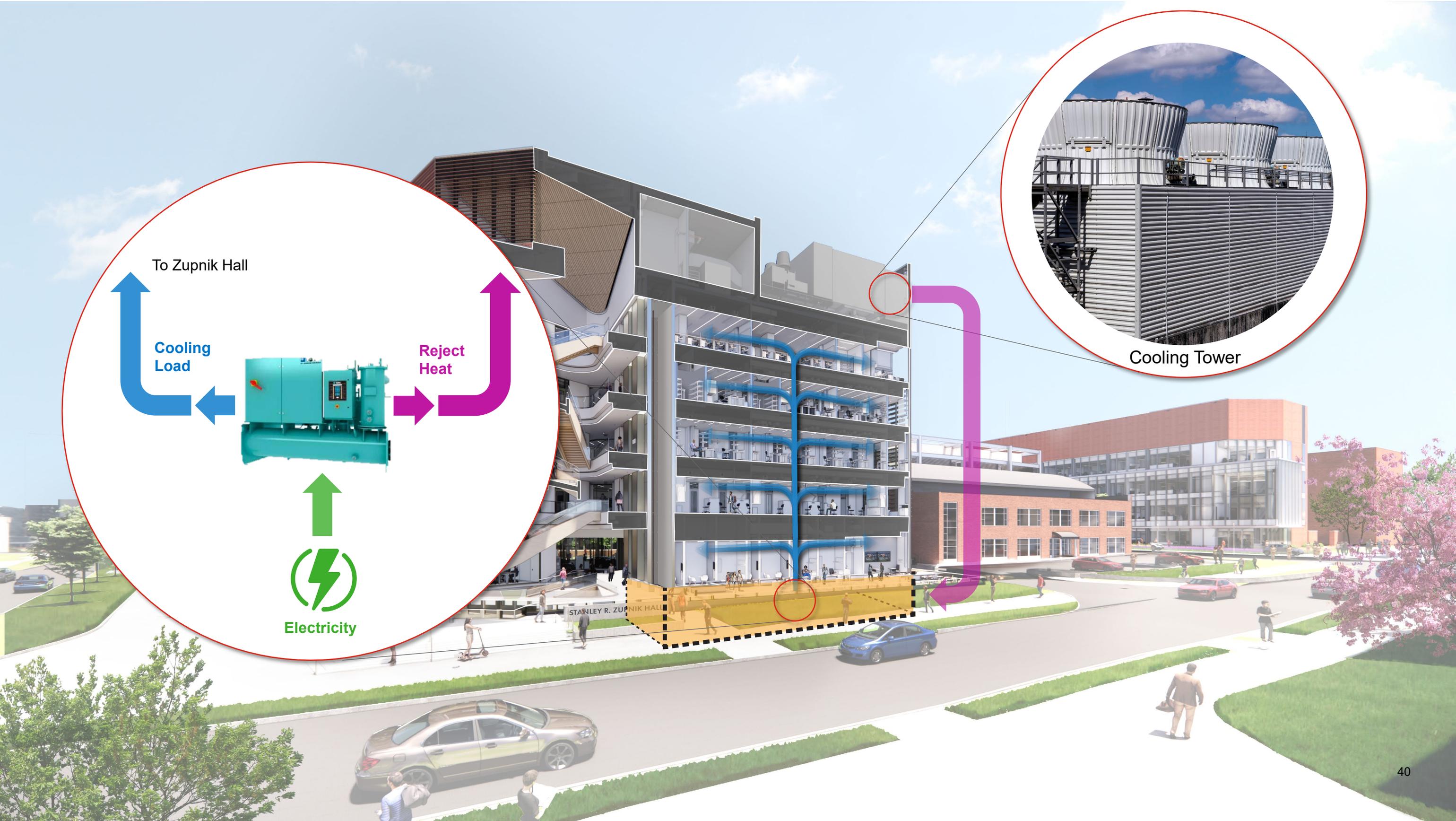


Electricity



Cooling Tower





To Zupnik Hall

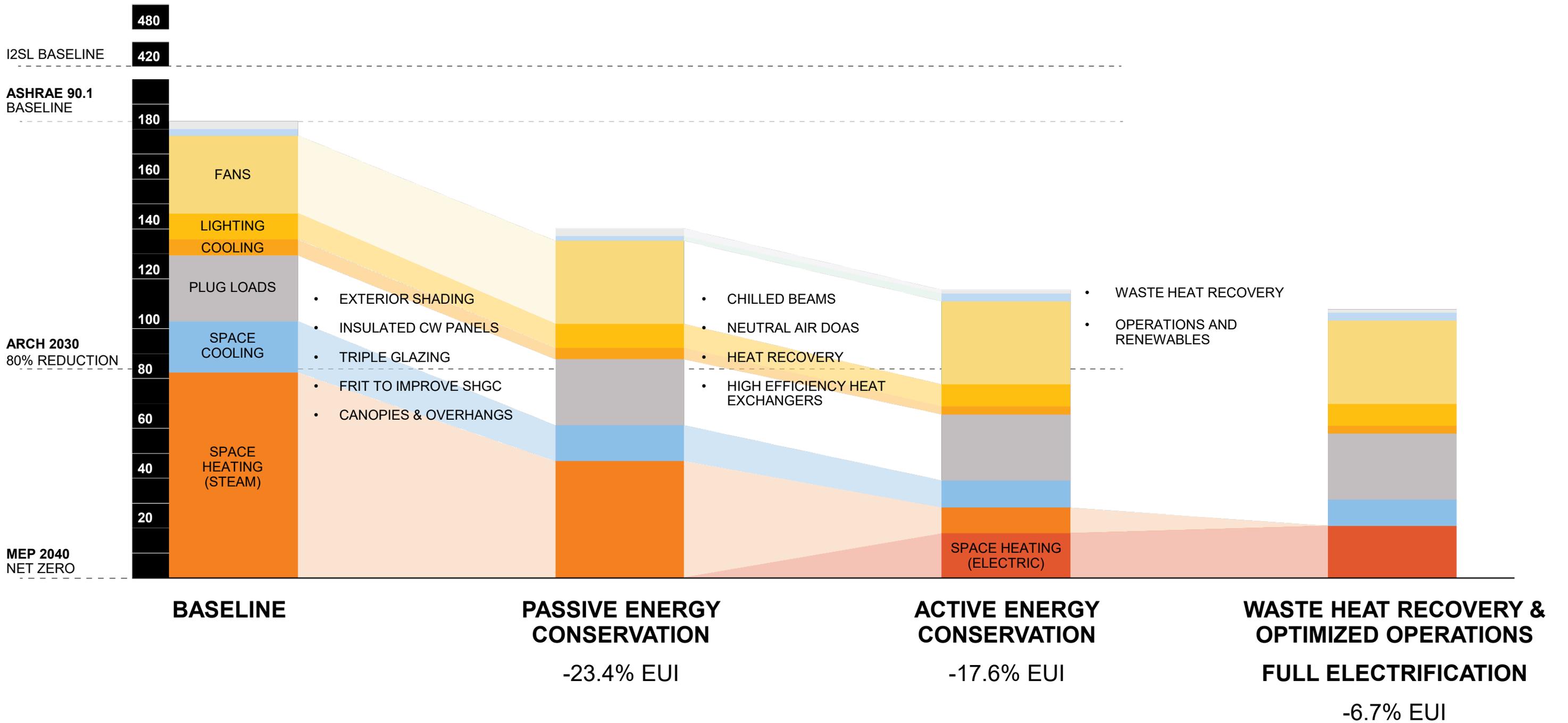
Cooling Load

Reject Heat

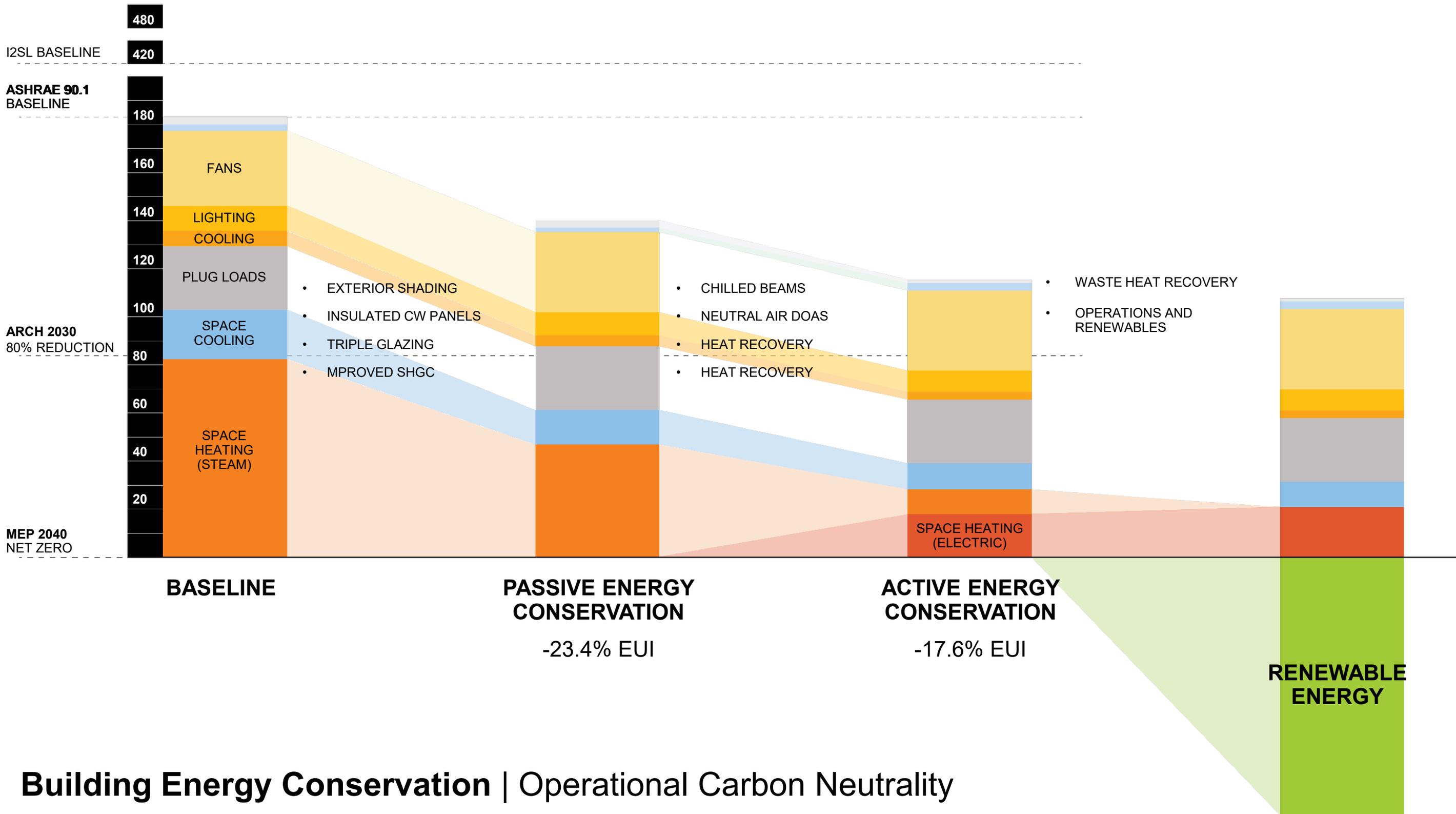
Electricity

Cooling Tower

STANLEY R. ZUPNIK HALL



Building Energy Conservation | Waste Heat Recovery



Building Energy Conservation | Operational Carbon Neutrality

University of Maryland's Commitment - Renewables

100%

renewable purchased electricity

9,000

solar panels on campus



PV ready design

Future PV on penthouse roof, reserved space for electrical equipment)

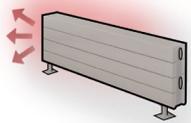


Achieving Net-Zero

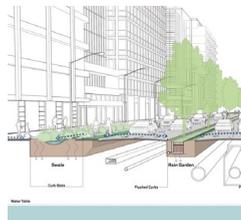
Atrium Interior Daylighting



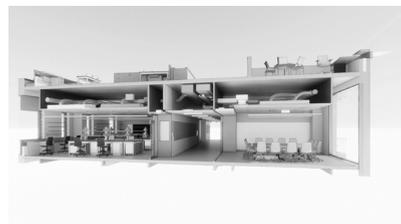
Low Temp Hot Water Radiation



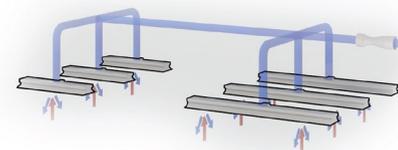
Stormwater Management



Air-Share



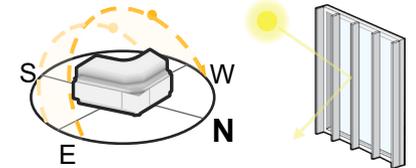
High Efficiency Chilled Beam Cooling



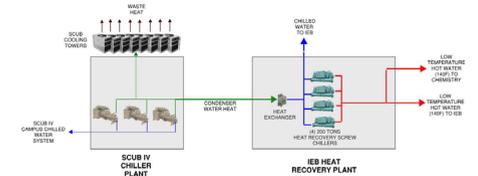
Air Handling with Energy Recovery Wheels; 100% Outdoor Air



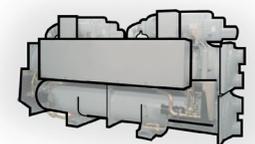
Orientation Specific Enhanced Glazing & Shading



Campus Chilled Water Loop Heat Rejection



Waste Heat Recovery & Export



Q&A



Brad Crowley PE, LEED AP
Principal, Ballinger



Jason Ciotti-Niebish AIA, LEED GA
Associate Principal, Ballinger