CHPS Technical Session Part 1 Ralph DiNola

CHPS and Advanced Buildings Technical Session

CHPS Training: Solutions for Green Schools in Massachusetts

April 21, 2016

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Ralph DiNola
CEO
New Buildings Institute


tappé architects

MA High Performance Schools

SCHOOL	LOCATION	CRITERIA USED
Monomoy Regional High School	Harwich, MA	MA-CHPS
Freeman Kennedy School	Norfolk, MA	MA-CHPS
Rochester Memorial High School	Rochester, MA	MA-CHPS
Roger L. Putnam Vocational Technical Academy	Springfield, MA	MA-CHPS
Sherwood Middle School	Shrewsbury, MA	MA-CHPS
Thompson Elementary School	Arlington, MA	MA-CHPS
Ashland High School	Ashland, MA	CA-CHPS
Berkshire Hills Regional MS	Great Barrington, MA	CA-CHPS
Beverly High School	Beverly, MA	MA-CHPS
Blackstone Valley Tech HS	Upton, MA	MA-CHPS
Bridgewater Raynham Regional HS	Bridgewater, MA	MA-CHPS
etc...		

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Assessment Tool
Version 3.1
NORTHEAST CHPS
Criteria
For
NEW CONSTRUCTION
and
RENOVATIONS
CHPS
NORTHEAST
COLLABORATIVE FOR
HIGH PERFORMANCE
SCHOOLS
neep


advanced buildings
New Construction
A prescriptive guide to achieve significant, predictable energy savings in new commercial buildings


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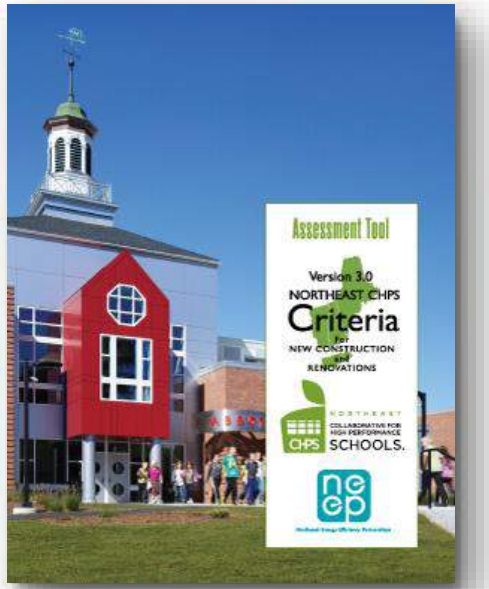
THE CRITERIA: METRICS AND EXAMPLES

Seven Basic Metrics	Related Example
1. Integrated Design Process	Engineers consult with teachers & students
2. Indoor Environmental Quality	Walk-off mats keep pollutants outside
3. Energy Usage	Photosensor activated lighting
4. Water Usage	Low-flow toilets & waterless urinals
5. Site Selection/Development	Facility located near public transportation
6. Materials & Waste Management	Locally produced materials
7. Operations & Metrics	Occupant behavior seminars

THE CRITERIA: POINTS AND EMPHASIS



Project Type	Required Points
Major Renovations	85
New Construction	110

Criteria	Prerequisite Points	Total Points Possible
Integration and Innovation	6	21
Operations and Metrics	12	23
Indoor Environmental Quality	27	76
Energy	13	68
Water	6	21
Sites	4	22
Materials & Waste Management	4	19
TOTALS	72	250

CHPS Energy Criteria

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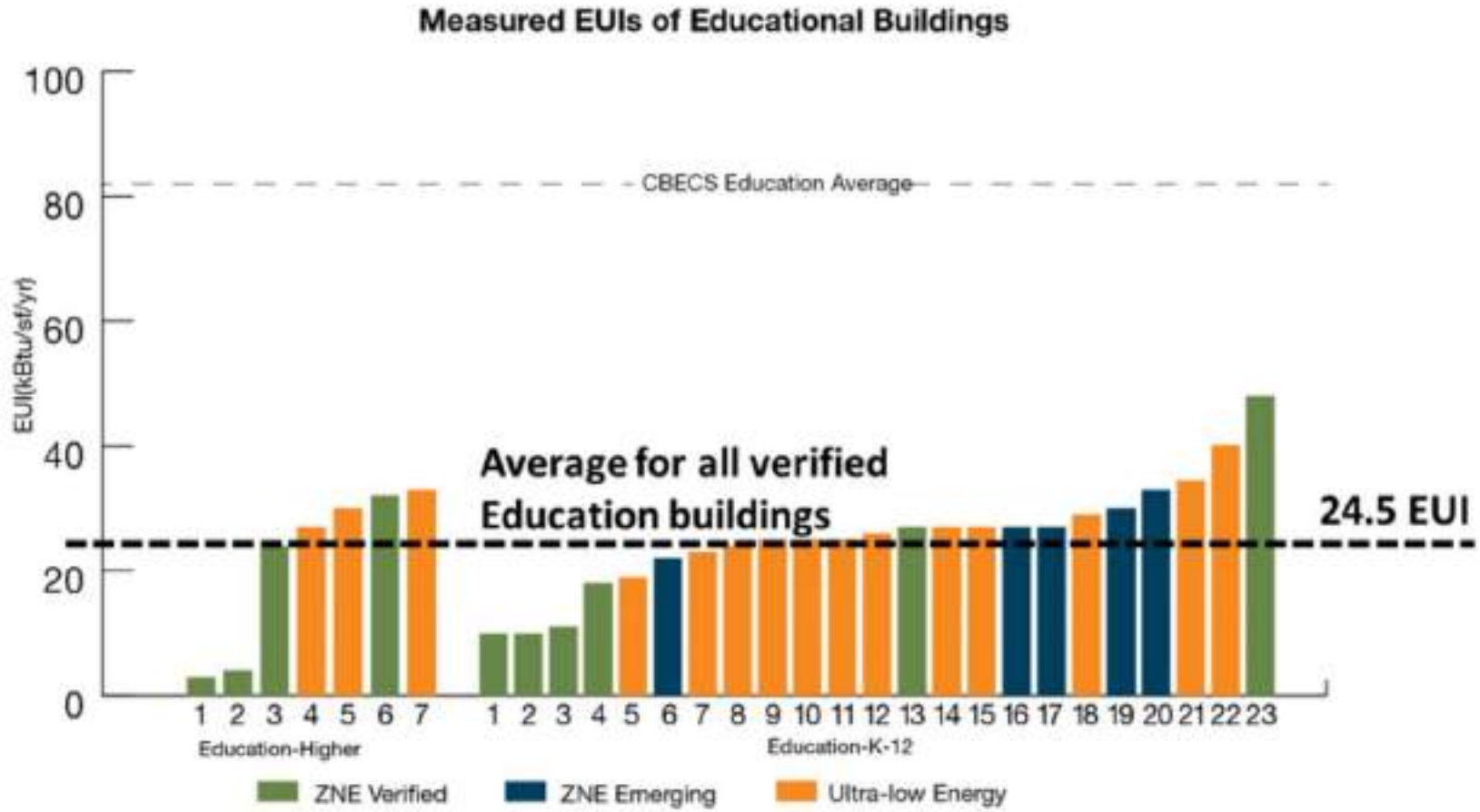
Performance Range - Education



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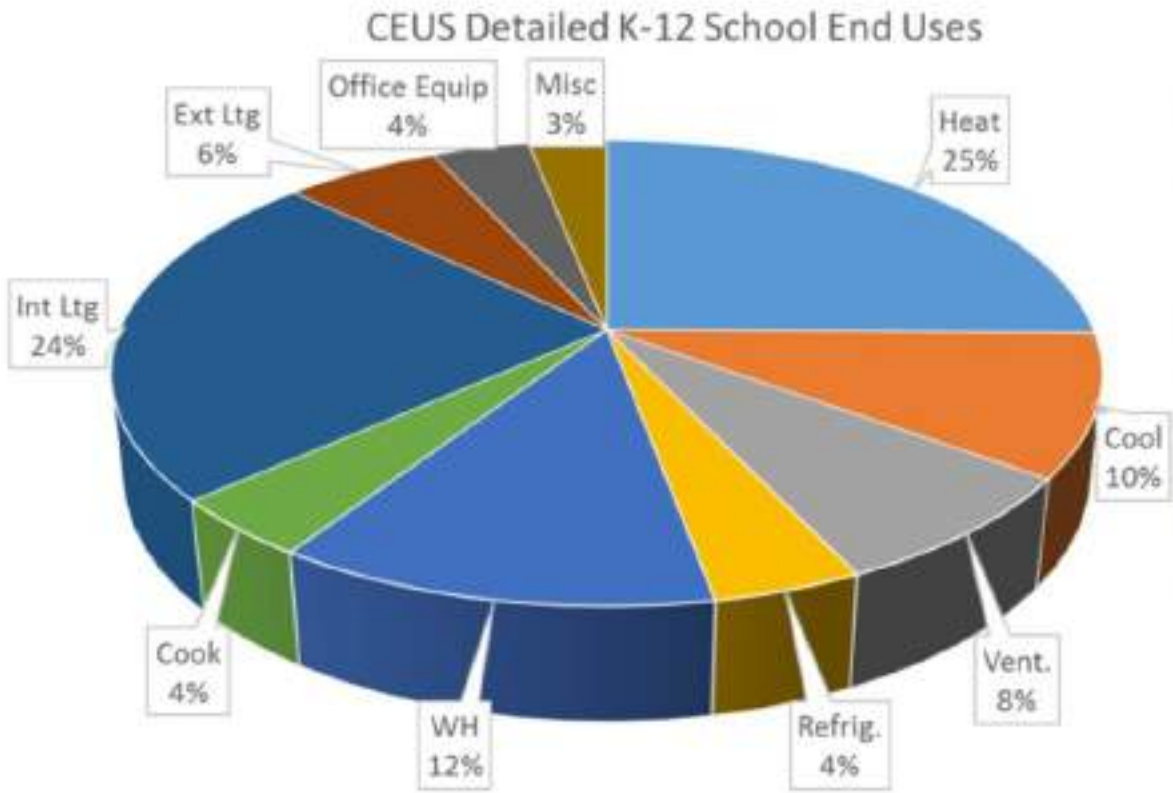
Benchmarking Existing Facilities: Understanding Energy End Uses



Heating, Cooling, Ventilation
= **Envelope & HVAC Equip.**

Lighting, Plugs, Cooking, Refrig.
= **Interior Equipment**

All Usage
= **Controls & Occupants**

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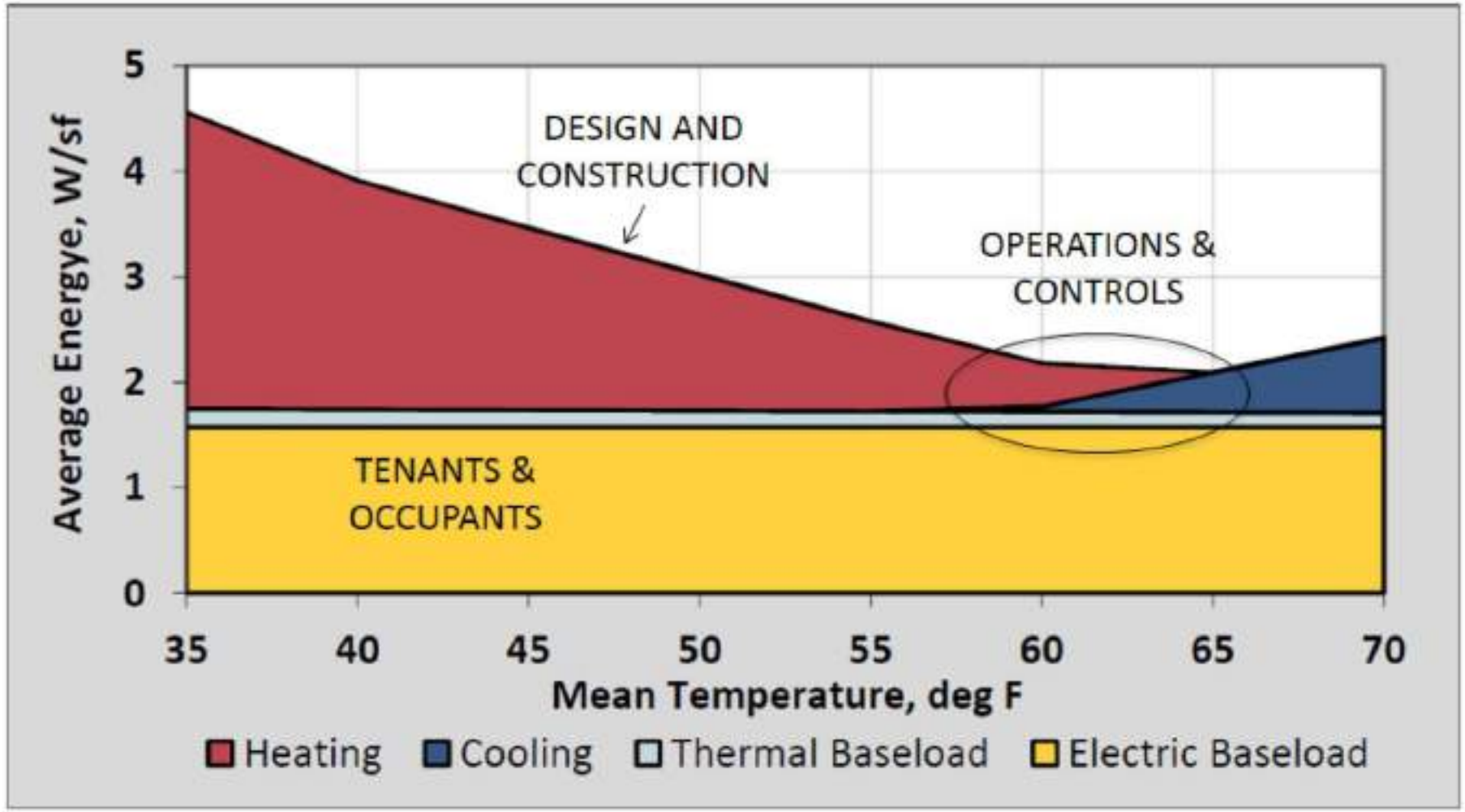
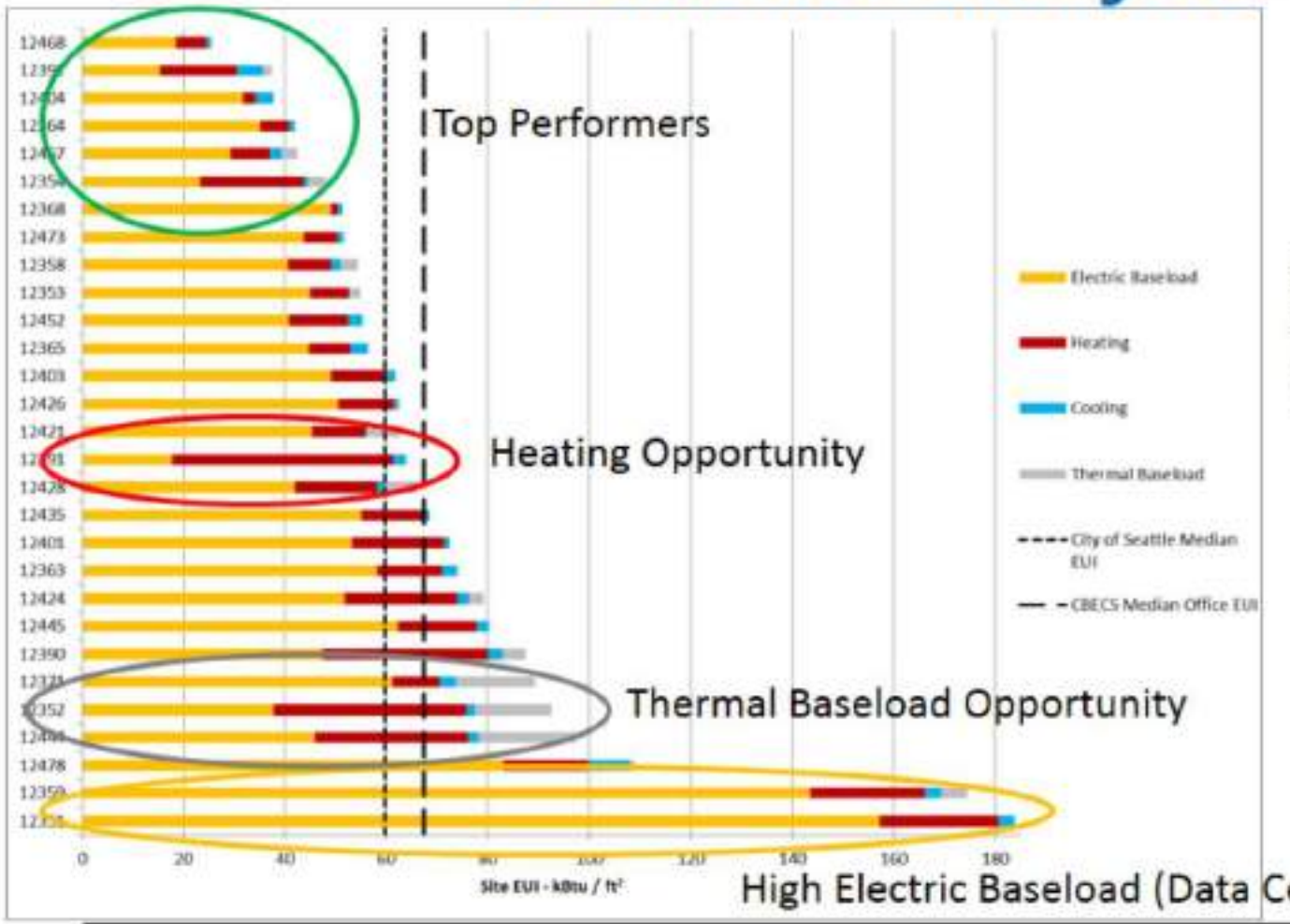
Energy signature:
Cambridge City Hall Annex



FirstView:
Portfolio Analysis



Seattle 2030 District Portfolio Analysis (NBI, 2014)

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Requirement

Prerequisite	EE 1.0	School design for new construction and new buildings on existing campuses shall exceed by 10% the baseline established in ASHRAE Standard 90.1-2010 or the IECC 2012. This correlates to a maximum zEPI score of 51. The design shall also receive an ENERGY STAR score through Target Finder. There is no minimum ENERGY STAR score requirement. **OR** Design the school according to the standards established by the basic requirements of **Tier 2** of *the Advanced Buildings New Construction Guide* from the New Buildings Institute.


advanced buildings
New Construction
A prescriptive guide to achieve significant, predictable energy savings in new commercial buildings

Advanced Buildings New Construction Guide

NBI's prescriptive solution for achieving high performance in new commercial construction and major renovation projects

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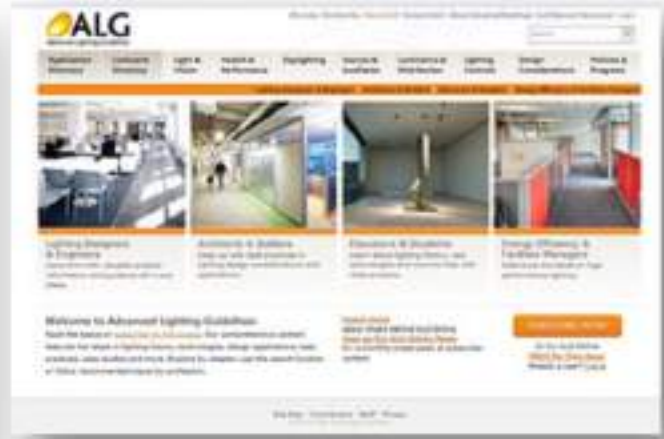

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Table of Contents

Additional reference material in specific Criteria and other *Advanced Buildings: New Construction Guide* information can be found on the Advanced Buildings website at www.advancedbuildings.net.

Tier One

All of the Criteria listed in this section are required components of *Core Performance*, originally published as Version 1 of the *Advanced Buildings* Program. These requirements are applicable for projects comparing to an energy code baseline of 2010 or earlier (such as ASHRAE90.1-2010, or IECC 2009). Energy savings projections for this Tier of *Advanced Buildings* are predicted in comparison to these earlier versions of code and are based on the implementation of all applicable measures in this section.

1.0 Introduction
1.1 Prerequisites
1.2 Air Barrier Performance
1.3 Opaque Envelope Performance
1.4 Fenestration Area and Performance
1.5 Minimum IAQ Performance
1.6 Lighting Controls
1.7 Lighting Power Density - Interior and Exterior
1.8 Cool Roofs
1.9 Mechanical Equipment Efficiency Requirements
1.10 Economizer Performance
1.11 Energy Recovery Ventilation
1.12 Demand Control Ventilation
1.13 Acceptance Testing
1.14 Additional Efficiency Package Option

Tier One

1.0 Introduction

1.1 Prerequisites

1.2 Air Barrier Performance

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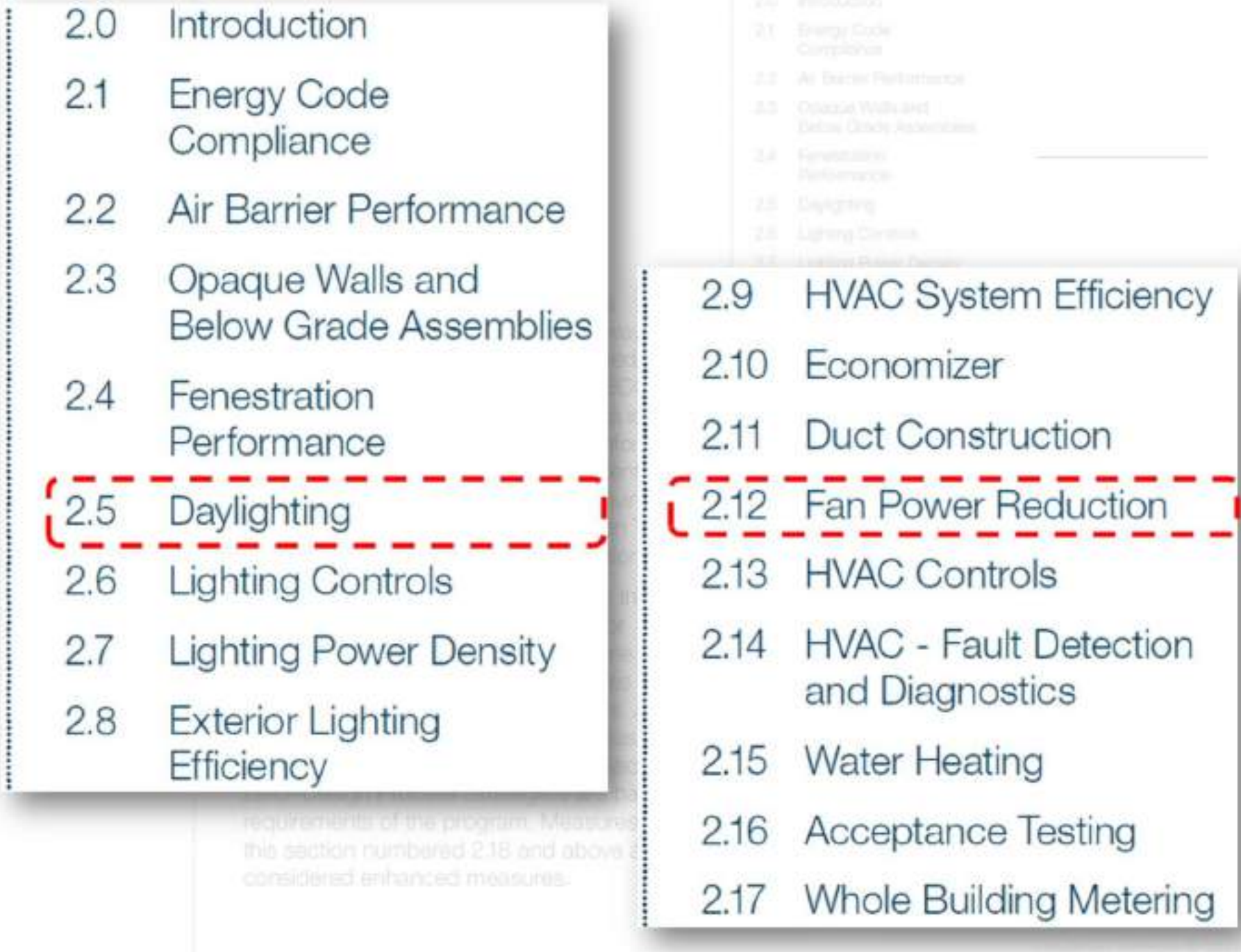
Tier Two

Section Two of the Guide incorporates strategies designed to provide a pathway for whole-building performance that exceeds the more recent code versions, such as IECC 2012 and ASHRAE 90.1-2010. Projects in jurisdictions that have adopted and enforce these codes must follow the requirements of this section to achieve significant savings beyond code. The measures in Section Two supersede the strategies listed in Section One.

This section is divided into two parts; the basic requirements of the program (for advanced code jurisdictions) and some optional additional enhanced strategies which may be adopted by individual projects. All of the measures up to and including measure 2.17 (and including the measures in Section Zero–Design Process Strategies) are basic requirements of the program. Measures in this section numbered 2.18 and above are considered enhanced measures.


2.0 Introduction
2.1 Energy Code Compliance
2.2 Air Barrier Performance
2.3 Opaque Walls and Below Grade Assemblies
2.4 Fenestration Performance
2.5 Daylighting
2.6 Lighting Controls
2.7 Lighting Power Density
2.8 Exterior Lighting Efficiency
2.9 HVAC System Efficiency
2.10 Economizer
2.11 Duct Construction
2.12 Fan Power Reduction
2.13 HVAC Controls
2.14 HVAC - Fault Detection and Diagnostics
2.15 Water Heating
2.16 Acceptance Testing
2.17 Whole Building Metering

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Tier Three

The Performance Pathways section of the *Advanced Buildings: New Construction Guide* is designed to provide strategies for additional savings to projects which might be able to undertake additional efforts to increase energy efficiency levels. These pathways represent broader design strategies that require an integrated and informed design approach to more advanced efficiency strategies than those represented by individual savings measures. They may also require deeper analysis or expertise from the design team and may not be applicable to all project types or conditions. However, these design pathways often represent an opportunity for significant additional savings beyond the basic requirements of the *Advanced Buildings* program. For this reason they are considered as Tier Three of the program.

Achieving Tier Three in the *Advanced Buildings: New Construction Guide* requires that projects follow the requirements of Section Zero, Section Two, and one or more Performance Pathway strategies from Section Three.

Tier Three

Pick One

0.0 Design Process Strategies

NREL's Research Support Facilities (RSF), Golden, CO. Photo Credit: Dennis Schroeder/NREL

Design Process Strategies (Prerequisite for all Tiers)

The measures described in this section are referred to as Design Process Strategies, and all projects using this Guide should implement all of the strategies described in this chapter. These strategies have been developed to make the design process more effective, leading to better integrated design outcomes. This category defines specific steps which are necessary to comply with the requirements of the *Guide*.

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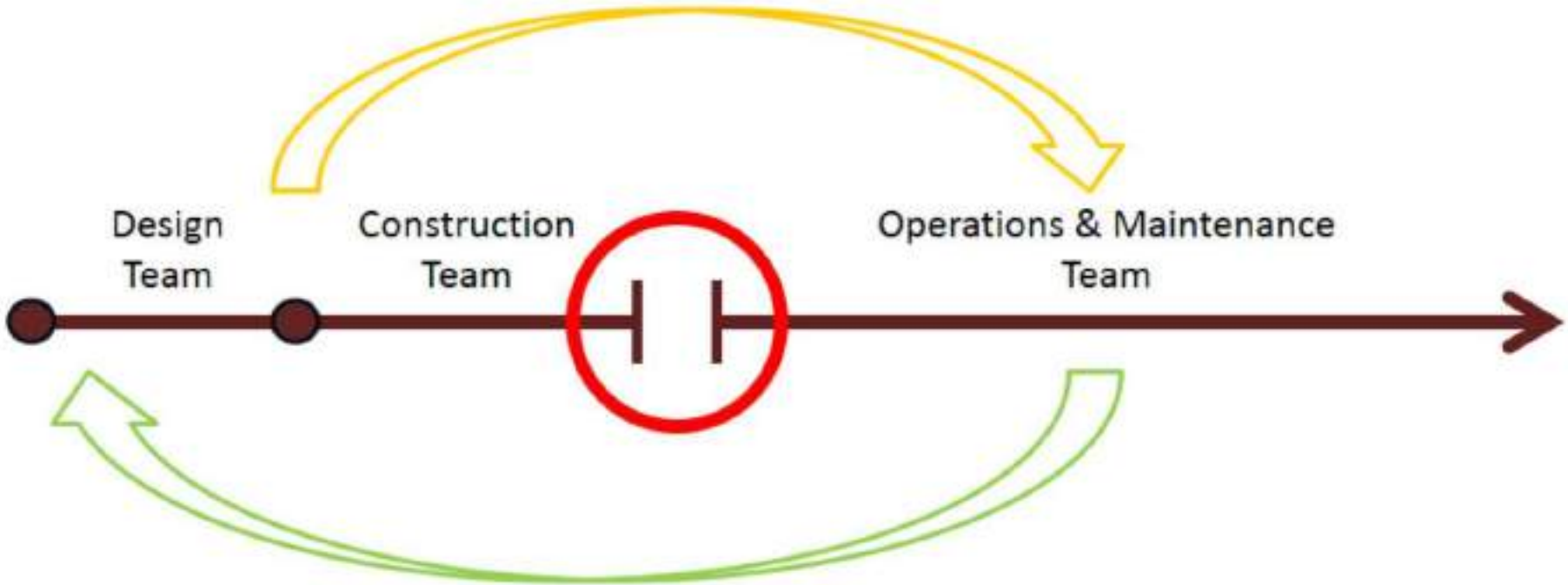
Design for Operations

Integrating operations team into the design process



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0.1 Identify Design Intent

0.1 IDENTIFY DESIGN INTENT

Core Performance Building: Brooks School, North Andover, MA. Photo credit: Architerra

Purpose

Develop consensus among the project team and owner as to the performance goals of the project and identify design strategies to achieve these goals. Ensure the design is developed in a way that meets the objectives of the building program including energy and environmental needs. Discuss *Advanced Buildings New Construction Guide* requirements and identify implementation strategies.

Criteria

The project team shall conduct a team meeting to identify key energy and environmental goals and principles. This meeting should consist of a facilitated discussion ***before*** the schematic design process has concluded. Discussion should include how *Advanced Buildings New Construction Guide* criteria will be implemented. If the *AB:NC* program is initiated later in the design process, complete this step as soon as possible.

Meeting participants should include all key project team members, including:

- Owner
- Architect
- Mechanical Engineer
- Electrical Engineer and/or Lighting Designer
- General Contractor (if selected)
- Utility Program Representative
- Leasing Agent (if speculative development)
- Facilities Manager
- End User Representative

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Mandatory Minimums

30 points

EE 1.1 Utilize the protocol in Energy EE 1.0 for quantifying reductions in total energy use. Points are awarded according the percentage saved over a baseline building. Projects may optionally use the Zero Energy Performance Index (zEPI), which provides a more stable benchmark that will not vary with future code updates.

Points	Reduction Requirement	zEPI Equivalent
Prerequisite	10% minimum reduction	51
9 Points*	15% minimum reduction	49
12 points	20% minimum reduction	46
18 points	30% minimum reduction	40
22 points	40% minimum reduction	34
25 points	50% minimum reduction	29
28 points	60% minimum reduction	23
31 points	70% minimum reduction	17
34 points	80% minimum reduction	11
37 points	90% minimum reduction	6
40 points	100% minimum reduction (zero net-energy school)	0

Interpolation between the values in the above table is permitted.

Projects may not achieve more than 18 points unless they can demonstrate that their designed EUI is less than or equal to 40 kBtu/sq.ft.

*In MA only: For an additional 2% reimbursement from the Massachusetts School Building Authority, the project must achieve a minimum of 9 points (15% minimum reduction) for EE 1.1.

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zEPI: the Zero Energy Performance Index

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Zero Energy Performance Index (zEPI)

The 2015 International Green Construction Code (IgCC) includes many progressive measures that will improve the energy performance of buildings. One important provision describes the Zero Energy Performance Index (zEPI), which provides a scale for measuring commercial building energy performance. zEPI represents a fundamental shift in measurement of building efficiency as it sets energy targets for actual energy consumption rather than using a predictive energy model of building energy performance to calculate a "percent-better-than-code" metric.

zEPI sets an energy use intensity (EUI) target for building type and is adjusted for climate. It is also the measure by which a building's energy efficiency is calculated once operational and occupied based on measured energy use data.

Why is zEPI needed?

The zEPI scale marks key energy measurement milestones as well as the performance of individual projects or policies. It permits direct comparisons in order to understand the relative performance of each of these elements in measurement of energy performance.

Comparing the energy efficiency of buildings by referencing their percent savings beyond code can create confusion:
"Which code?" "What year?" Given there have been at least six major commercial energy codes on the books at any given time in the United States since 2000, identifying the correct baseline can take some time.

zEPI sets a constant goal of zero and shifts the conversation from percent better than code to percent from zero, which is the kind of market shift that is required for buildings to achieve wide-scale net zero and exemplary energy performance.

zEPI* Scale to ZNE

AB Criteria: Tier 2 Savings

Advanced Buildings New Construction Guide from New Buildings Institute

Criteria	% Reduction
Tier 2	2.7%
Criteria 2.18: Enhanced Envelope	1.9%
Criteria 2.19: Enhanced Glazing	0.7%
Criteria 2.20: Enhanced LPD	0.8%
Criteria 2.23: Demand Control Ventilation	1.3%
Criteria 3.2: Advanced Envelope*	4.4%
Criteria 3.3: Advanced Daylighting	0.7%
Criteria 3.6: Variable Capacity Heat Pump (VRF)	9.2%
Criteria 3.8: Plug Loads	6.2%
*If pursuing this Criteria, do not count savings from Criteria 2.18 or 2.19	

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Zero Energy Capable

2 points	EE 2.1.1	Zero Net-Energy Capable. A complete design of a PV system that will provide 100% of the annual electric energy needs and operate an average efficiency of at least 80% of the optimal for your location as determined by the US DOE's PVWatts program. The roof-top PV arrays must cover at least 65% (unless a smaller area is needed to provide full capacity) of the total roof area (the remainder of the PV can be located on parking covers or free-standing mounting structures). Other solutions may be considered on a case by case basis. The complete PV system can be installed with: • No structural modification to the roof to accommodate 5 lbs. per sq. ft. additional weight. • No additional roof or wall penetrations are need for electrical wiring. • No physical expansion of electrical or mechanical rooms to accommodate the inverter(s) and other electrical system components. The project must have a projected annual site EUI of 40 kBtu per square foot to qualify for these credits. OR
	EE 2.1.2	Zero Net-Energy. Show through the energy modeling required for EE 1.0 that on-site renewable energy systems produce as much energy on an annual basis as is used by sum of all the building systems. Project is eligible for two (2) innovation points from II 10.1. The project must have a projected annual site EUI of 40 kBtu per square foot to qualify for these credits.

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2.4 Fenestration Performance

Table 2.4.1

Climate Zone	1	2	3	4	5	6	7	8
Vertical Fenestration (0-30% window-to-wall ratio)	U-0.46	U-0.46	U-0.40	U-0.37	U-0.37	U-0.29	U-0.22	U-0.22
Vertical Fenestration (30-40% window-to-wall ratio)	U-0.36	U-0.36	U-0.30	U-0.29	U-0.29	U-0.22	U-0.17	U-0.17
Vertical SHGC	0.25	0.25	0.25	0.35	0.35	0.35	0.40	0.40
Skylight	U-0.65	U-0.65	U-0.50	U-0.50	U-0.50	U-0.50	U-0.50	U-0.50
Skylight SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

The values in this table apply to the entire fenestration assembly.

Notes: In order to meet these requirements, fenestration performance may be averaged for the entire building on a weighted average basis. For buildings with 30-40% WWR, the weighted average performance of all fenestration must meet the 30-40% U-value requirement.

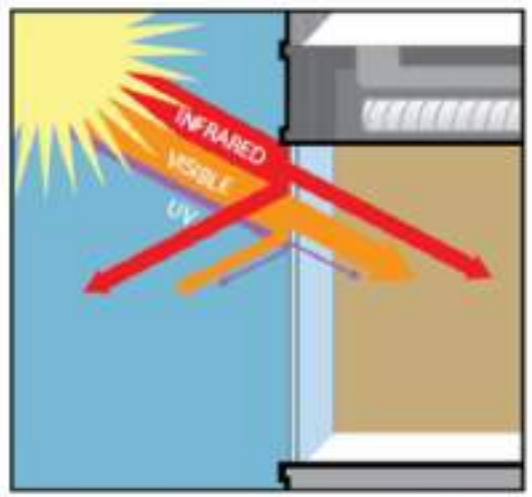
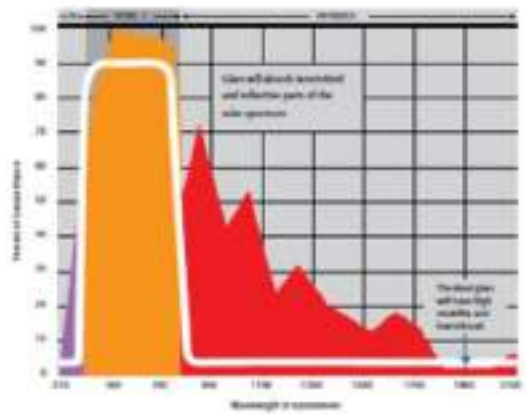


Diagram showing the advantage of using low-e glass to reduce solar gains.



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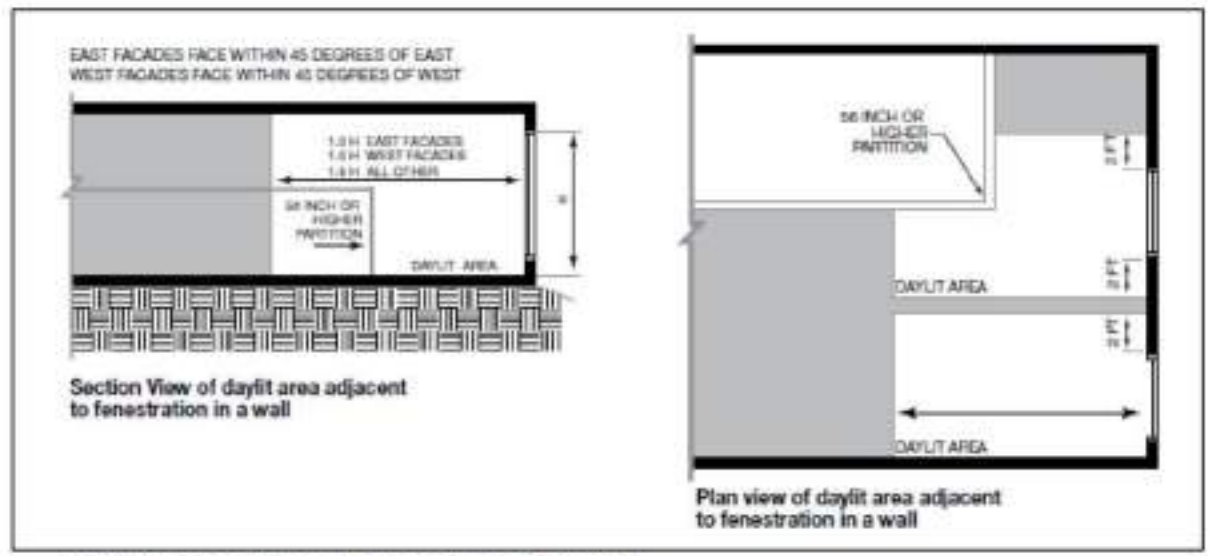
2.5 Daylighting

BEST PRACTICES

Small control zones increase the complexity and cost of automatic daylight controls. For this reason many base codes, including the IECC, exempt small daylit zones from automatic daylight control requirements (e.g. below 250 sf, check the base code in effect for your project). Designing so that control zones are larger, (usually larger than about 2,500 sf), will help ensure the control system remains cost effective. It will also help keep the system simpler and therefore easier to keep properly calibrated. If exempted by the base code, small daylit zones are not required to have automatic daylighting controls to meet this criterion unless their area is being used to meet the 35% threshold.

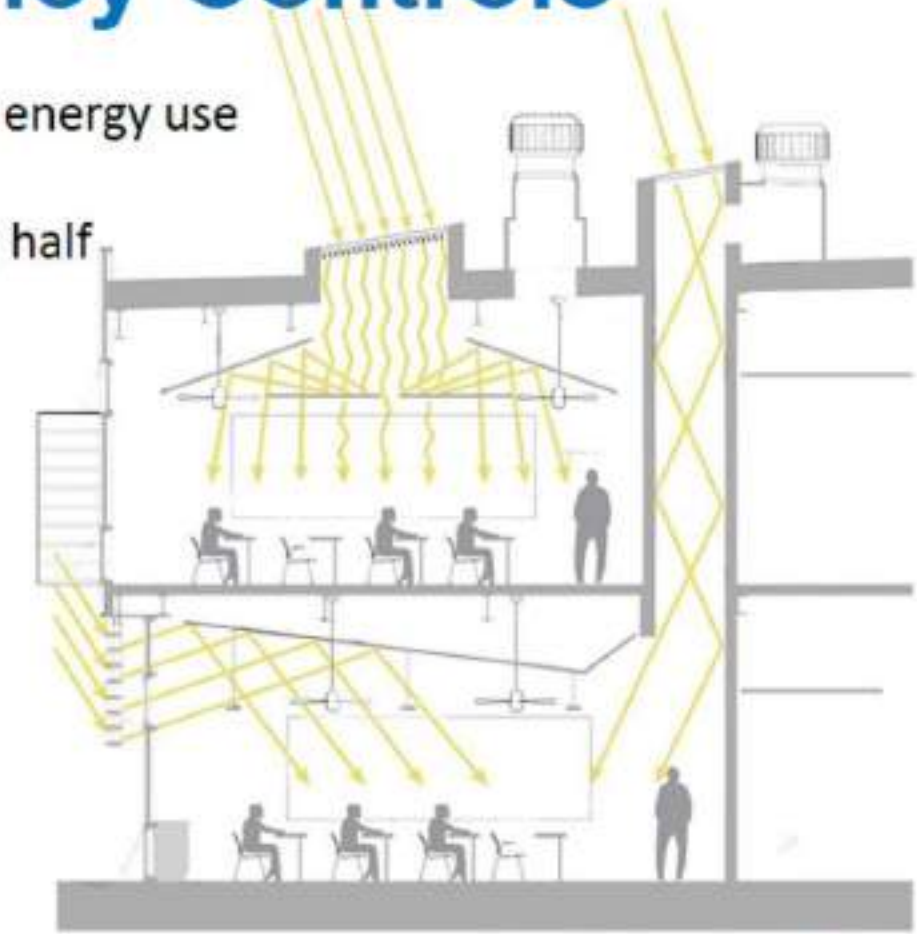


Daylight Zone Adjacent to Fenestration in a Wall

Integrated Daylighting and Occupancy Controls

- Lighting can reach 20% of energy use
- School hours are optimal
- Cut lighting energy use by half

Source: Boora Architects



Source: http://www.srgpartnership.com/

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Natural Ventilation

Natural Ventilation & Energy Conservation Interlocks

Intent

Provide a bonus for school designs that incorporate natural ventilation and an incentive to install interlocks on doors and windows.

EE 6.1 – Natural Ventilation & Energy Conservation Interlocks

Natural ventilation is an effective energy design strategy for schools in many climates. Natural ventilation is already credited in the Superior Energy Performance criterion (EE 1.1) and this criterion offers additional bonus points when the strategy is employed.

EE 6.1 – Natural Ventilation & Energy Conservation Interlocks	Credit
	2 points
Applicability	**Verification Required**
This criterion applies to new schools, a	

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2.9 HVAC System Efficiency

Purpose

Reduce the energy consumption associated with heating and air conditioning through the installation of efficient equipment.

Criteria

- All HVAC equipment shall meet the minimum efficiency requirements in Tables 2.9.1 through 2.9.7.
- Gas Unit Heaters shall include an intermittent ignition device and have either power venting or a flue damper.
- Gas Furnaces <225,000 Btu/hr should have an AFUE rating of 94 or higher. Gas furnaces that are part of rooftop package equipment shall have an AFUE of at least 80.
- Boilers shall be provided with an intermittent ignition device, an air positive shut-off device (such as a flue or vent damper) and variable speed drives for all combustion fans.
- Equipment not listed in Tables 2.9.1 through 2.9.7 shall meet ENERGY STAR Criteria where available.

Energy Management Systems

Energy Management System

Intent
Provide control, accountability, and optimization of building energy performance.
EE 5.1 – Energy Management System
EE 5.2 – Advance Energy Management System and Submetering

Energy Management Systems (EMS), lighting control and metering are important systems for controlling, monitoring and understanding patterns of energy use in schools.

The prerequisite requires a base level EMS system to be installed, whereas EE 5.2 gives points for a more advanced system.

EE 5.1 – Energy Management System		**Credit**	
		2 points	
Applicability	**Verification Required**		
All projects.	Design Review	Construction Review	Performance Review

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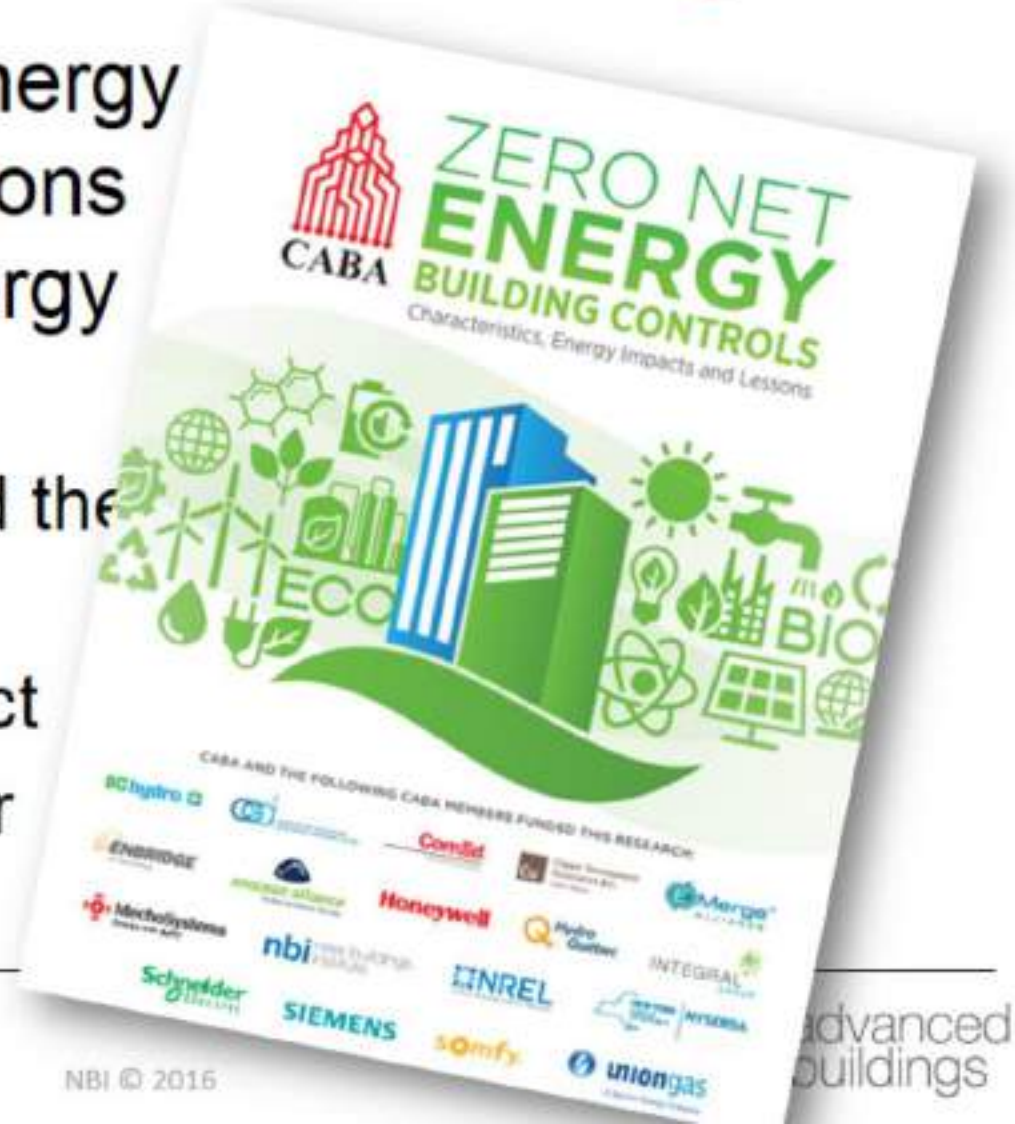
NBI Zero Net Energy Building Controls Study

Characteristics, Energy Impacts, and Lessons from Zero Net Energy Buildings

1. The Selection and the System.
2. The Energy Impact
3. The Use and User Experience



2.17 Whole Building Metering

DPR Construction Office, San Diego, CA. Image credit: www.buildingdashboard.com/clients/dpr/sandiego/

Criteria

Provide the building with energy measurement equipment, including:

- Measurement devices capable of measuring whole-building electric and gas usage in one-hour intervals (electricity measurement devices shall measure both voltage and amperage).
- A user interface capable of displaying energy usage for current day, previous day, same day of previous year, monthly data and cumulative energy usage for previous 12 months.
- Storage capacity of no less than 36 months of data for all energy types connected to all measurement devices and accessible from the user interface (Remote data storage solutions are acceptable alternatives to on-site data storage provided the data is continuously available to an on-site data display system).

Purpose

Assure the persistent delivery of energy and environmental benefits from the building by collecting and reviewing ongoing energy performance data.

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Commissioning

EE 3.0 – Commissioning			Prerequisite 4 points
Applicability	**Verification Required**		
All projects.	Design Review	Construction Review	Performance Review

EE 3.1 – Additional Commissioning Qualifications			Credit 1 point
Applicability	**Verification**		
All projects.	Design Review	Construction Review	Performance Review

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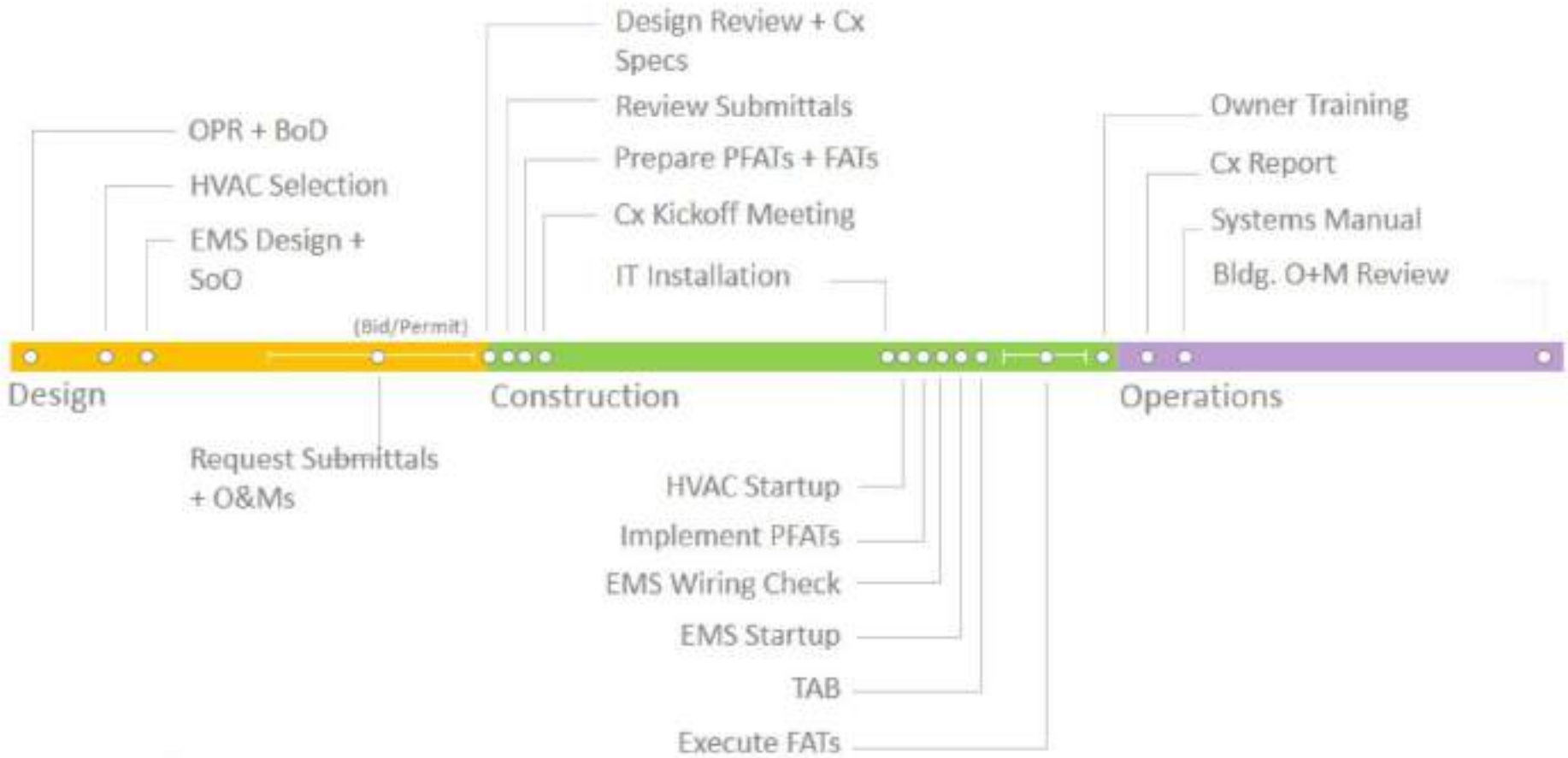
Building Commissioning



Incentives

Local Energy Efficiency Incentives and Assistance

Intent

Require participation in local energy efficiency incentives and technical assistance programs.

EE 7.0 – Local Energy Efficiency Incentives and Assistance

Virtually every utility customer in the Northeast region is eligible to participate in at least one, and typically several, energy efficiency programs. The programs offer either technical assistance or incentives for efficient equipment and practices. Many programs offer both technical assistance and financial incentives for the installation of efficient equipment and the incorporation of efficient design practices

Incentives

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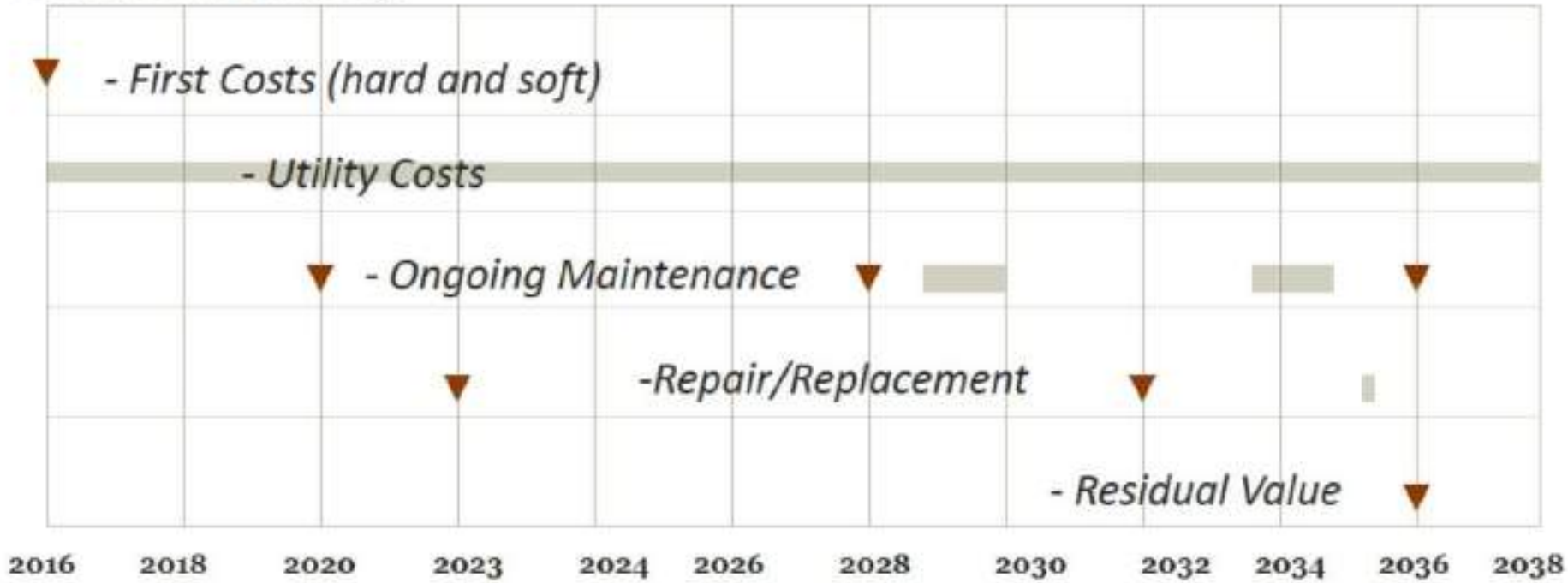
Life Cycle Cost Analysis - LCCA

What is the full price of a building?

Life Cycle Cost =
Net Present Value of:



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George V. Leyva Middle School Administration Building


Thank You!
Ralph DiNola
CEO, NBI
ralph@newbuildings.org
David and Lucille Packard Foundation Building
Courtesy: EHDD