BUILDING LEADERS 2013 AIA Convention June 20-22, Denver

AIA

ZERO NET ENERGY BUILDINGS: FROM POLICY TO PRACTICE

TH305

Thursday, June 20, 2013, 4:00 PM - 5:30 PM

Learning Units [As published]

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Course Description

Buildings represent perhaps the greatest potential reservoir of energy savings available to us as a society, accounting for some 40 percent of our annual energy use. In recent years, a number of dedicated and resourceful practitioners have shown that constructing buildings that use no more energy than they are able to produce on-site—"zero net energy buildings"—is not only possible but also a practical and tangible example of our collective commitment to a clean energy future.

Yet zero net energy buildings remain, in large part, more of an aspiration than a reality. Recognizing the leadership potential of the public sector, the panel proposes that the road to full-scale deployment of zero net energy buildings starts with the facilities our states and communities construct.

The report **"Roadmap to Zero Net Energy Public Buildings: Recommended Steps for the Northeast & Mid-Atlantic"** was developed in collaboration with a group of regional building energy stakeholders and outlines key steps the public sector can take to facilitate the eventual broad adoption of zero net energy building practices. Ultimately the greatest benefit will come from greening our existing building stock. However, the report focuses on new construction because it provides the greatest opportunity for immediate action with the added benefit of substantial long-term energy and cost savings. This presentation will highlight the conclusions from the study, including immediate "critical next steps" that should be taken now and "intermediate-term steps" for the next 10 to 15 years. To underscore these issues, the presentation will conclude with a "lessons learned" session from two current Massachusetts zero net energy projects:

Currently in design is the **Division of Fisheries and Wildlife (DFW) Building** in Westborough, Massachusetts. This 45,000-gross-square-foot Field Headquarters Building includes offices, labs, meeting rooms, and classroom areas on the site of the existing DFW headquarters building on the campus of the former Lyman School. This project is to be a new home for the Environmental Review and Endangered Species Program, the Hunter Education Program, and the Department of Fish and Game's Office of Fishing and Boating Access. The facility will achieve zero net energy through solar photovoltaics and innovative mechanical systems as well as building envelope quality and reduction of all energy loads through building management. As part of the project, the existing approximately 12, 500-square-foot Richard Cronin Building and adjacent trailers will be demolished. The Cronin Building is in poor condition and is not adaptable for reuse. However, elements of the building will be salvaged and incorporated in the new project, and educational materials on the history of the facility and site will be developed.

Recently dedicated by Governor Deval Patrick, the **John W. Olver Transit Center** in Greenfield, Mass., is the first zero net energy building of its kind in the United States. The transportation hub will house community space and offices for the Franklin Regional Transit Authority and the Franklin Regional Council of Governments. The center will also serve as an Amtrak station with the completion of the Knowledge Corridor Rail Project in approximately two years and is expected to be a catalyst for redevelopment and growth in the region. Some of the key green features include air conditioning provided by an active chilled beam system, a solar wall that preheats fresh air by as much as 15 degrees during peak winter sun, second-stage preheating via a ground source heat pump, and daylight modeling used to determine optimal placement of windows, clerestory, and skylights. Renewable energy was provided through a combination of locally sourced biomass for heating and photovoltaic panels.

Learning Objectives

1. Describe the barriers and lessons learned to design and maintain a zero-net-energy building.
2. Define zero net energy and how it relates to public policy.
3. Recognize the opportunity public buildings present in becoming demonstration projects for new technology and the importance of engaging all stakeholders in the process (occupants, design team, and others).
4. Develop a road map to achieve zero net energy and identify a menu of energy efficiency strategies to apply to their projects.

Agenda

- Introductions
- Roadmap to ZNE Public Buildings
- Division of Fisheries and Wildlife Building
- John W. Olver Transit Center
- Summary
- Questions

Speakers

Carolyn Sarno, Senior Program Manager
NEEP (Northeast Energy Efficiency Partnerships)

Daniel Bernstein AIA
Architerra

Mark Walsh-Cooke PE, Principal
Arup

Roadmap to ZNE Public Buildings

Carolyn Sarno, Senior Program Manager
NEEP (Northeast Energy Efficiency Partnerships)

Northeast Energy Efficiency Partnerships

Accelerating Energy Efficiency

Mission

Accelerate the efficient use of energy in the Northeast and Mid-Atlantic Regions

Approach

Overcome barriers to efficiency through collaboration, education & advocacy

Vision

Transform the way we think about and use energy in the world around us.

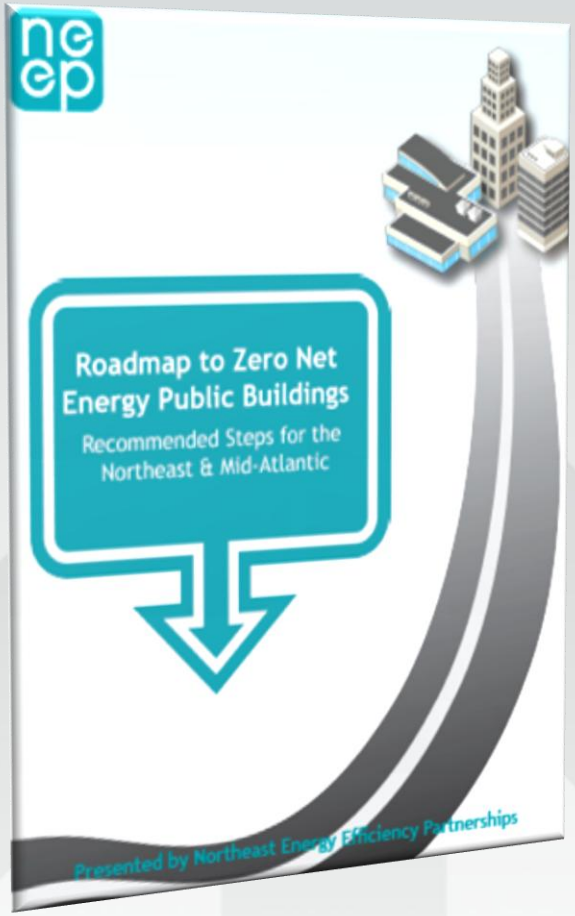
Working Towards Zero

NEEP's Vision

The work done today on High Performance Buildings will pave the way for the development of zero net energy buildings, buildings that consume no more energy than they produce, on a broader scale throughout the region.

Roadmap to Zero Net Energy

Public Buildings



- New Construction
- Developed with Leadership Group

- Key steps
  - Intermediate-term (10-15 years)
  - Critical (Now)

What is a Zero Net Energy Building?

A zero net energy building produces as much energy as it consumes over the course of a year

Why Public Buildings?

The public sector has a responsibility to lead.

The public sector has a longer investment horizon.

Intermediate Steps

Information and Education

Building Energy Codes

Utility Regulation

Finance

Critical Next Steps

Step 1

Develop a "Path to Highest Performance" Information Campaign

- Bullet-point briefings
- Presentations
- Fact sheets
- Educational modules
  - K-12 and post-secondary curricula
- A public web site

Critical Next Steps

Step 2

Promote the Continued Development of Exemplary Public Buildings

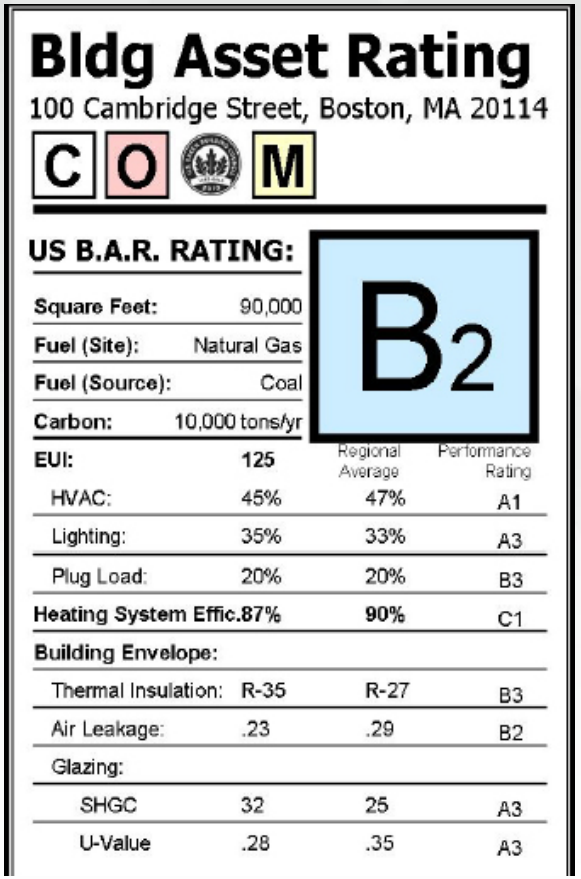
Courtesy of Rhode Island Department of Education

Critical Next Steps

Step 3

Prioritize Measurement and Reporting of Public Building Energy Performance

- Ensuring consistent measurement of building energy performance
  - Rate and disclose energy
    - Mandatory
    - Well designed (recommendations for possible improvements)
  - Benchmarking
    - ENERGY STAR's Portfolio Manager



Bldg Asset Rating

100 Cambridge Street, Boston, MA 20114

C O M

US B.A.R. RATING: B2

Square Feet:	90,000		
Fuel (Site):	Natural Gas		
Fuel (Source):	Coal		
Carbon:	10,000 tons/yr		
EUI:	**125**	Regional Average	Performance Rating
HVAC:	45%	47%	A1
Lighting:	35%	33%	A3
Plug Load:	20%	20%	B3
Heating System Effic.	**87%**	**90%**	C1
Building Envelope:			
Thermal Insulation:	R-35	R-27	B3
Air Leakage:	.23	.29	B2
Glazing:			
SHGC	32	25	A3
U-Value	.28	.35	A3

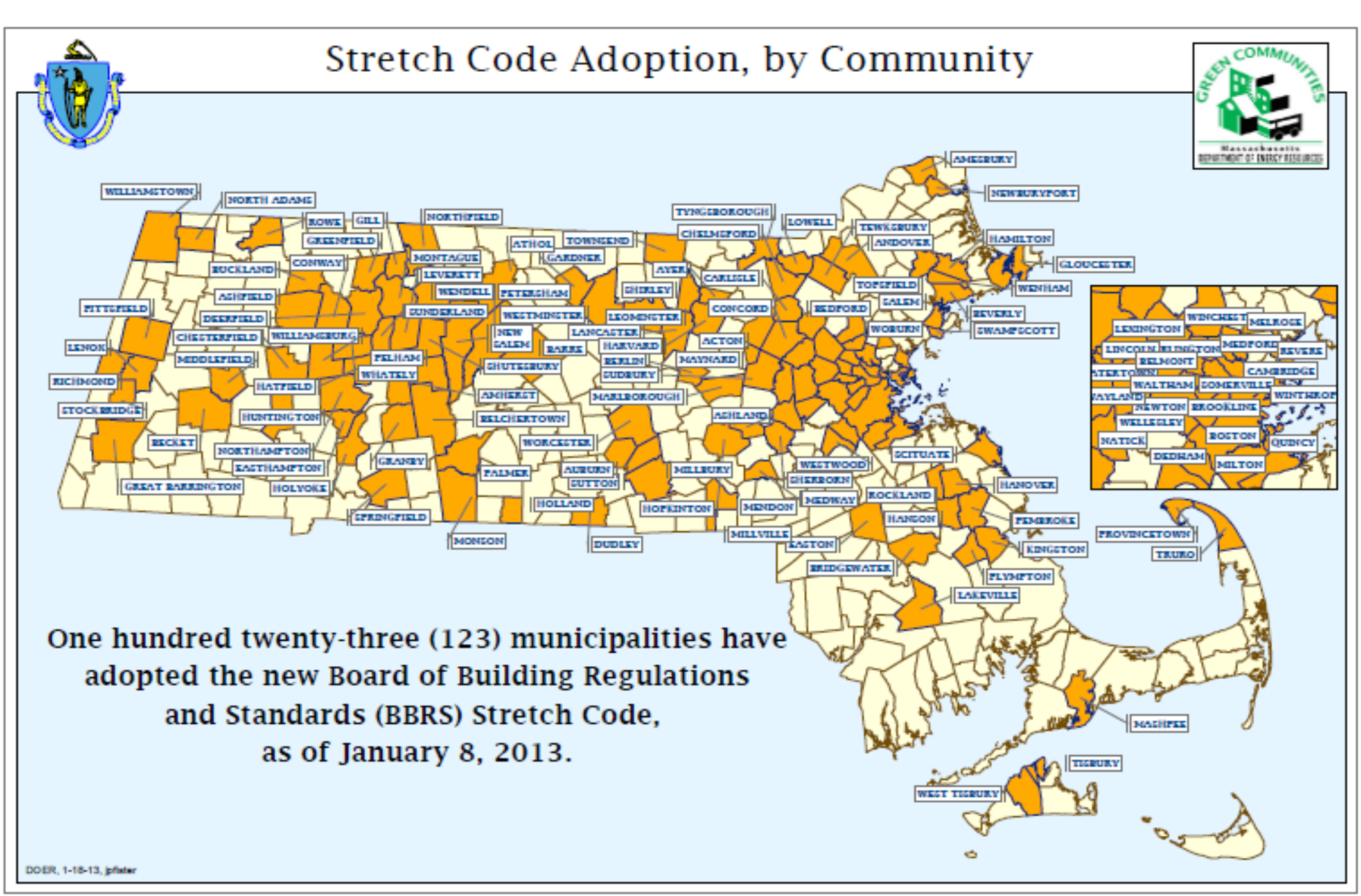
Critical Next Steps

Step 4

Implement Stretch Building Energy Codes

- Get gradually stricter over time
- Be outcome-based
  - Not relying solely on prescriptive requirements
- Include provisions for continuous commissioning of building systems
- Cover all energy consumed in the building including plug loads as well as major mechanical systems.

Massachusetts Stretch Code



Critical Next Steps

Step 5

Create a Revolving Loan Fund or Similar Mechanism to Provide Capital for Energy Investments

- Budgets in NEEP's region grew 12.5 percent from 2008 to 2010
- End of an ARRA
- Initial capitalization an issue
  - Fund should be self-sustaining once it is established
  - ESCO's…?

The Path Toward Zero

Begins with:

- Significant reductions in as-designed building energy consumption
- Building operations that ensure as-designed performance.

Image courtesy of the Putney School, VT

Division of Fisheries and Wildlife Building

Daniel Bernstein
Architerra

AIA/COTE Top 10 Green Building
Toward Zero Net

Cambridge School of Weston
Garthwaite Center for Science & Art

Weston, MA

AIA New Hampshire Merit Award
Toward Zero Net Energy

Keene State College

Technology, Design & Safety Center

Keene, NH


EXIT

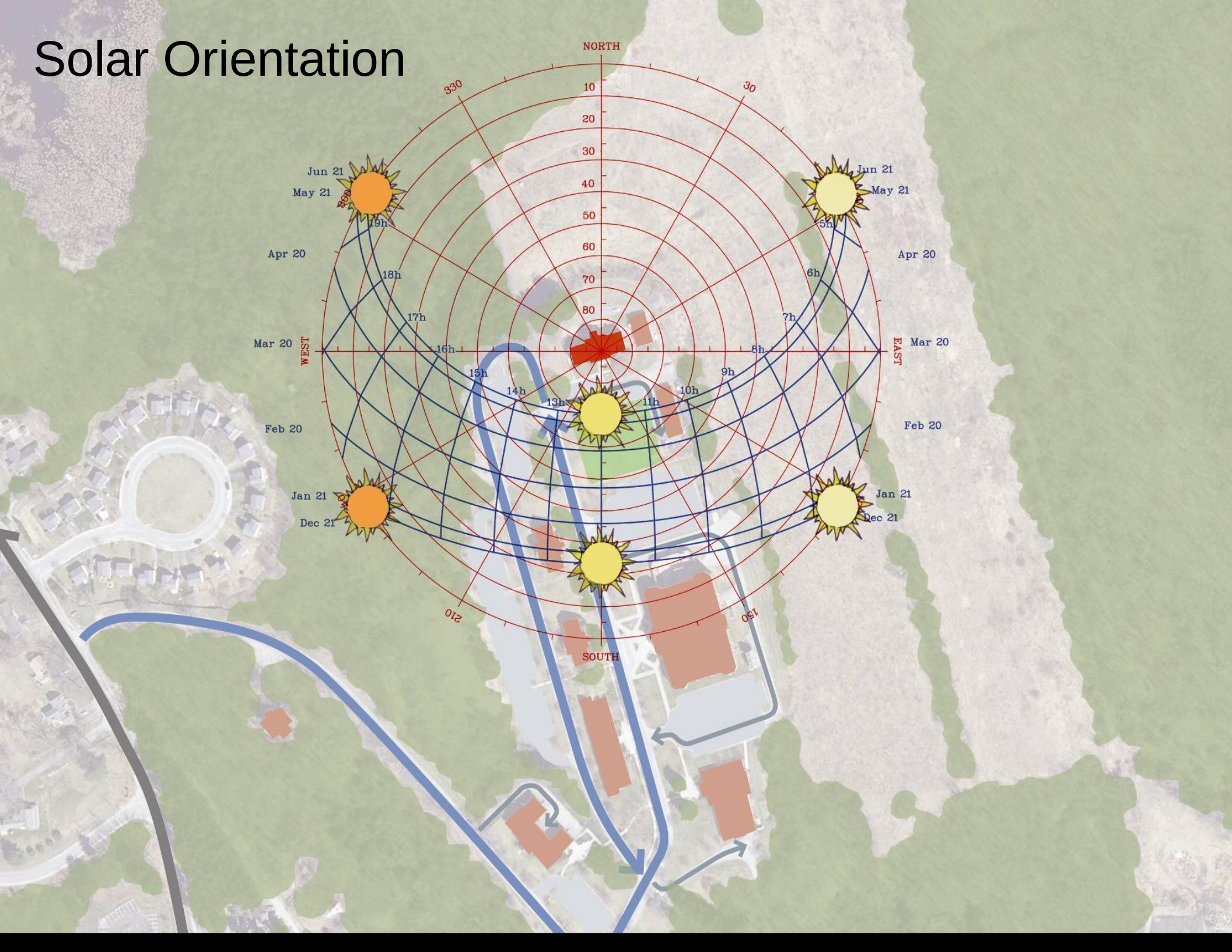
First Public Zero Net Office Building in Massachusetts

Massachusetts Division of Fisheries & Wildlife

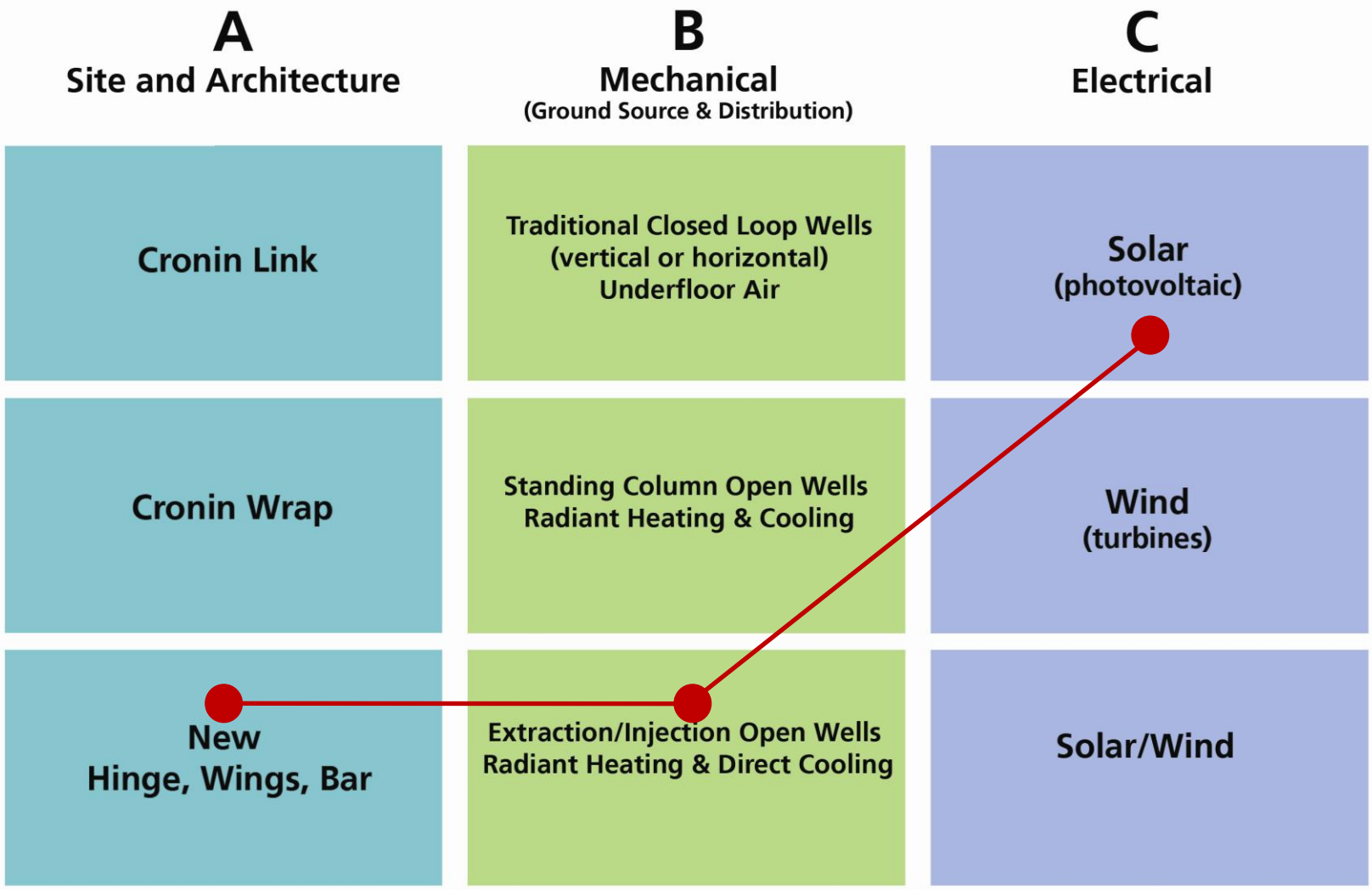
Field Headquarters

Westborough, MA

Solar Orientation



Options Matrix



Add-ons

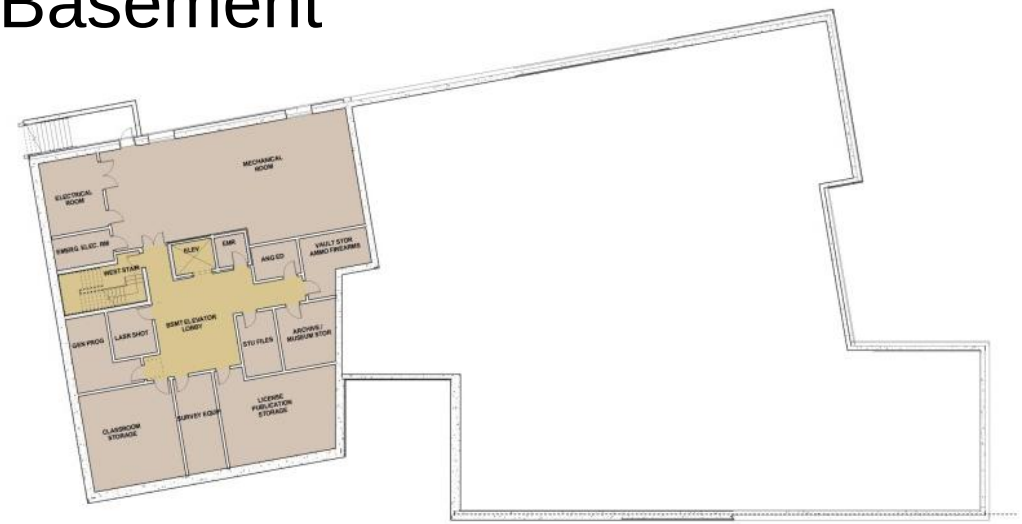
1. Biomass Backup
2. Solar Thermal
3. Distributed Heat Pump
4. Hydroelectric
5. Standing Column
6. Interseasonal Storage:
   ice pool below building
   heat lens

Level 1

Level 2

Level 3

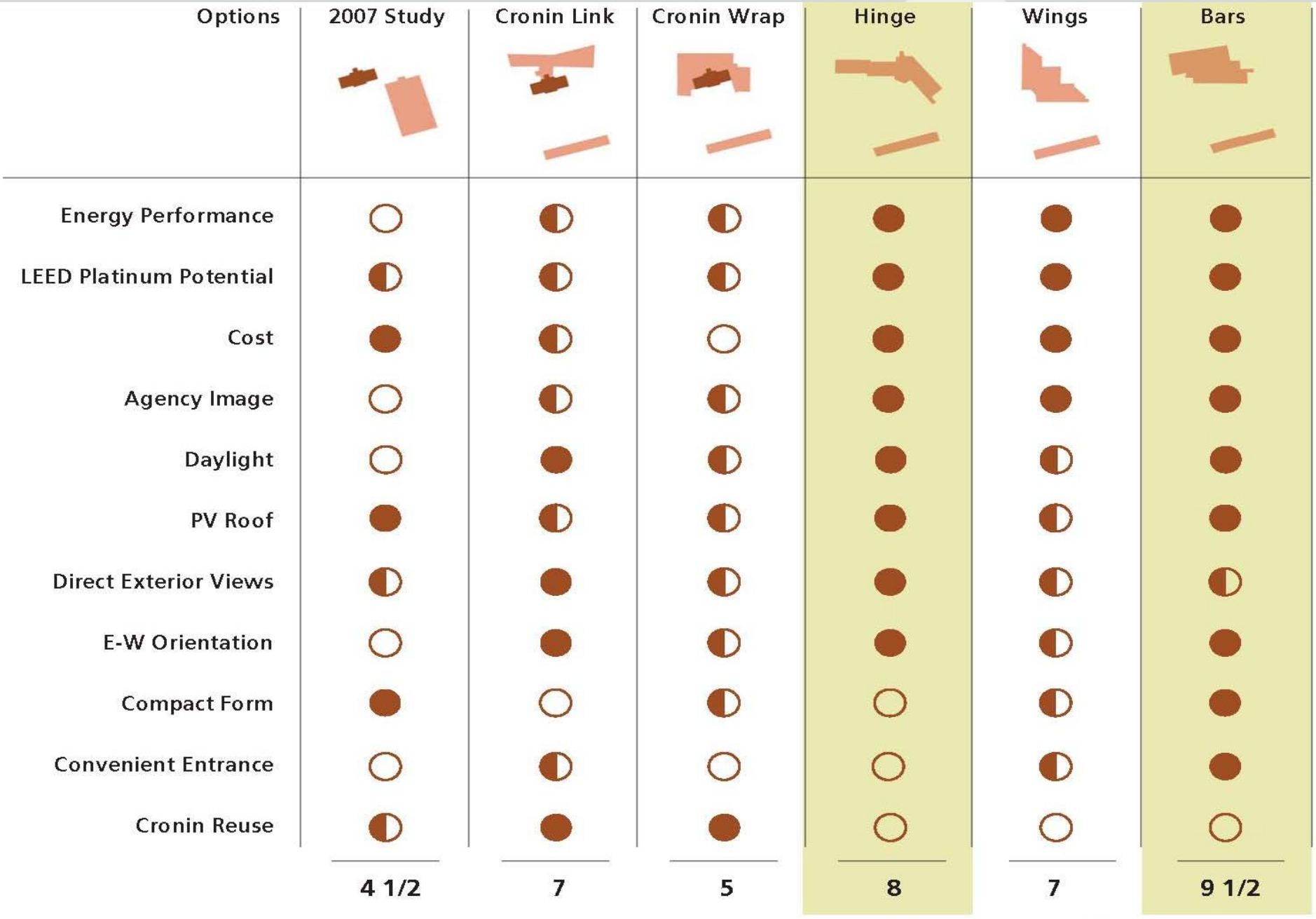
Basement



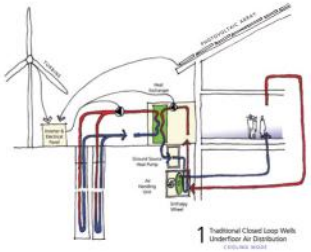
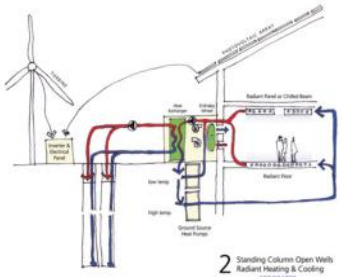
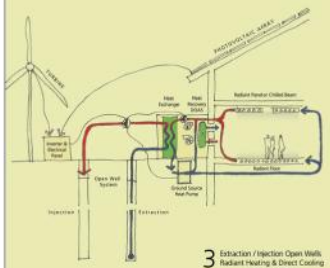
Level 1	Level 2	Level 3	Basement
17,505 SF	14,975 SF	7,080 SF	5,405 SF

TOTAL
44,965 SF

Architectural / Site Options Comparison



Mechanical Options Comparison

Options	Traditional Well Underfloor Air	Open Well Radiant	Extraction / Injection Well Radiant w/Direct Cooling
			
Cost	◐	◐	◐
Efficiency	○	◐	●
Operating Ease	◐	◐	◐
Durability	◐	◐	◐
Space Requirements	○	●	●
Permitting	●	◐	○
Indoor Environmental Quality	◐	●	●
Peak Power Requirements	○	◐	●
	3	5	5 1/2

○ Good ◐ Better ● Best

Electrical Options Comparison

Options	Photovoltaics	Wind	PV + Wind
			
Cost (Including Subsidies)	●	◐	◐
Efficiency	●	○	◐
Operating Ease	●	○	◐
Durability	●	○	◐
Space Requirement	●	○	◐
Permitting	●	○	○
Acoustics	●	○	○
Generation/ Load Match	◐	◐	●
Demonstration Potential	◐	◐	●
Carbon Footprint	○	●	◐
Regional Economic Development	◐	◐	●
	8 1/2	3	6

○ Good ◐ Better ● Best

Renewable Energy

Photovoltaic

280 kW Array
16,000 Square Foot Roof

Wood Pellets

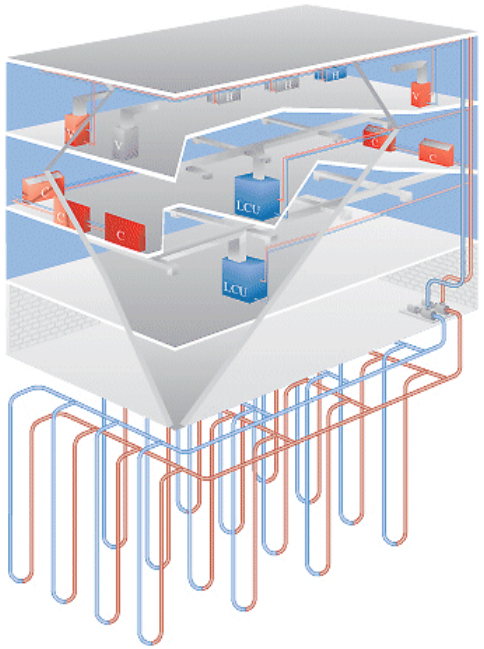
20 Tons per Year
1,000 cubic feet / year
Deliveries each 4 to 6 weeks

Wind

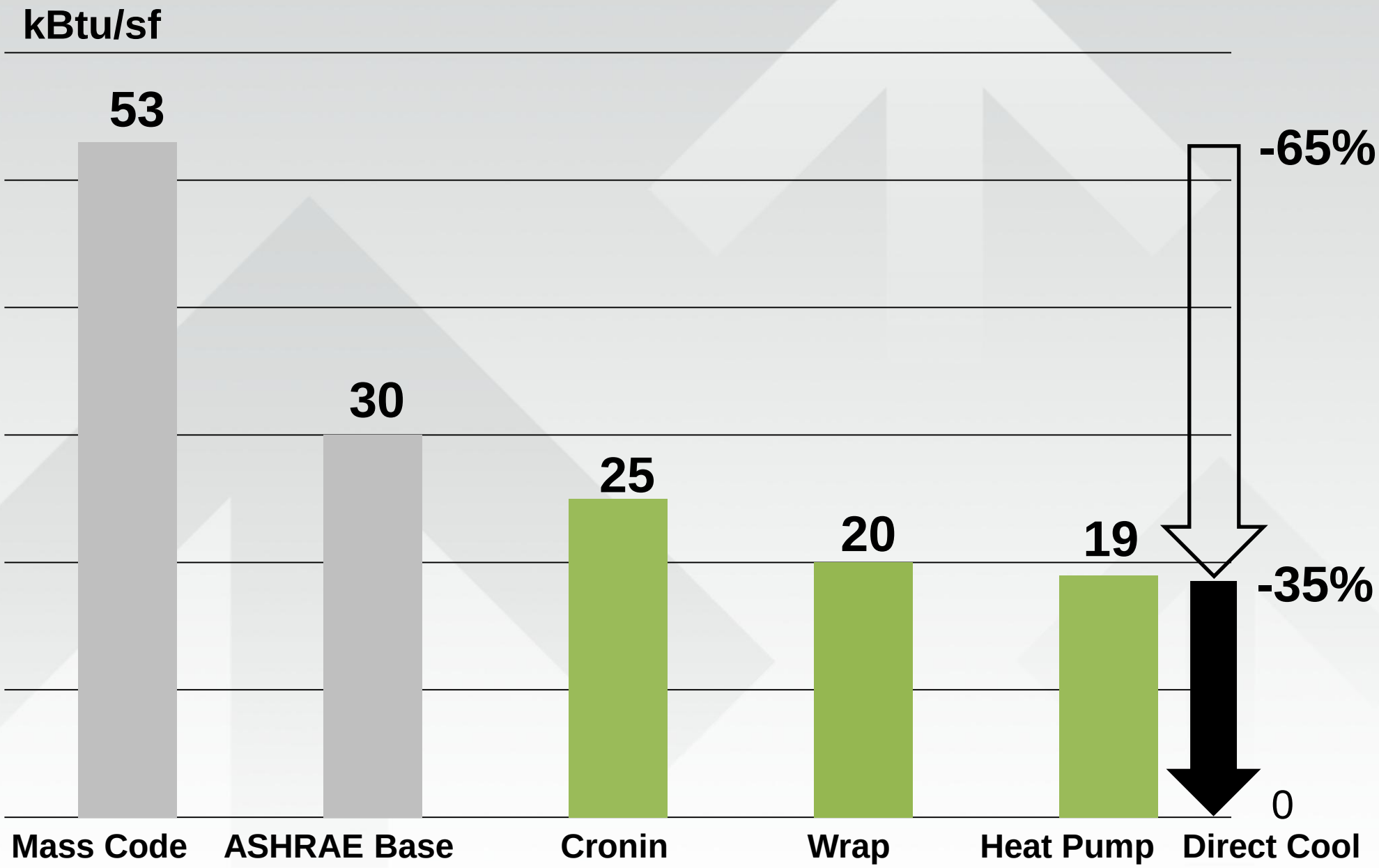
250kW Turbine
50’ blades
150’+ High at Hub

Ground Source Heat Pumps

2 to 3 Standing Column Wells
1,500 Feet Deep
Or
20 Closed Loop Wells
500 Feet Deep

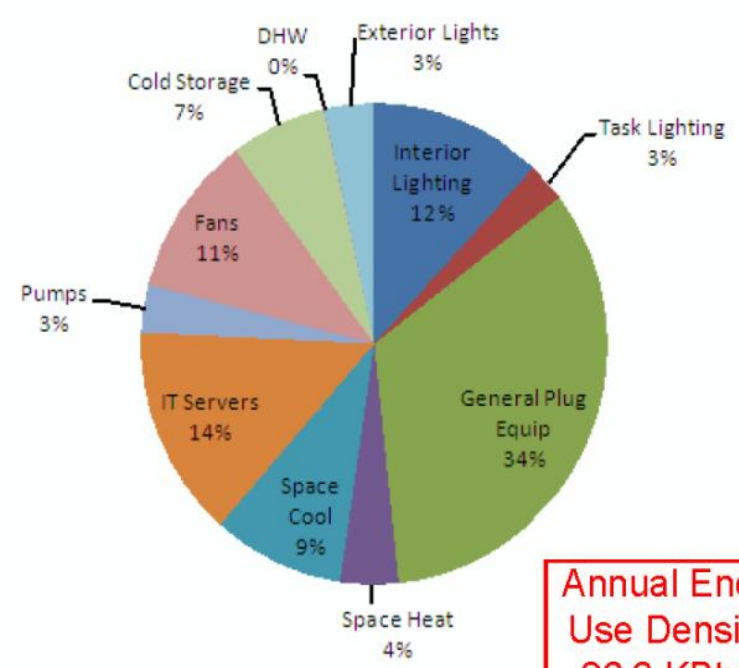


Energy Modeling Results



Energy Story

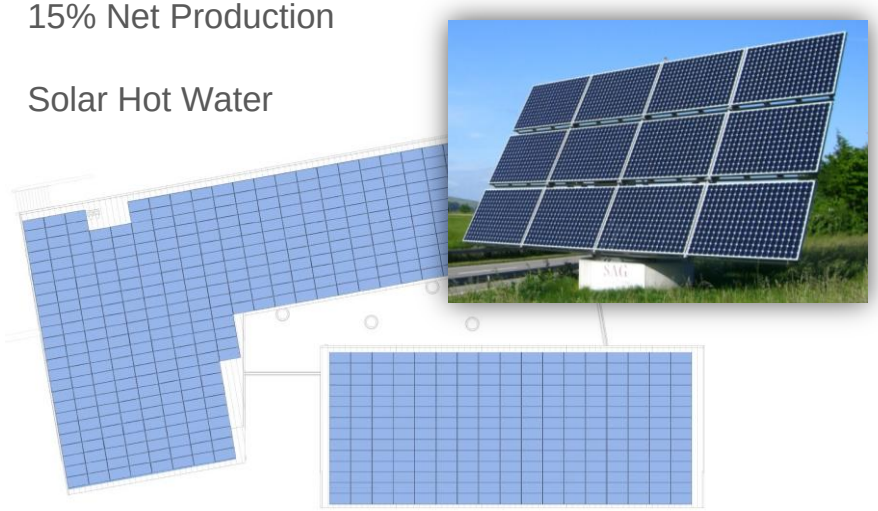
Geothermal
20 to 24 Closed Loop Wells
400 feet deep

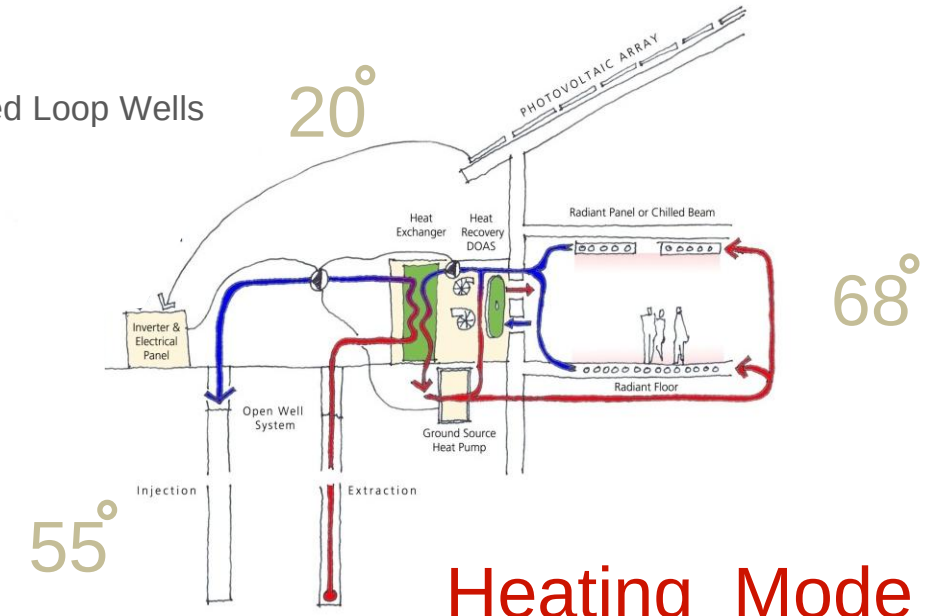


Annual Energy Use Density = 26.3 KBtu/ft²

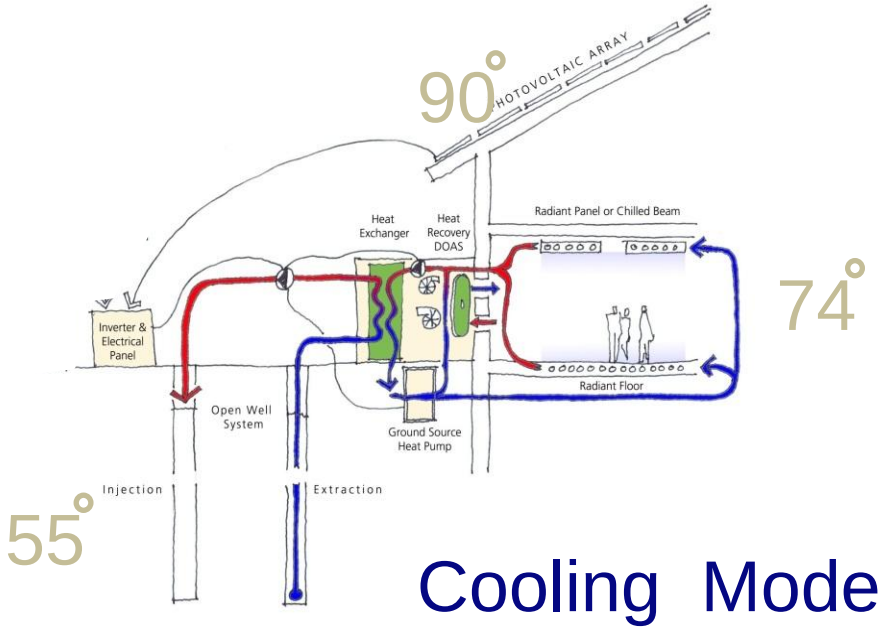
PV Array 295kW
375,000 kWh/Year Production
325,000 kWh/Year Demand
15% Net Production

Solar Hot Water





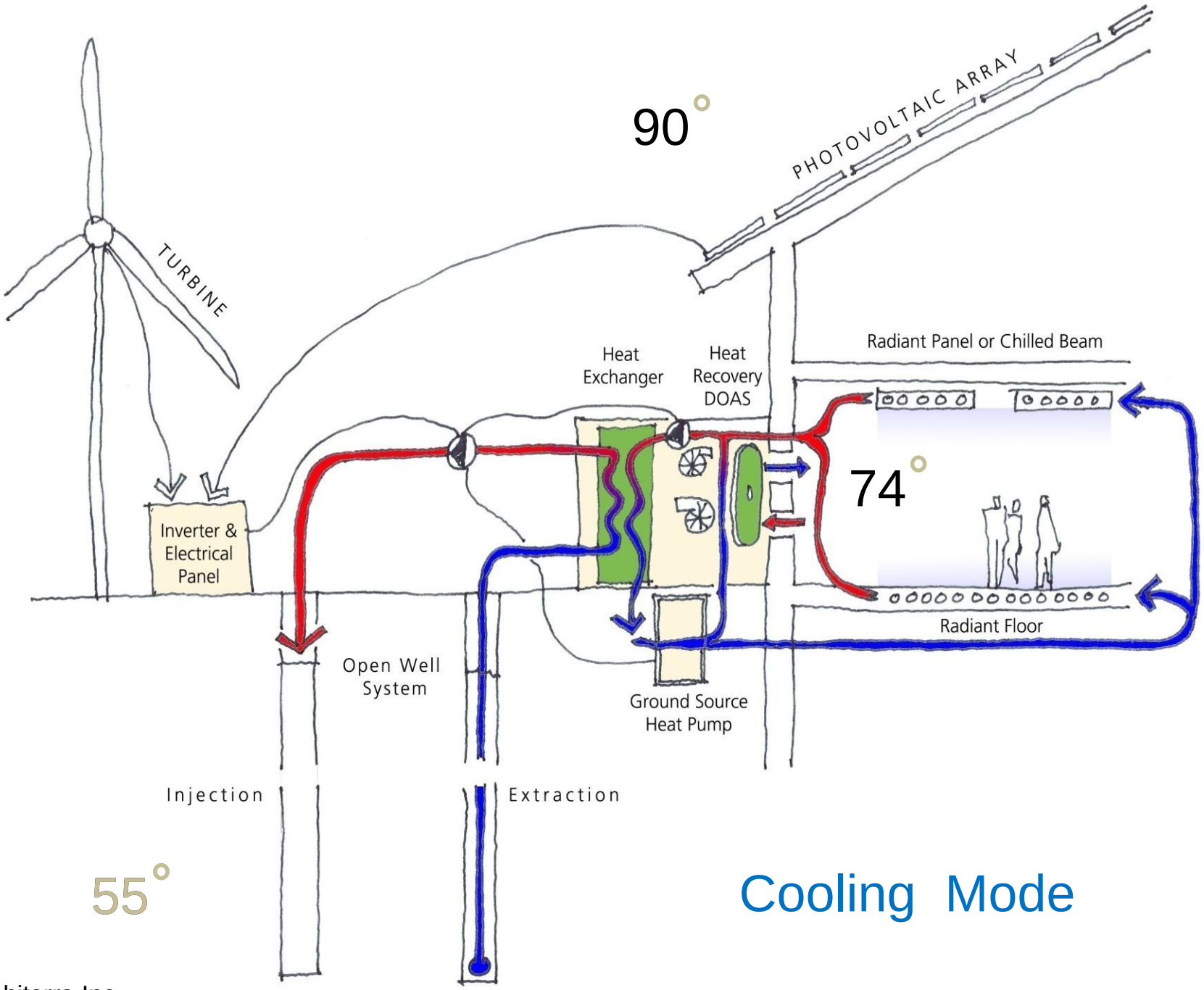
Heating Mode



Cooling Mode

Extraction / Injection Open Wells

Radiant Heating & Direct Cooling



Cooling Mode

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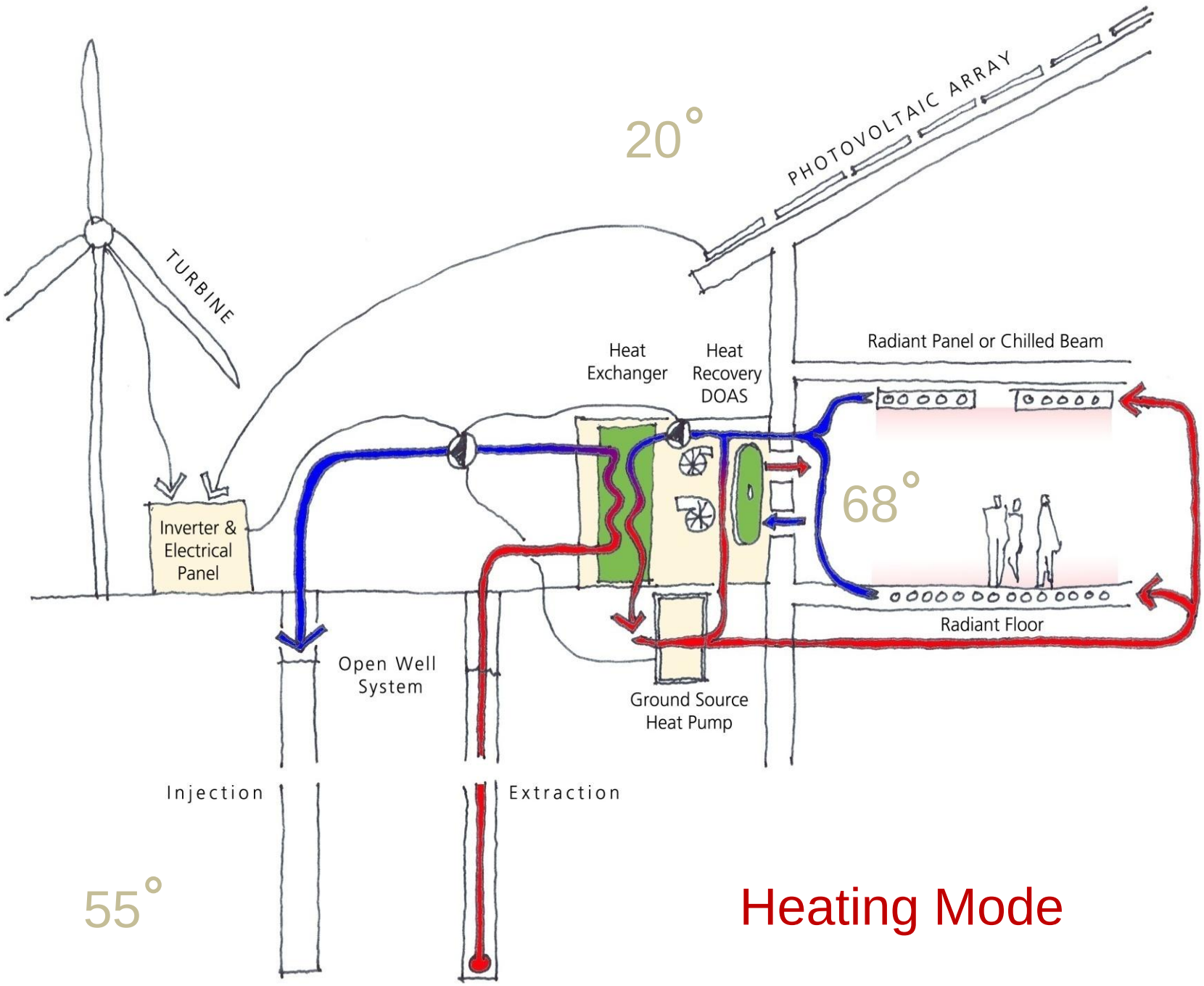
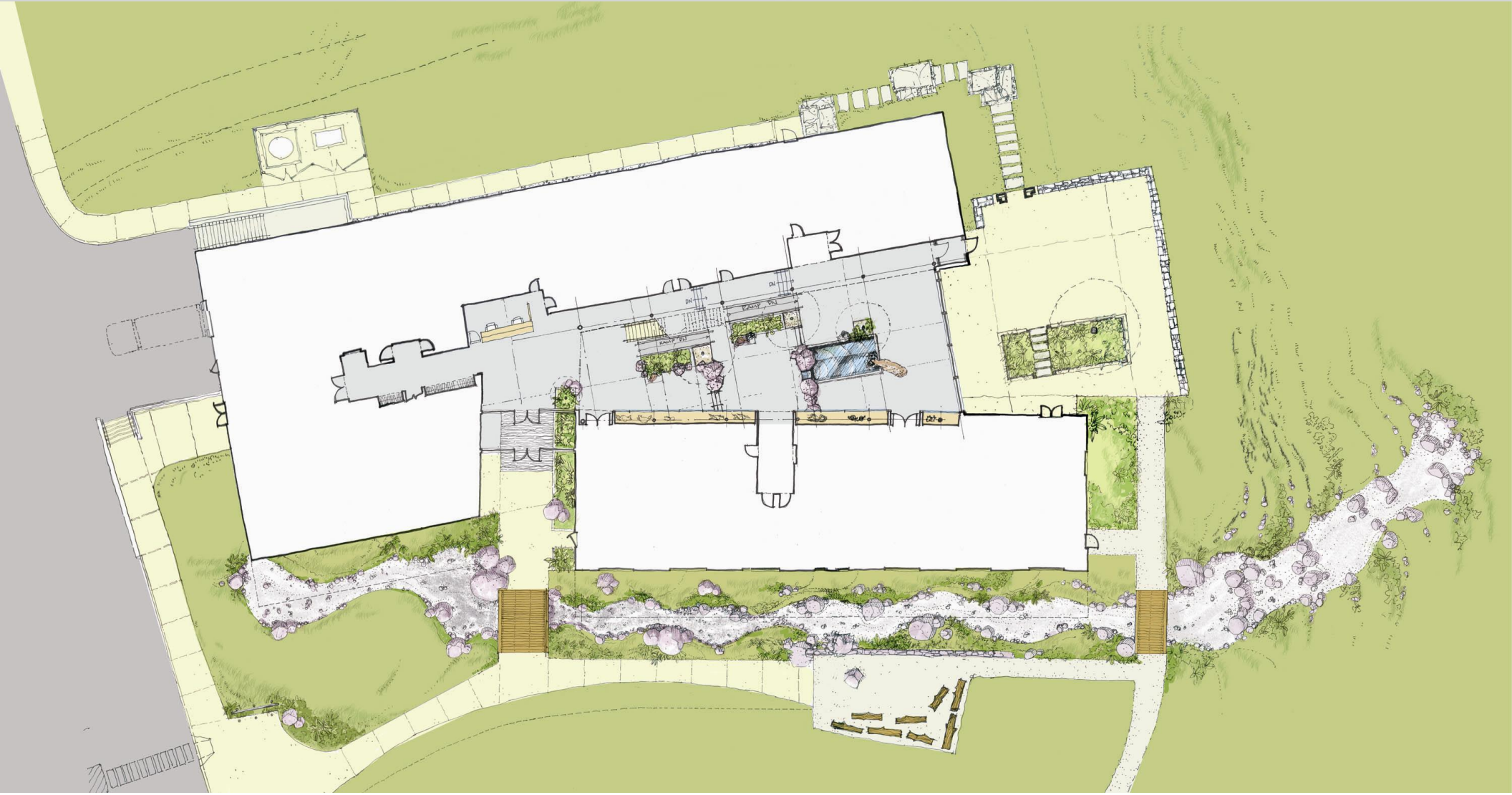
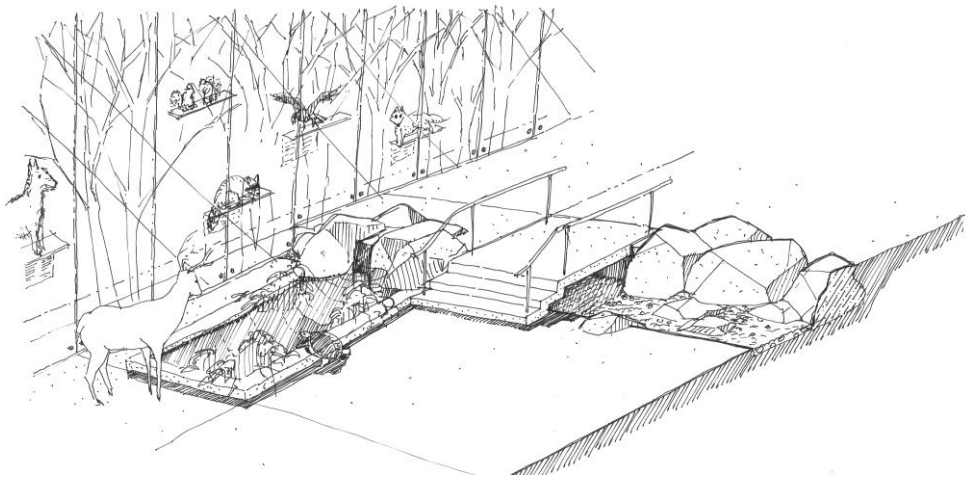


Heating Mode





Differential Glazing by Orientation

South 29%

East 34%

North 25%

West 11%

Energy Plus Building
Toward Carbon Neutral Campus

ARCHITERRA

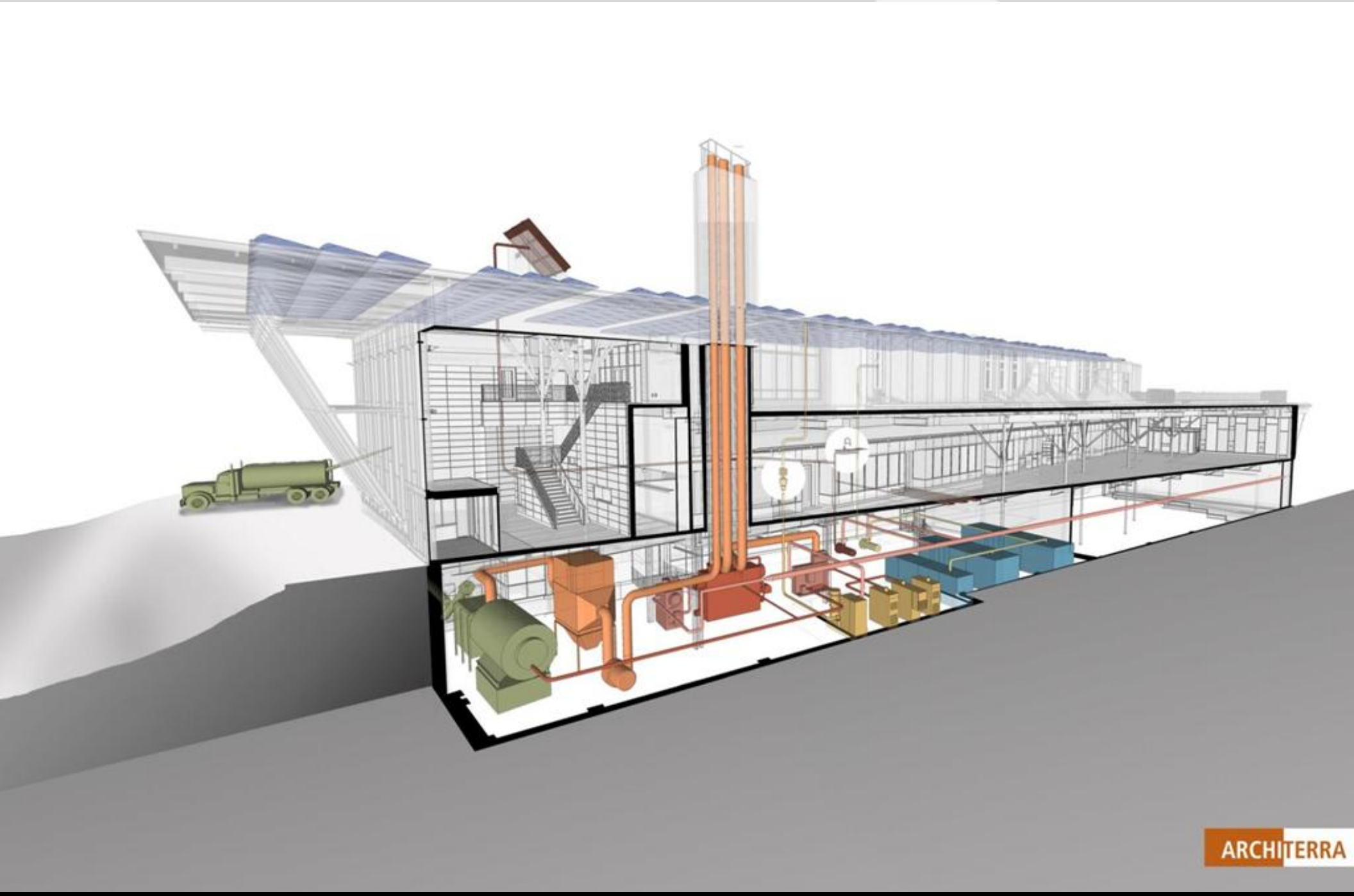
SUNY College of Environmental Science & Forestry
Gateway Building
Syracuse, NY


AUBURN
SYRACUSE
HAULERS

Net Zero Energy

Energy Plus

Combined Heat & Power Plant




SUNY-ESF www.esf.edu


Tyvek
Tyvek
Tyvek

Concourse & Café


ROXUL AFB
GENESIS


Tyvek

John W. Olver Transit Center

Mark Walsh-Cooke, Principal
Arup

Project Team

Franklin Regional Council of Governments
Franklin Regional Transit Authority

Charles Rose Architects

Arup - MEP, fire/life safety, lighting, sustainability

RSE Associates (structural)

Nitsch Engineering (civil)

Groundview (landscape)

BET (building envelope)


JOHN W. OLVER
12

“When you combine cutting edge design, zero net energy engineering, a downtown location that unites trains and busses and a project that has been an important part of our Recovery program, it is not surprising that this Center has such strong support.”

Jeffrey A. Simon, Director
Massachusetts Recovery & Reinvestment Office

Prior Site View

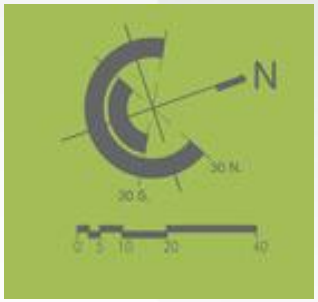
Site Context

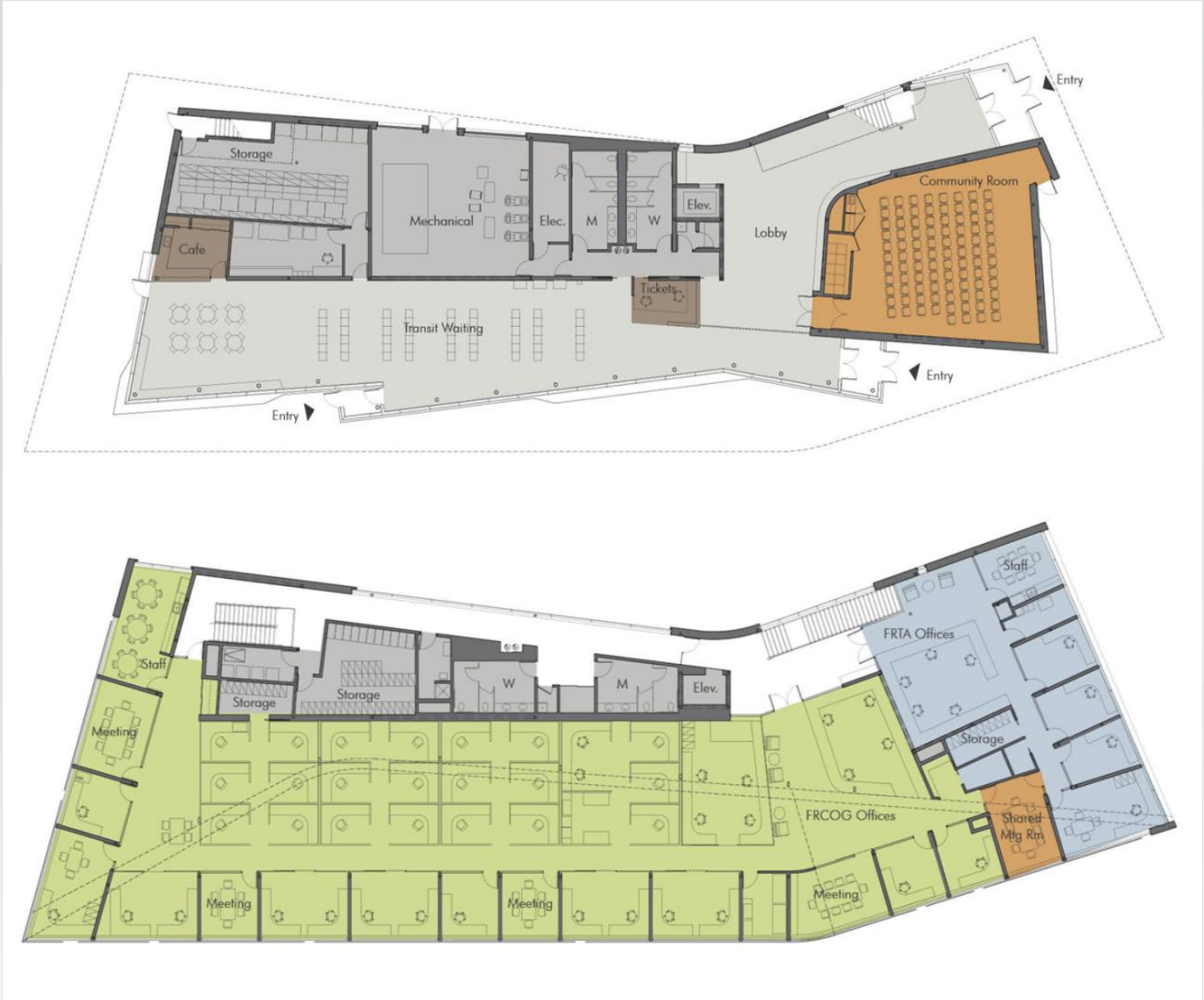
Courtesy of Charles Rose Architects

Getting to Zero Net Energy – Approach

Building Program (Reduce Loads)

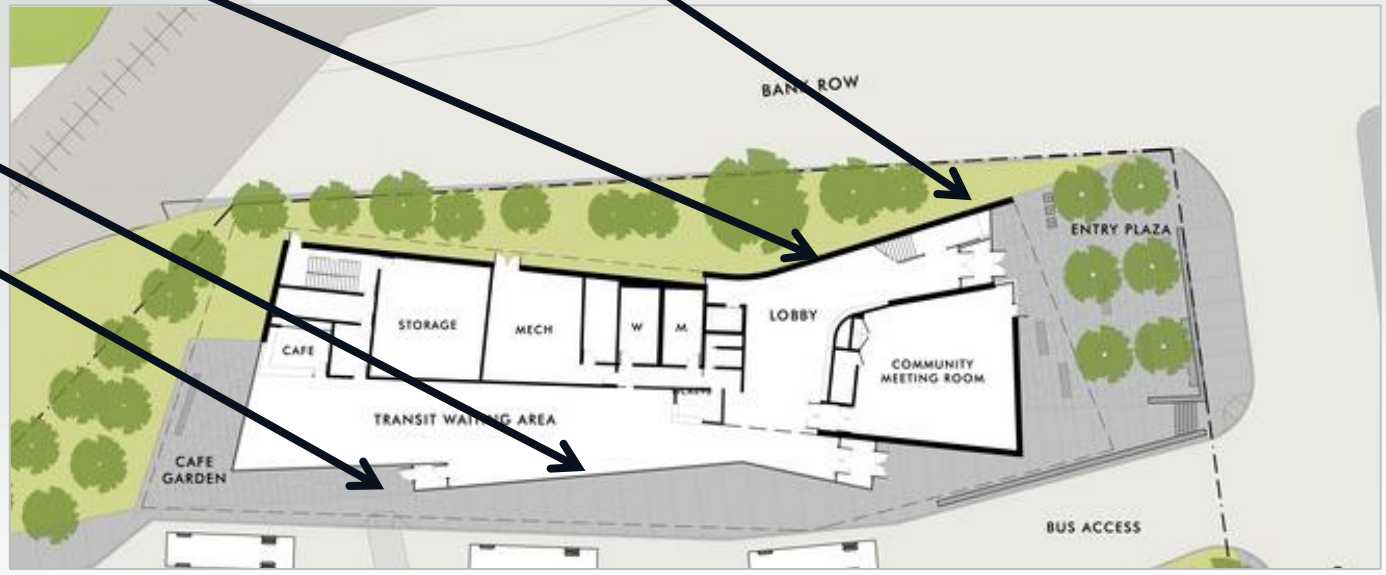
- Offices
- Community space
- Waiting and lobby
- Storage





Courtesy of Charles Rose Architects

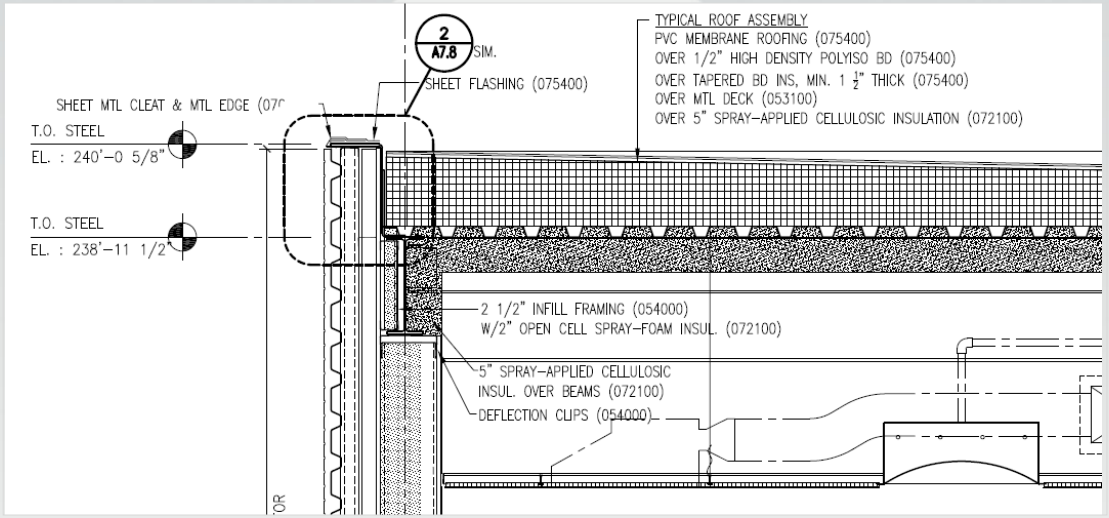
Façade Details (Passive Strategies)

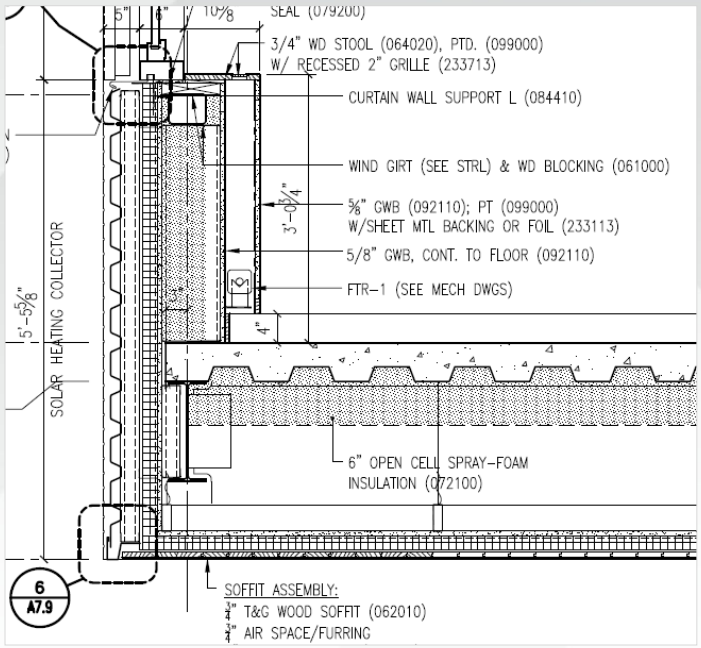


Façade Details (Passive Strategies)

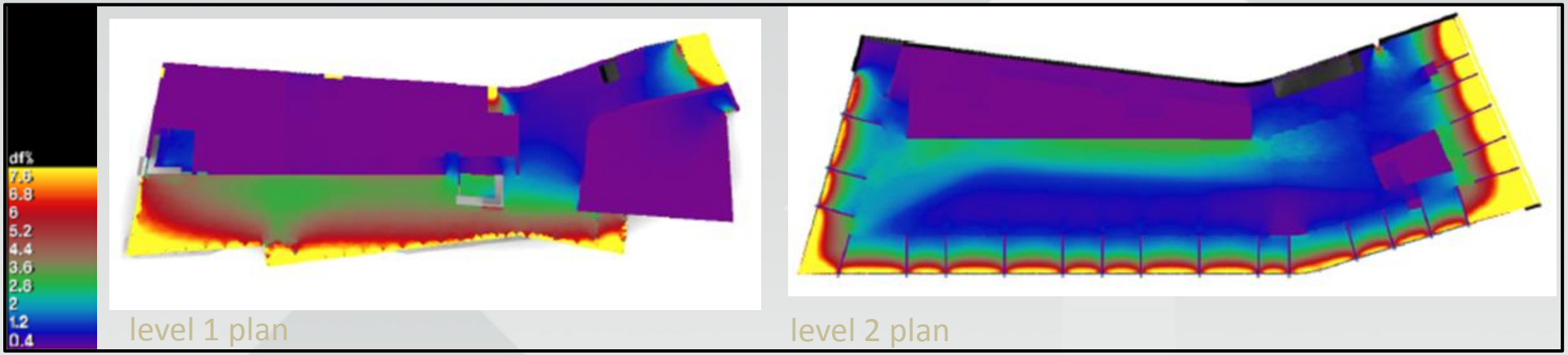
Building Envelope

- Roof R=42
- Walls R=33
- Overhang R=36
- Glazing Argon filled DGU





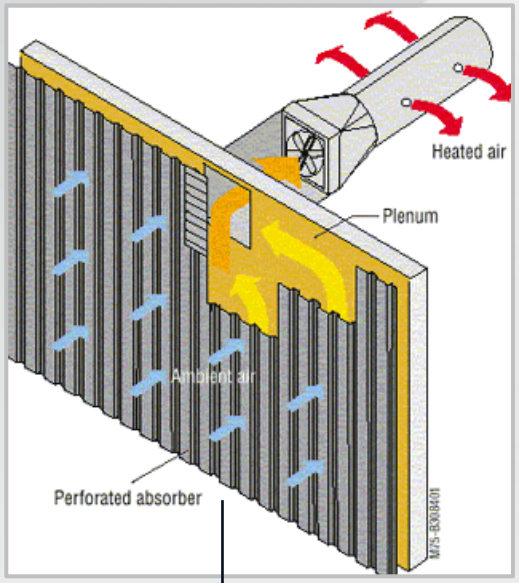
Daylight (Passive Strategies)

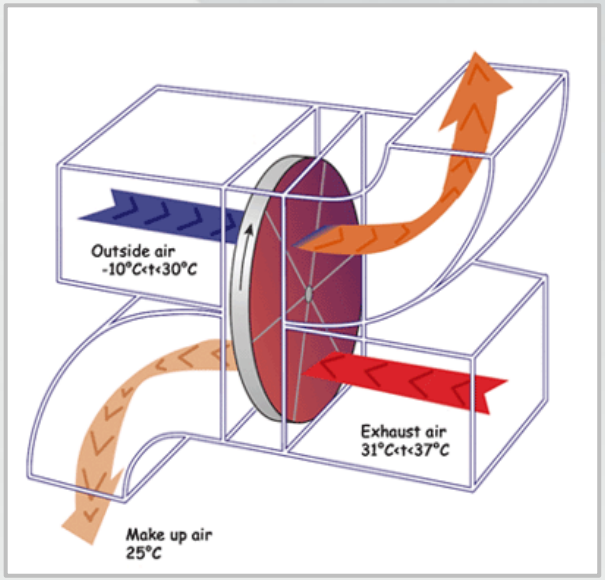


Light distribution in office on March 21, 9:00 a.m

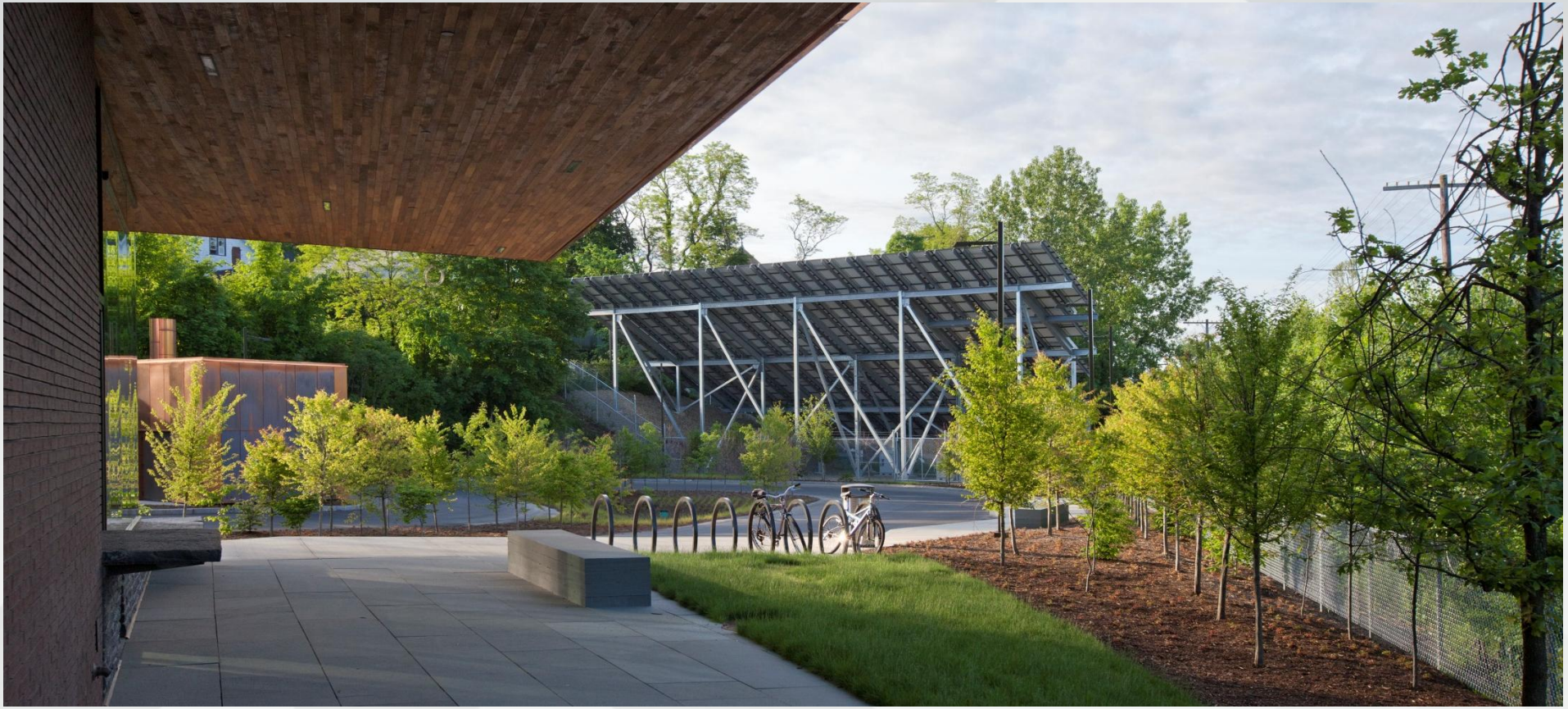
Systems (Active Strategies and Energy Recovery)

- Total energy wheel
- Ground source heat pumps
- Winter preheat
- Active chilled beams
- Demand controlled ventilation
- Lighting controls
- Premium efficiency motors
- Variable speed drives
- Cascade air
- LED lighting
- Energy monitoring and display





Renewable Strategies (Self Generation)



- 98kW PV Array
- Biomass Boiler
- Transpired Solar Collector

“We are here to not only celebrate this amazing transit hub that, thanks to President Obama’s commitment to getting Americans back to work by infrastructure investments created jobs and made our Commonwealth more energy efficient, but also to thank Congressman Olver for a career that has spanned many decades.”

Governor Deval Patrick
Commonwealth of Massachusetts

“Officials celebrate how public policy and design can come together to have a positive impact on sustainability, transportation, and economic development.“

(L-R, US. Rep. James McGovern, John W. Olver, Governor Deval Patrick, U.S. Rep. Stephen Kulik, Lt. Gov. Timothy Murray, Peter Rogoff of the FTA, State Stimulus Chief Jeffrey Simon)

“Arup is helping the FRCOG achieve its goals for energy reduction saving many thousands of dollars in annual running costs”

Linda Dunlavy
Franklin Regional Council of Governments


NOTICE


JOHN W. OLVER
12

on line building
energy dashboard

http://www.frta.org/JWO-Transit-Center-green-tech.html

John W Olver Transit Center Lessons Learned

- Communicate design assumptions
- Educate the building users
- Training for the building manager
- Continuous monitoring and reporting
- Continuous commissioning
- Renewable system power monitoring underway

Data From Monitoring

- Placeholder slides

Summary

1. Describe the barriers and lessons
2. Define zero net energy and how it relates to public policy.
3. Recognize the opportunity public buildings present
4. Develop a road map to achieve zero net energy

Contact Information

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