

Zero Net Energy Buildings

"A ZNEB is one that is optimally efficient, and over the course of a year, generates energy on-site using clean, renewable sources in a quantity equal to or greater than the total amount of energy consumed on-site."

Next Generation of Bold New Energy Initiatives

Ellen Watts AIA, LEED AP *Architerra Inc.* *June 18, 2010*

Getting to Zero

Final Report of the Massachusetts Zero Net Energy Buildings Task Force

24 Recommendations

Performance Standards
Improved Prescriptive Standards
Revised Performance Standards
Solar Readiness
Public School Construction & State Funded Projects

Energy Certificates
Electricity Sub-Metering

Expedited Permitting
Model Zoning By-Law

Phased Performance Standards

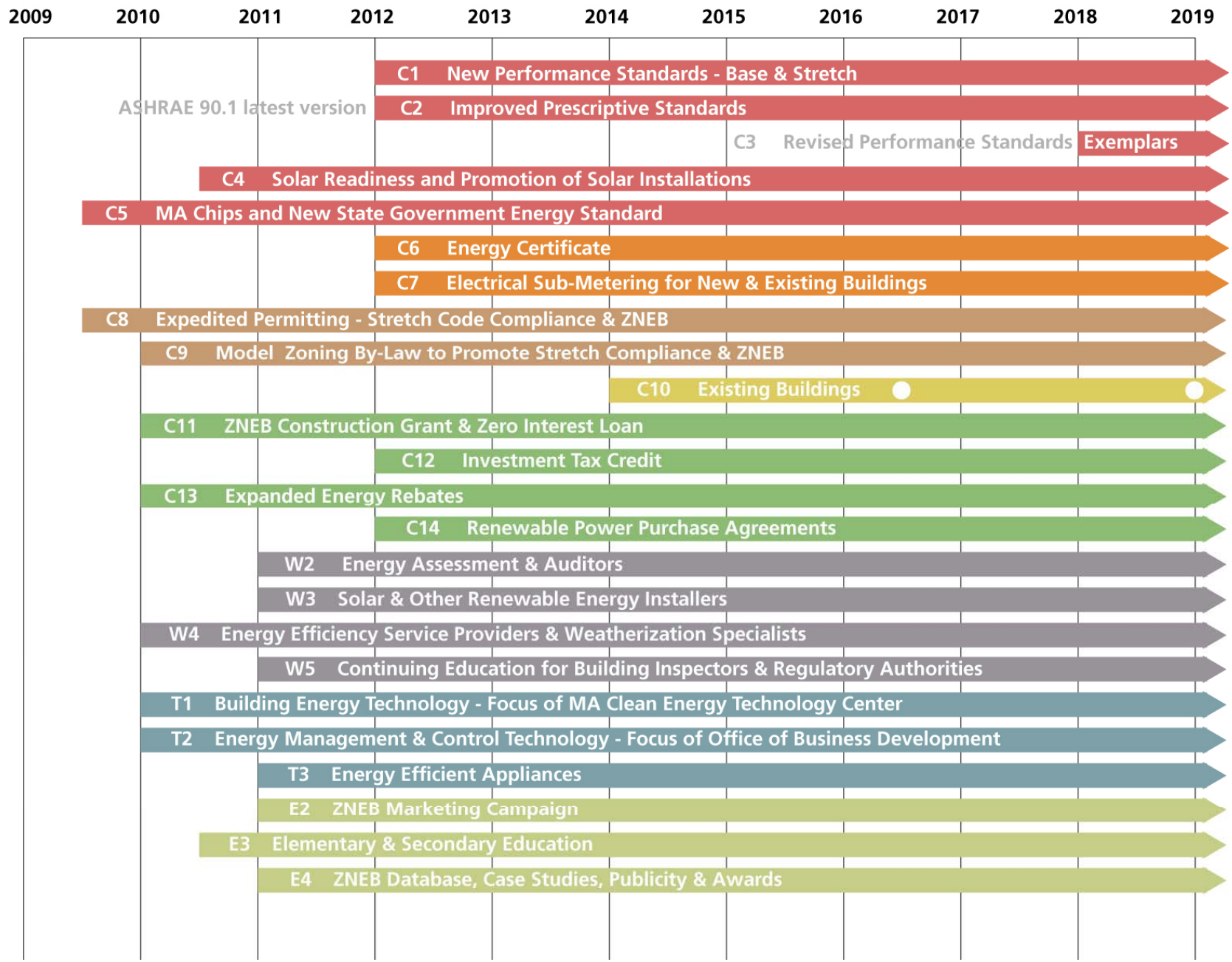
ZNEB Construction Grant & Zero Interest Loan
Investment Tax Credit
Expanded Energy Rebates
Renewable Power Purchase Agreements

Energy Assessment & Auditors
Solar & Other Renewable Energy Installers
Energy Efficiency & Weatherization Specialists
Continuing Ed for Building Inspectors & Regulators

Clean Energy Technology Center
Measurement and Controls
Energy Efficient Appliances

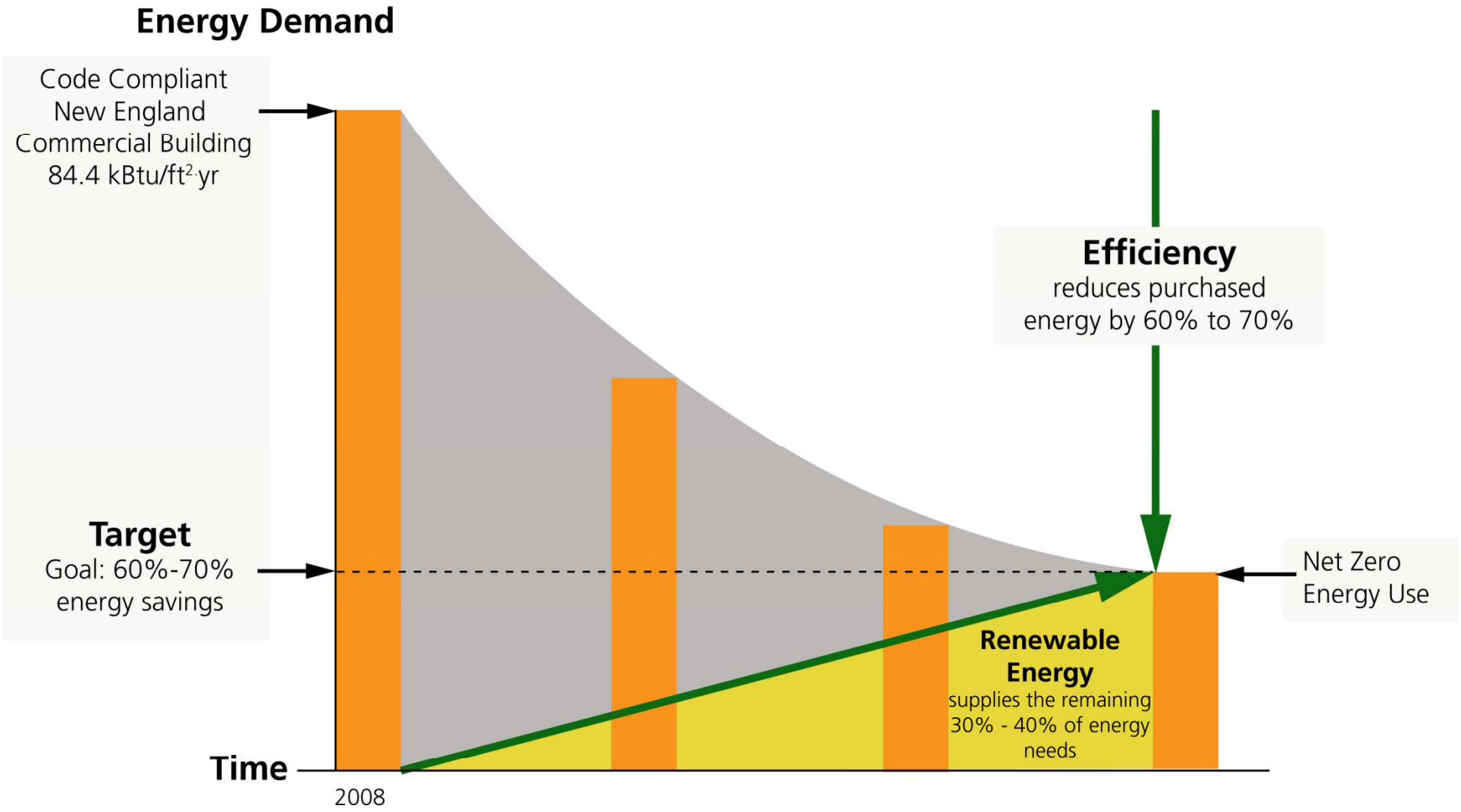
Elementary & Secondary Curriculum
Publicize ZNEB & High Performance

Target Implementation



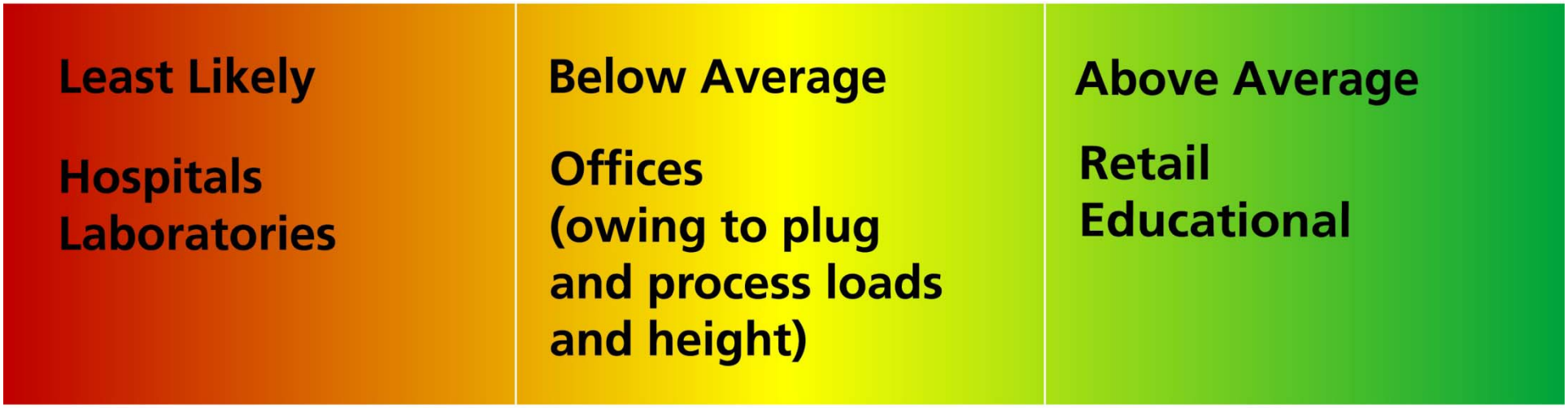
Pathway to ZNEB's by 2030

Federal R&D Agenda Approach to ZNEB



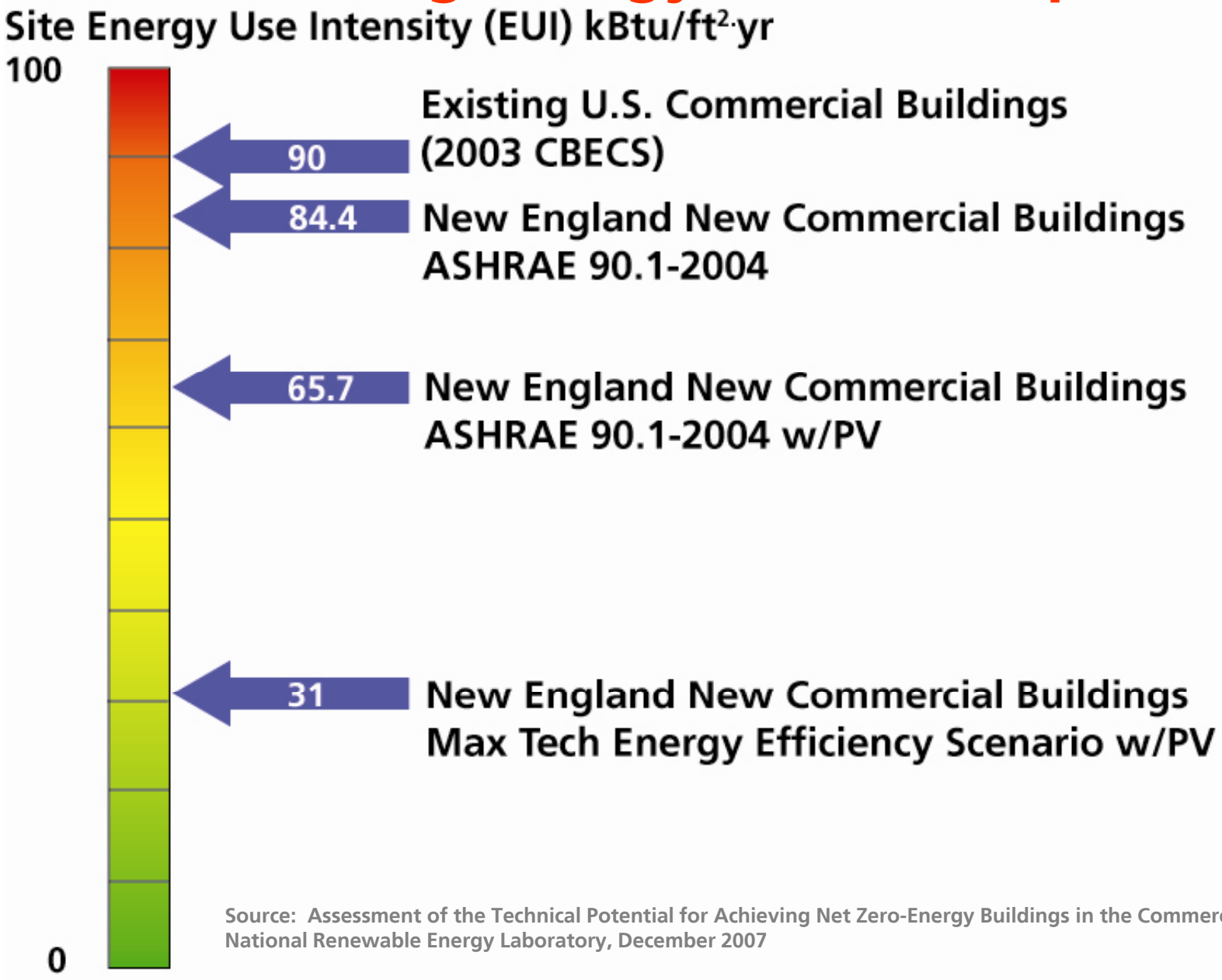
Source: Federal R&D Agenda for Net-Zero Energy, High-Performance Green Buildings, National Science & Technology Council, October 2008

NREL: Potential for ZNEB



Source: Assessment of the Technical Potential for Achieving Net Zero-Energy Buildings in the Commercial Sector, National Renewable Energy Laboratory, December 2007

NREL: Reducing Energy Loads = Top Priority



Source: Assessment of the Technical Potential for Achieving Net Zero-Energy Buildings in the Commercial Sector, National Renewable Energy Laboratory, December 2007

NREL: Factors & Priorities

Number of stories

Plug and process loads

Use (Principal Building Activity)

Location (Climate Zone)

Thermal Insulation

Lighting Equipment

Plug and Process Loads

HVAC Components

Passive Strategies

Source: Assessment of the Technical Potential for Achieving Net Zero-Energy Buildings in the Commercial Sector, National Renewable Energy Laboratory, December 2007

Exemplars show standards are achievable

Building Type:
Office (small)
Name:
Woods Hole Research Center
Location:
Woods Hole, MA
Date completed:
2003

Total annual energy use:
16.0 + 5.4 Kbtu/sq ft actual

Exemplars show standards are achievable

Building Type:
Office, visitor center
Name:
George Robert White Environmental Conservation Center, Massachusetts Audobon Society
Location:
Mattapan, MA
Date completed:
2002

Total annual energy use:
12.6 Kbtu/sq ft

Exemplars show standards are achievable

Building Type:
Office (small)
Name:
SPNF
French Wing
Location:
Concord, NH
Date completed:
2001

Total annual energy use:
37.4 Kbtu/sq ft

Exemplars show standards are achievable

Building Type:
Higher Education
Assembly, Classrooms
Name:
Vermont Law School
Oakes Hall
Location:
Royalston, VT
Date completed:
1998

Total annual energy use:
27.2 **Kbtu/sq ft**

Exemplars show standards are achievable

Building Type:
Higher Education
Research & Teaching
Laboratories,
Classrooms
Name:
Clark University
Lasry Center for
Bioscience
Location:
Worcester, MA
Date completed:
2005
Total annual energy use:
80 Kbtu/sq ft
modeled

Exemplars show standards are achievable

Building Type:
Higher Education
Teaching & Research
Laboratories, Assembly,
Library, Classrooms

Name:
University of New
Hampshire
DeMeritt Hall

Location:
Durham, NH

Date completed:
2008

Total annual energy use:
57 Kbtu/sq ft
modeled

Exemplars show standards are achievable

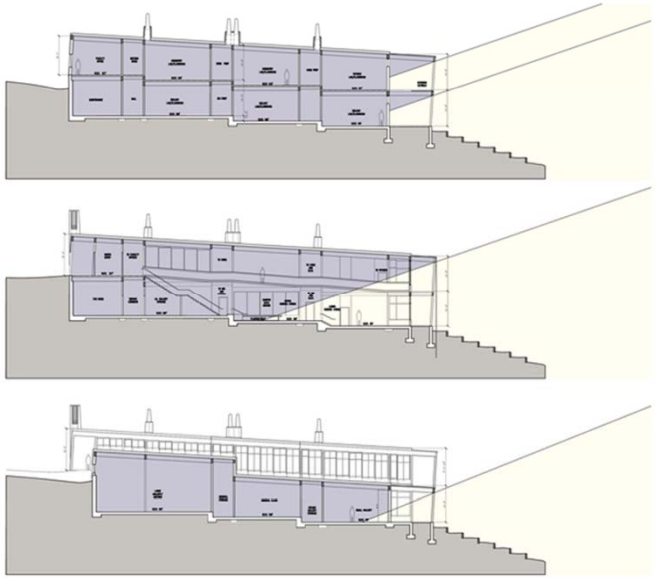
Building Type:
Secondary School Science Building
Name:
Brooks School Science Building
Location:
North Andover, MA
Date completed:
2008
Total annual energy use:
32 Kbtu/sq ft modeled

Exemplars show standards are achievable

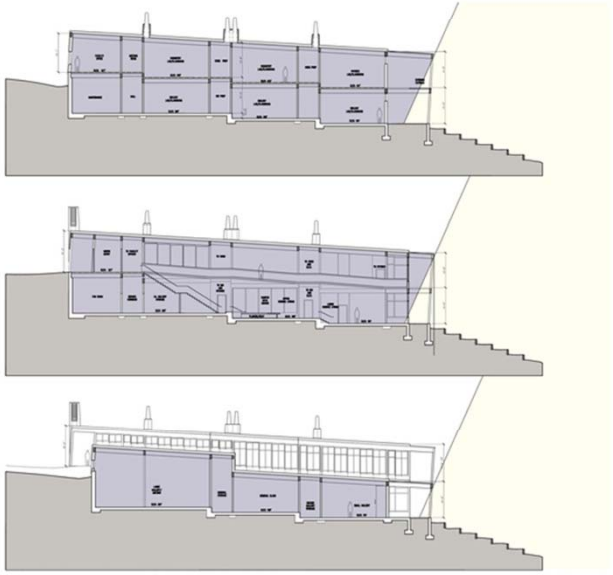
Building Type:
Secondary School
Science Building
Name:
Cambridge School of Weston
Garthwaite Center
Location:
Weston, MA
Date completed:
2007

Total annual energy use:
15.6 +11.5 **Kbtu/sq ft modeled**

Passive Strategies



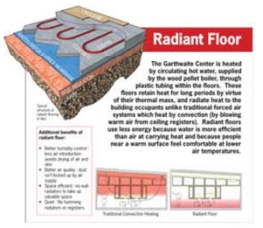
WINTER SUN ANGLE

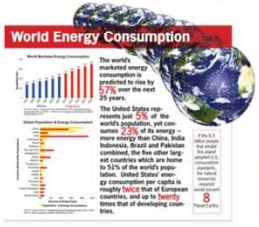


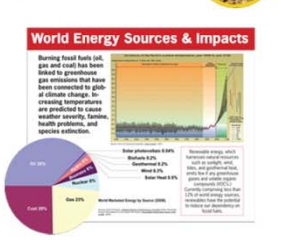
SUMMER SUN ANGLE

Renewable Energy

Mechanical Gallery & Sustainable Signage





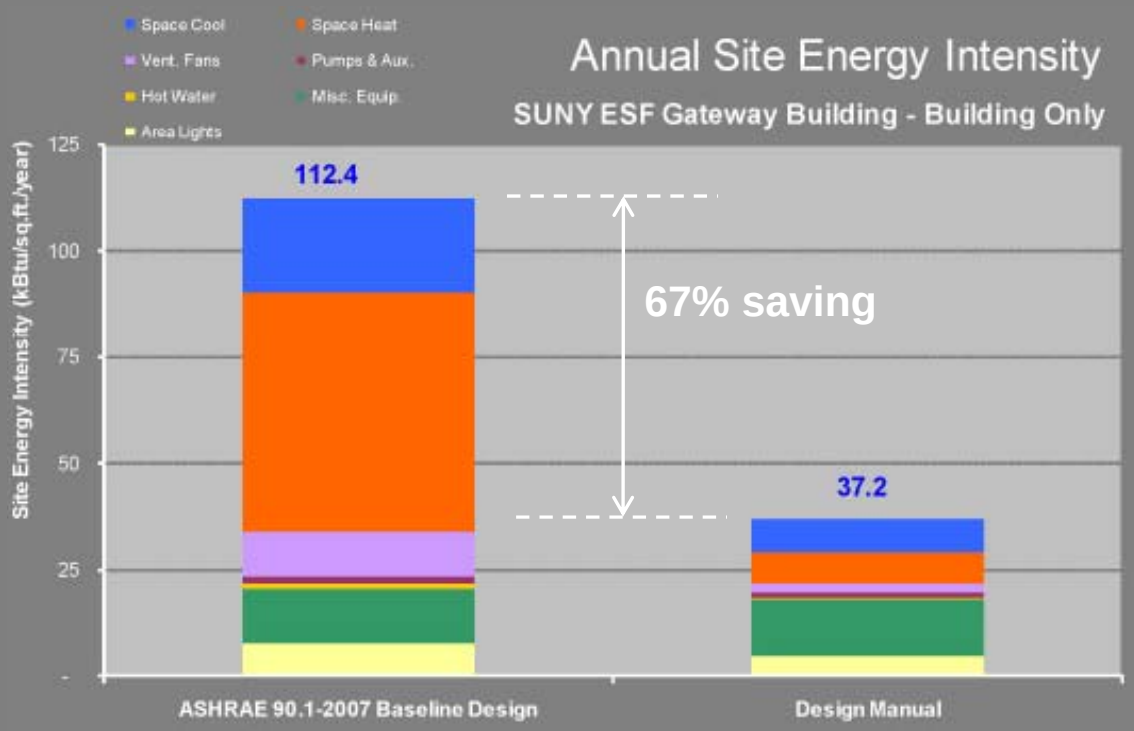


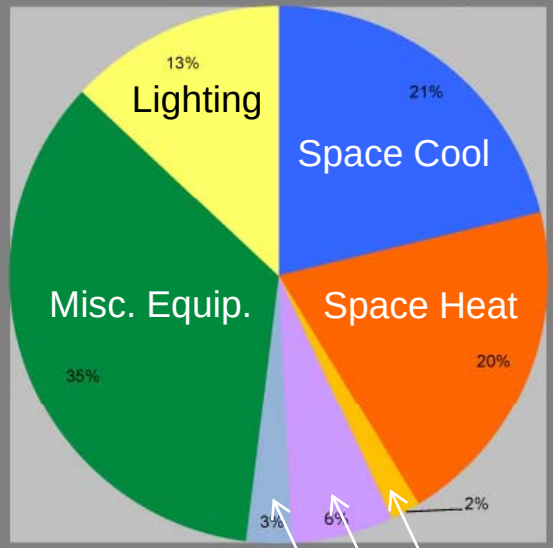
Building Type:
Higher Education
Assembly, Retail, Co-generation Plant
Name:
SUNY ESF Gateway Building
Location:
Syracuse, NY

Location:
Syracuse, NY
Date completed:
2012

Total annual energy use:
37.2 **Kbtu/sq ft**
modeled

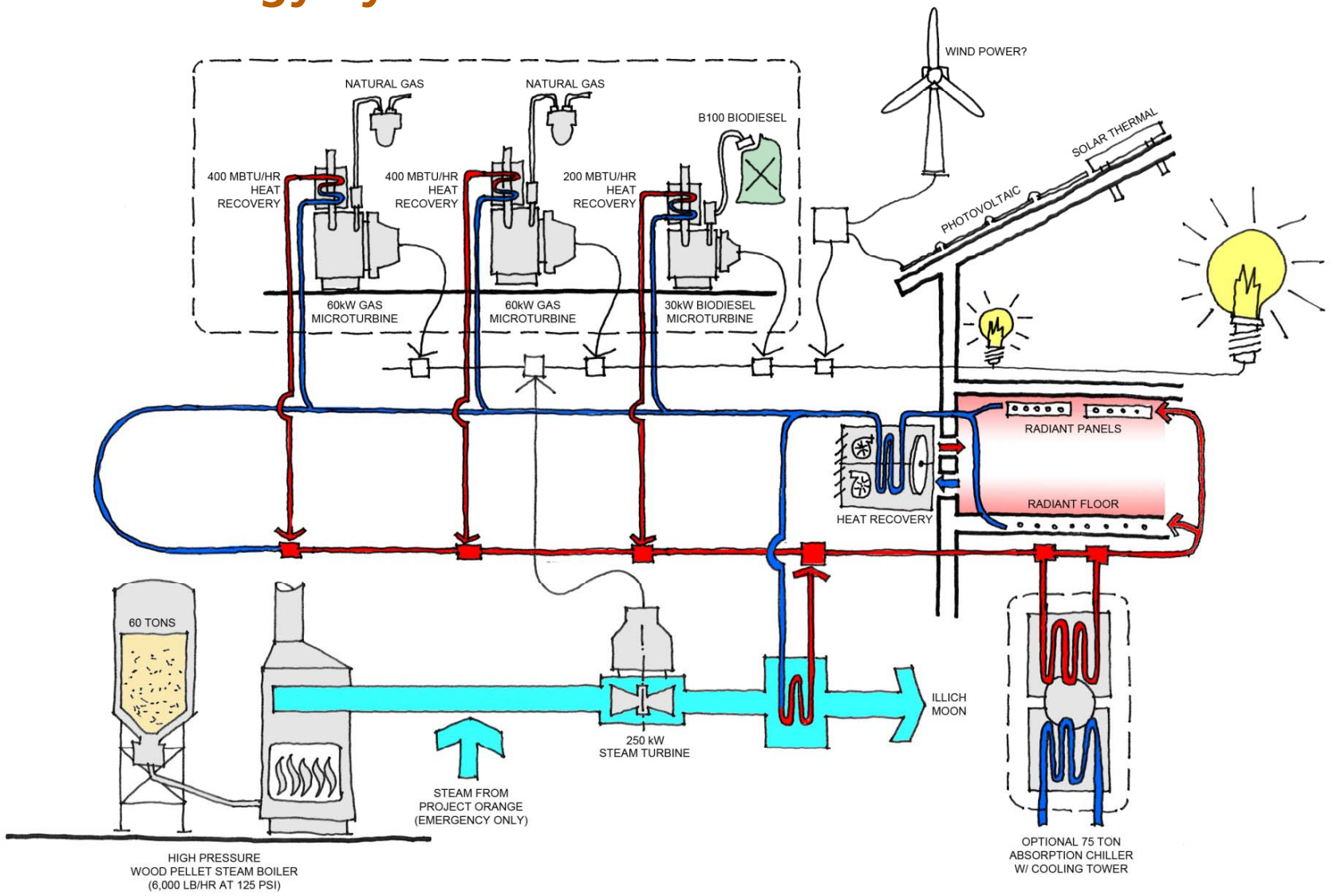
Energy Model





Est. Annual Energy Use: 1,874 MBtu
Est. Energy Intensity: 37.2 kBTU/sf/year

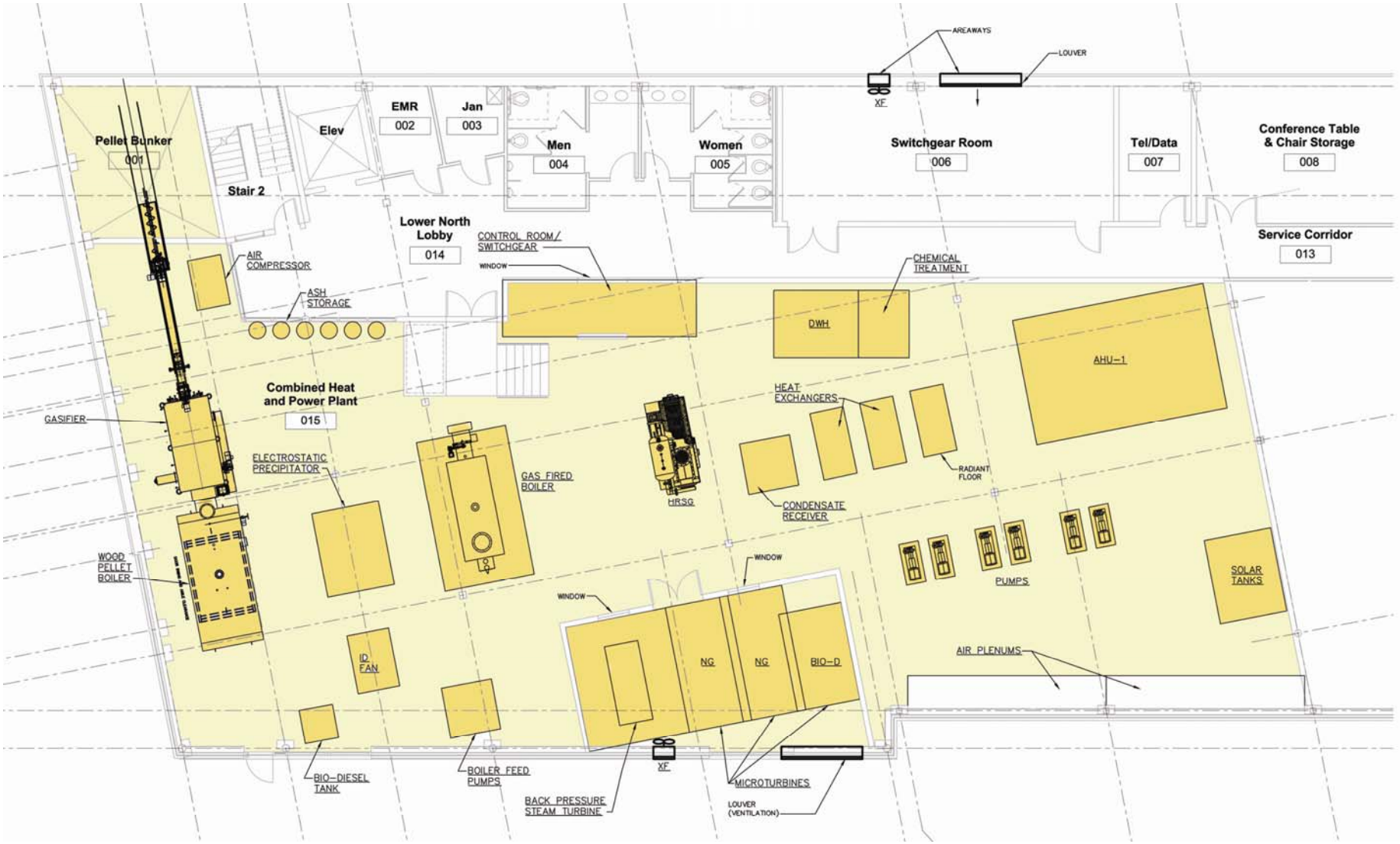
Renewable Energy System



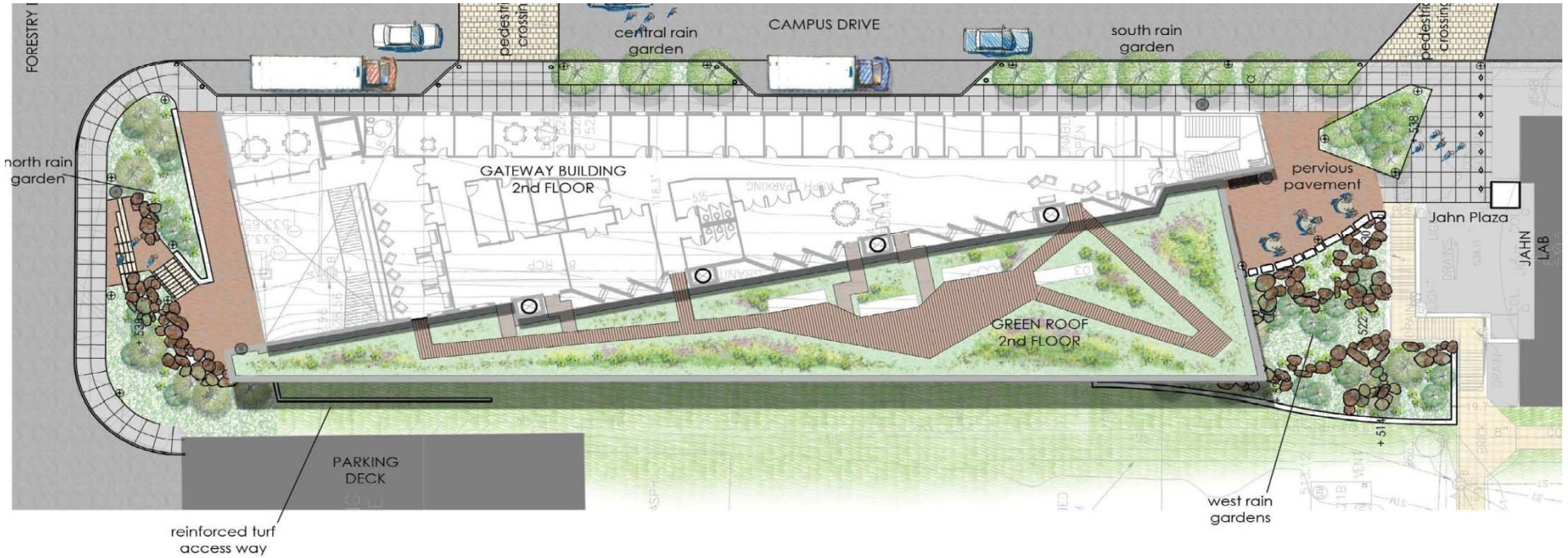
Heat: 7,500 MBTu/Hr, Power: ? kW max

- Wood Pellet boiler produces steam
- Steam generates power and hot water
- Alternate for micro turbines to generate power and heat

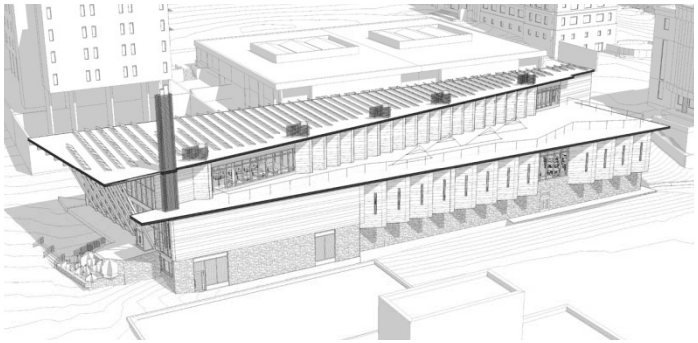
Combined Heat & Power Plant



Green Roof

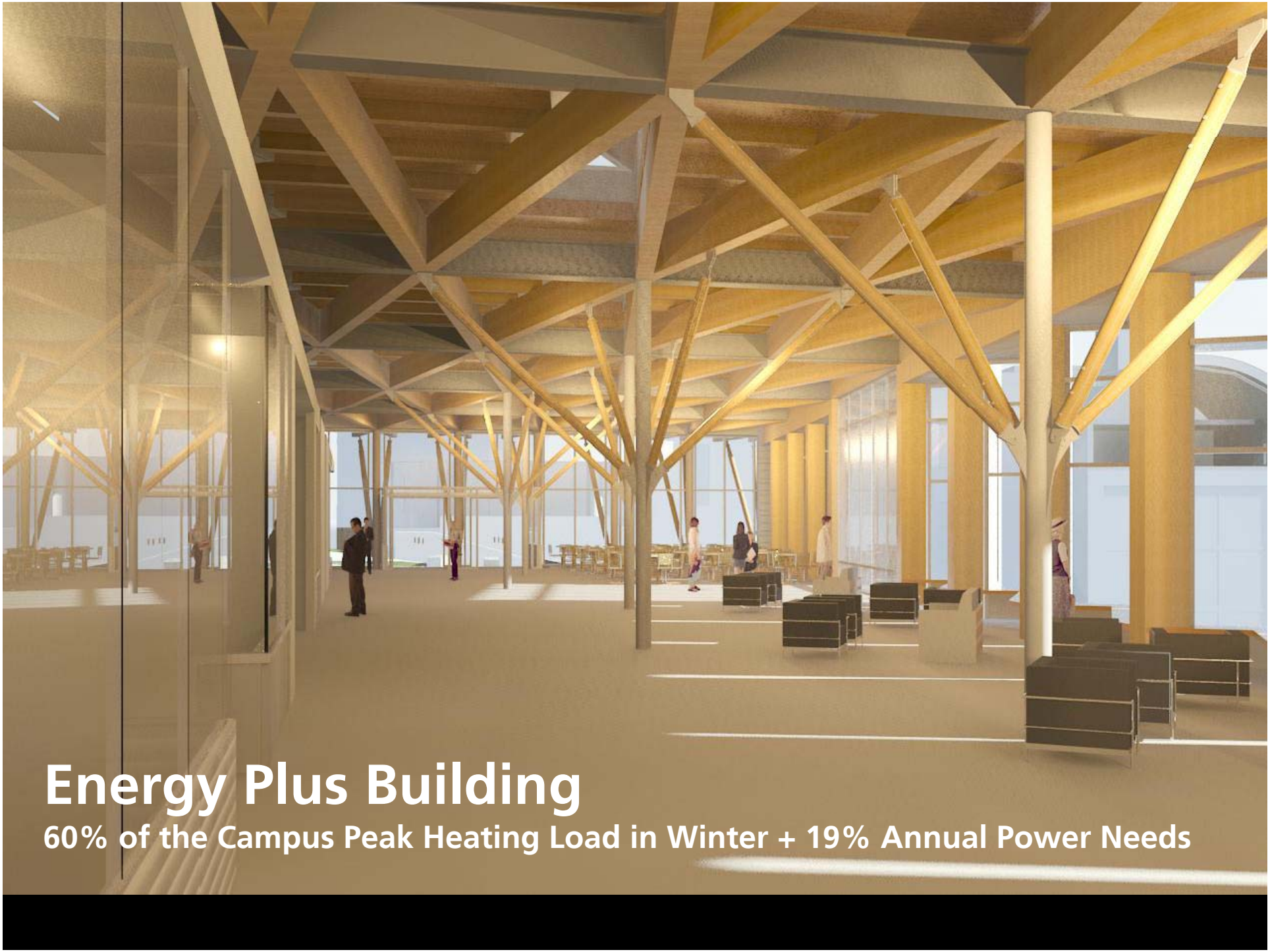

FORESTRY
central rain garden
CAMPUS DRIVE
south rain garden
north rain garden
GATEWAY BUILDING
2nd FLOOR
pervious pavement
Jahn Plaza
JAHN LAB
GREEN ROOF
2nd FLOOR
PARKING DECK
reinforced turf access way
west rain gardens

Photovoltaic



Sunpower 315 (B.O.D.) @ 30 degrees
389 Modules @ 315W = 122 kW


Going G



Energy Plus Building

60% of the Campus Peak Heating Load in Winter + 19% Annual Power Needs