



DLR Group

Architecture Engineering Planning Interiors

Speakers:



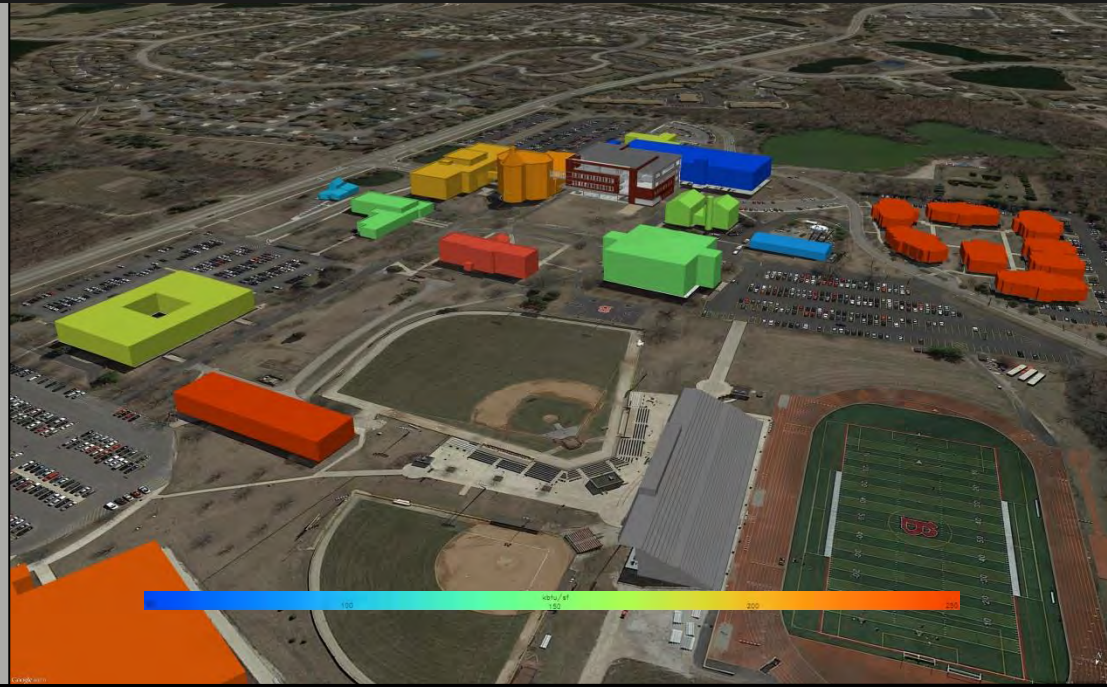
Ruairí Barnwell

Principal
Energy Services Leader



Ben Talbot

Associate
Senior Building Analyst



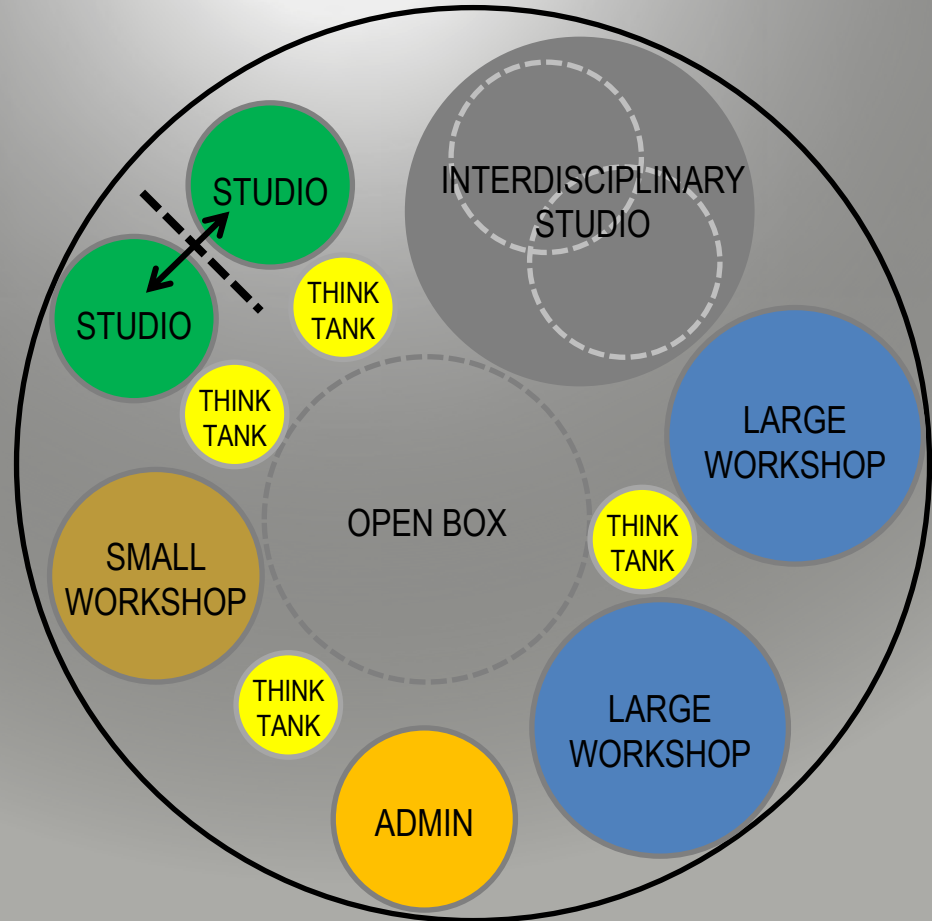
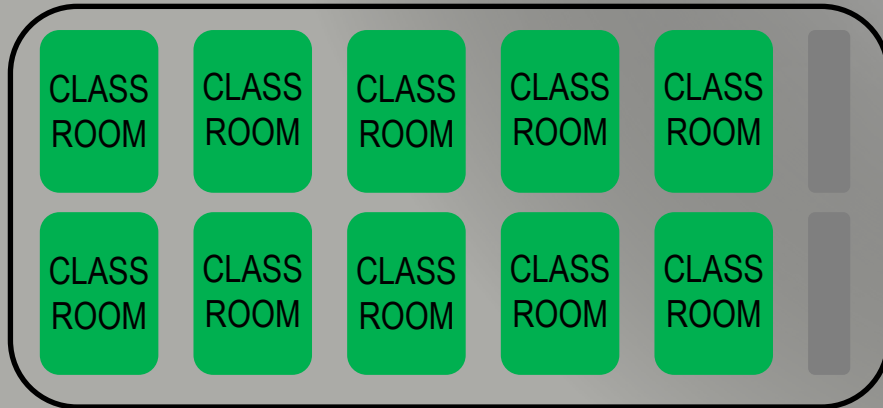
Holistic Approach to Optimization of Educational Facilities

LEARNING OBJECTIVES

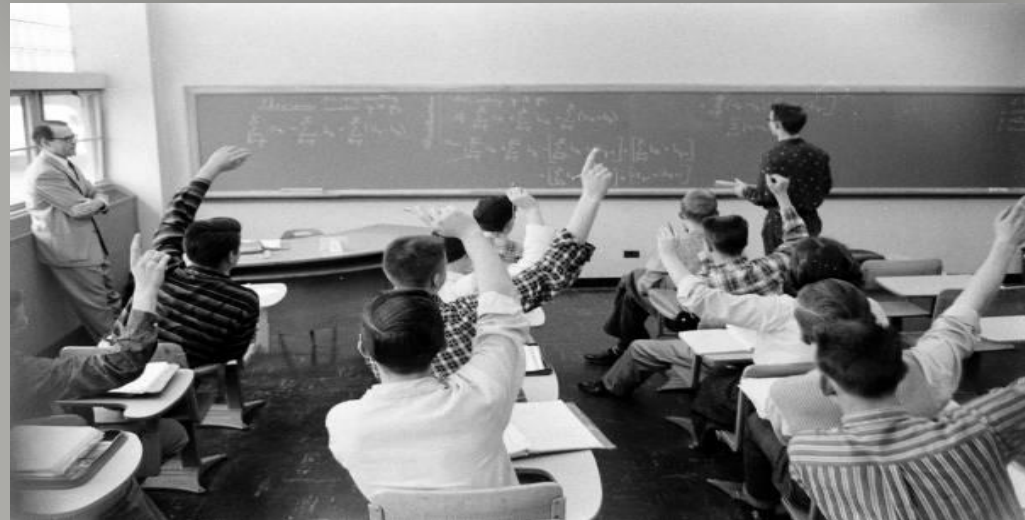
After attending this session, the attendees will be able to:

1. Learn about evolving needs in Educational Facilities and how the Retro-commissioning and Energy Assessment processes can be applied to meet these needs
2. Understand the relationship between Building Performance, Indoor Environmental Quality, Energy Reduction Goals and Student Achievement
3. Discuss industry factors that are driving energy efficiency in Educational Facilities such as Architecture 2030 challenge, increasingly stringent Energy Codes and High Performance Building Standards
4. Recognize the Potential of the Retro-commissioning process in the roadmap to net-zero energy for Educational Facilities

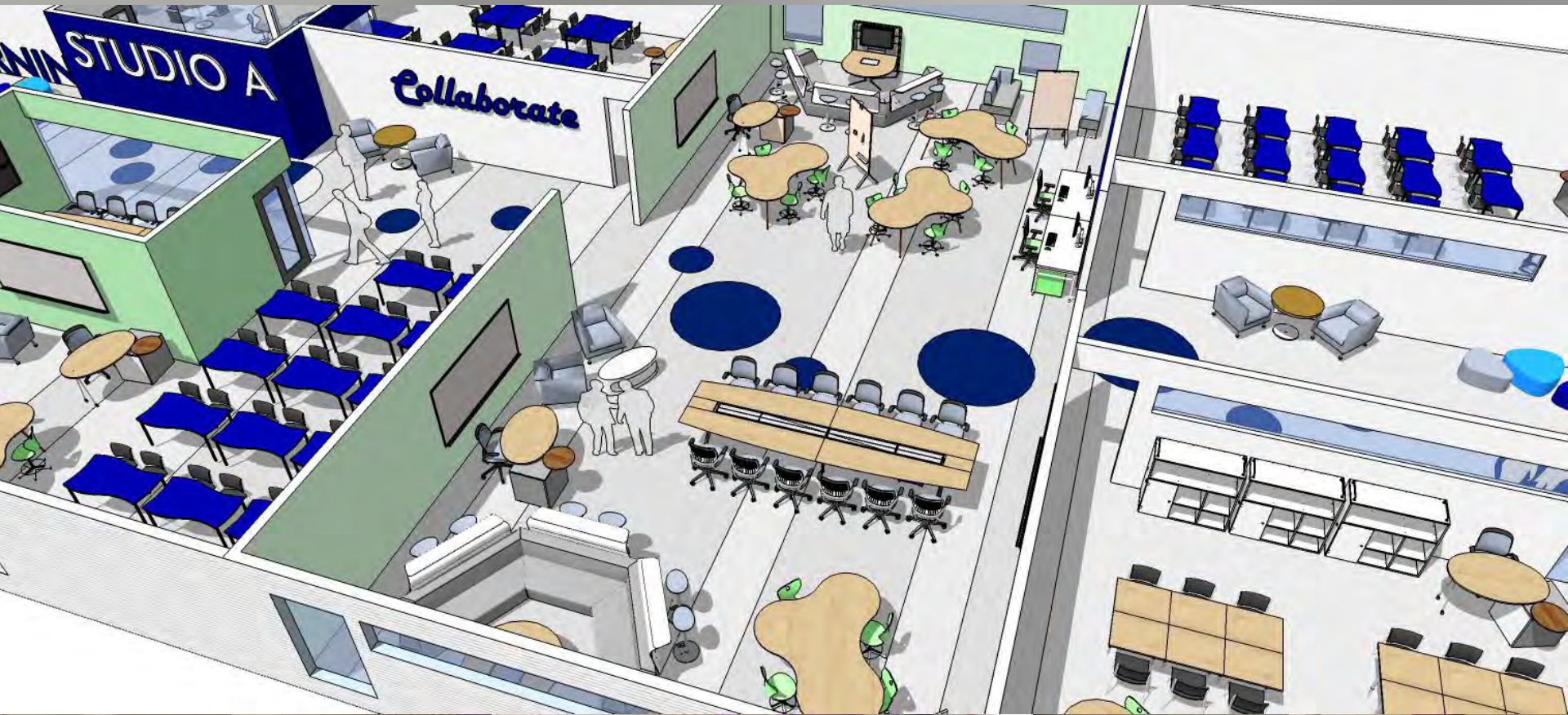
EDUCATIONAL SPACE NEEDS ARE CHANGING



THAT WAS THEN



THIS IS NOW





21st CENTURY LEARNING ENVIRONMENTS

CHANGING WORKPLACE NEEDS



THE **WELL** BUILDING STANDARD®

VERSION 1.0



AIR										
WATER										
NOURISHMENT										
LIGHT										
FITNESS										
COMFORT										
MIND										
	1	2	3	4	5	6	7	8	9	10

STUDENT & BUILDING PERFORMANCE



1. Environment

- Adequate Ventilation
- Thermal Comfort
- Air Quality
- Lighting/Daylighting
- Acoustics

2. Energy Use

- Gas
- Electric
- Water

STUDENT PERFORMANCE

60% of the schools had higher attendance rates, equaling **one fewer absence** per student per year

87% reported a positive impact on **student health**

85% reported positive effect on their **health and productivity**

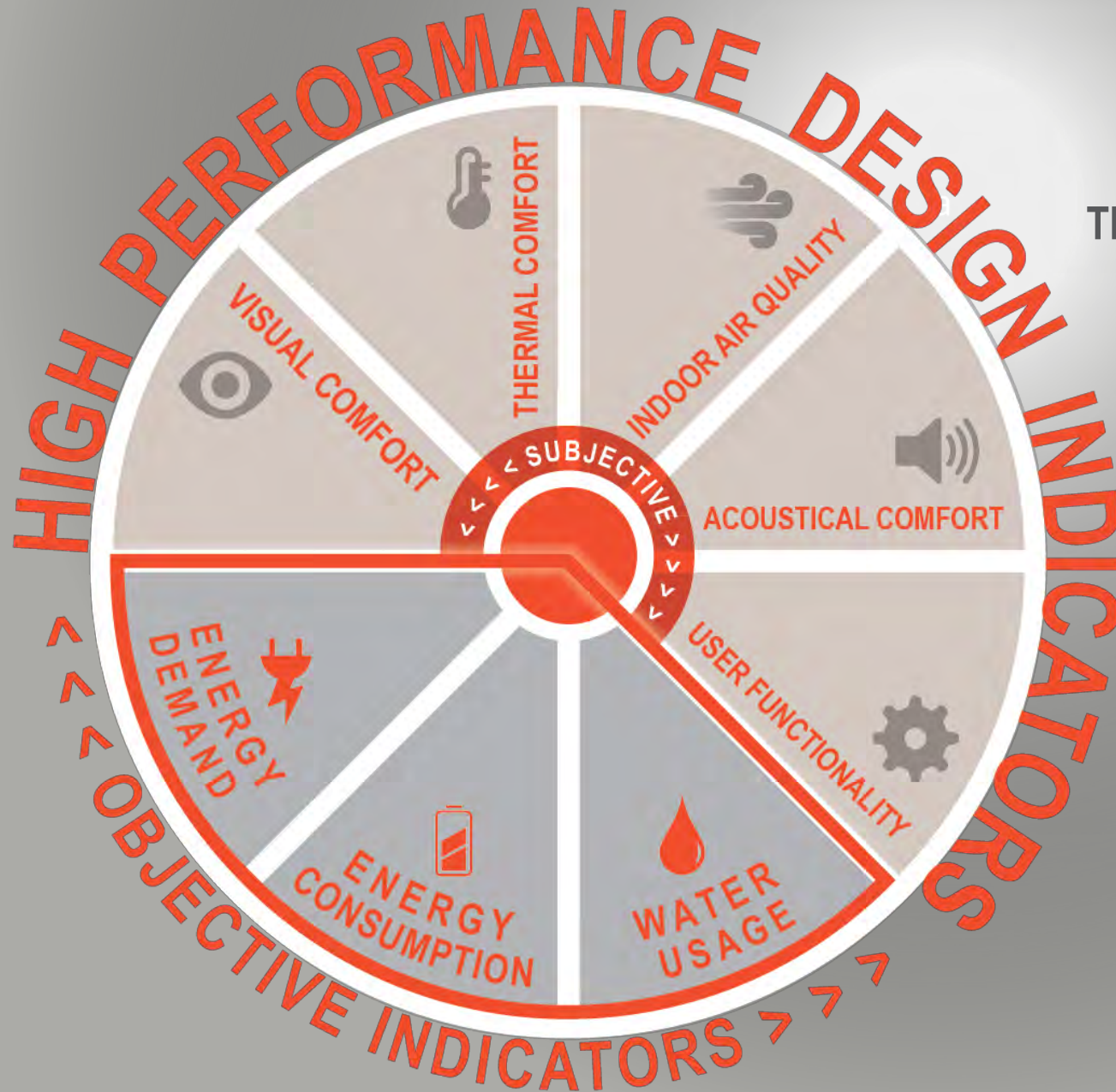
71% perceived the building has a positive effect on **achievement**

71% perceived a positive effect on **student behavior**

Institute for the Built Environment

Colorado State University

COLLEGE OF APPLIED HUMAN SCIENCES



Think Differently

Think Holistically

BUILDING PERFORMANCE MASTERPLAN

1 billion 21st Century Learning Environments (Capital Plan)
1 billion deferred maintenance

45 SCHOOLS

Build New vs. Renovate
Validate Capital Plan

\$111 Million 21st Century Learning Environments (Capital Plan)
\$139 Million deferred maintenance

45 SCHOOLS

Build New vs. Renovate?

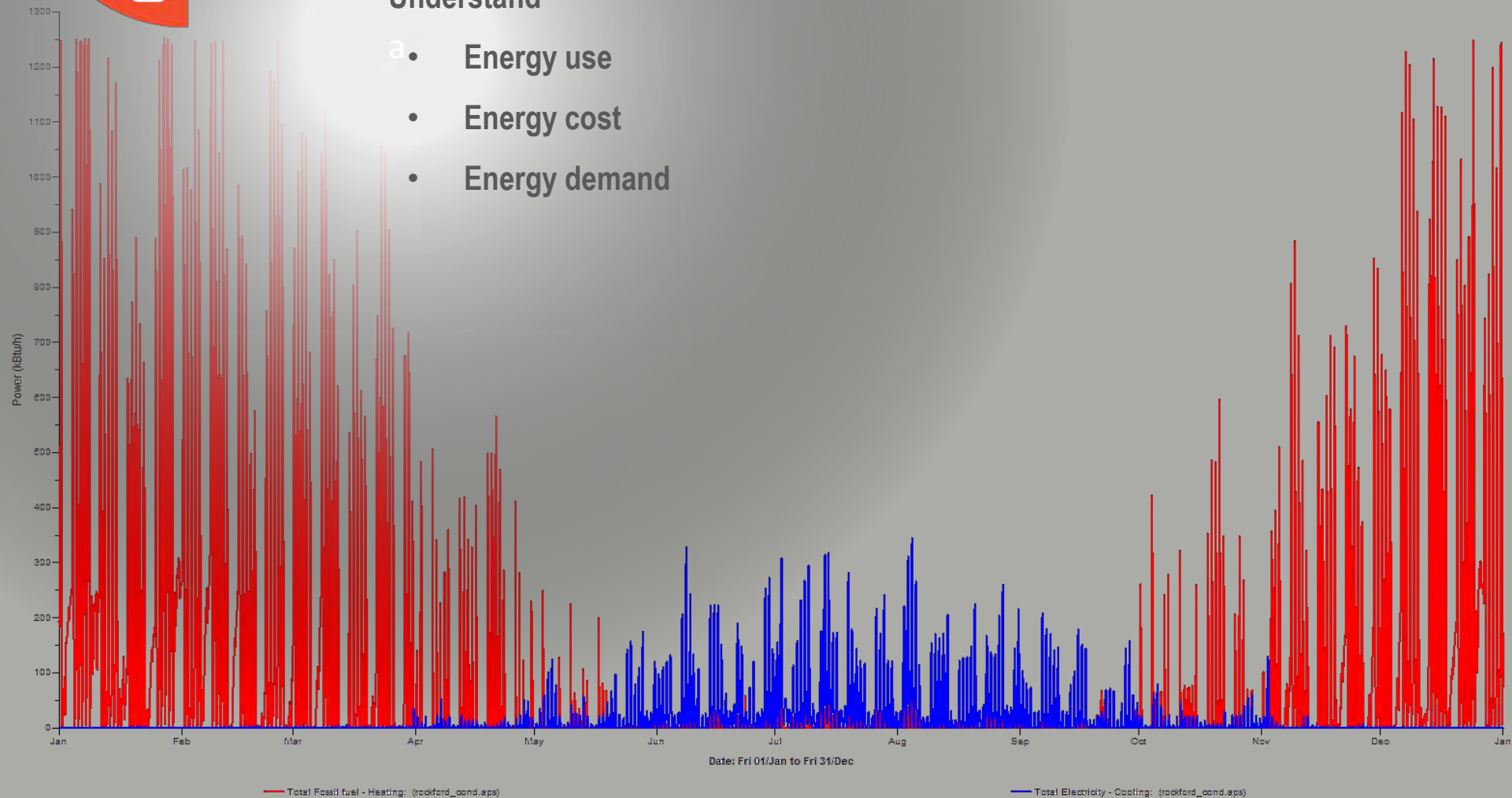
Validate Capital Plan



ENERGY CONSUMPTION

Benchmark existing facilities

- Understand
 - a. Energy use
 - Energy cost
 - Energy demand





ENERGY ANALYSIS TOOLS

a

Simulate

OpenStudio software simulates the energy use of different design and retrofit alternatives

Integrate

The **SEED Platform** compiles data across a portfolio of buildings from multiple sources

Assess

Energy Asset Score rates the physical attributes of a building

Exchange

BEDES translates data across tools through a common data dictionary

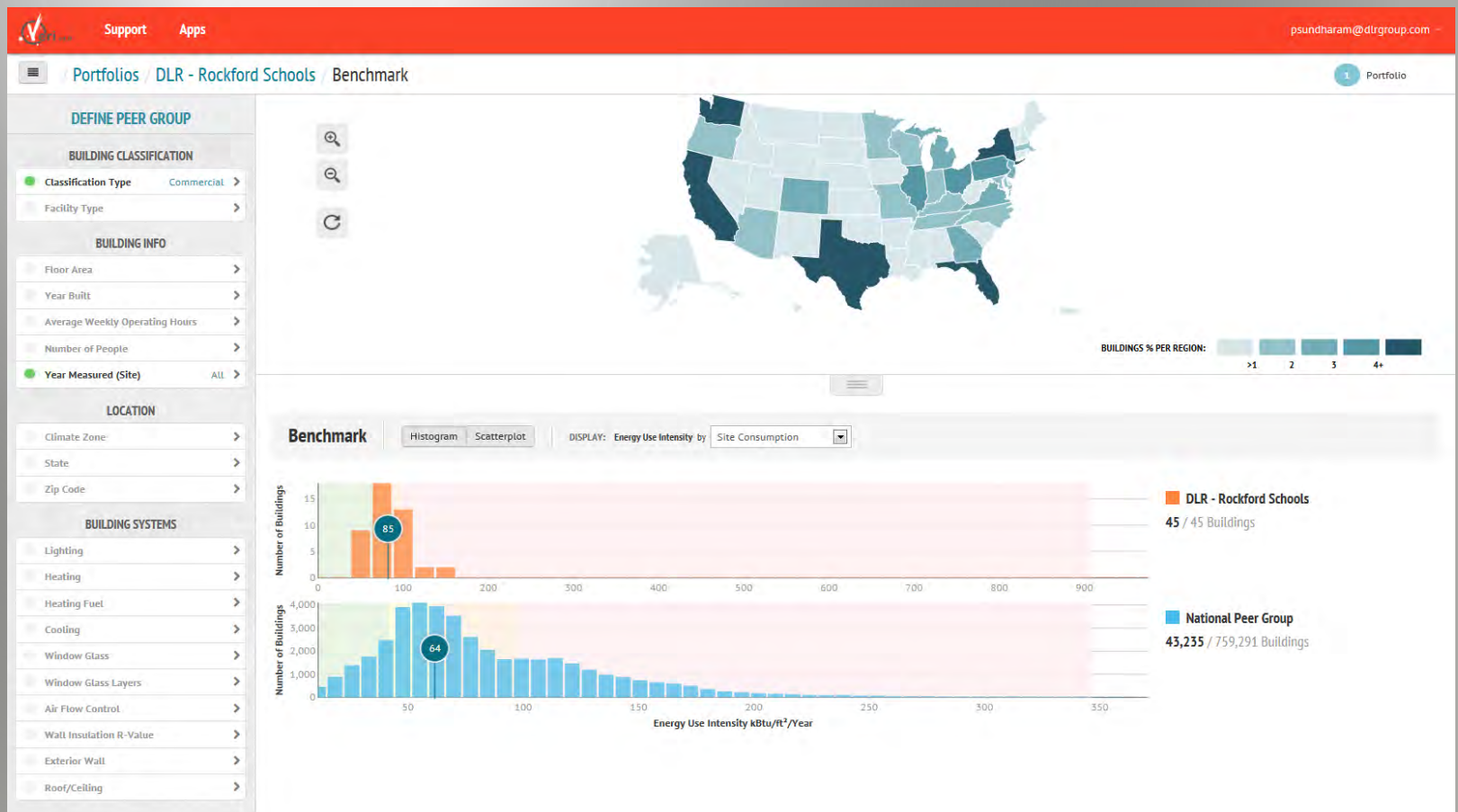
Compare

The **Building Performance Database** compares the energy performance of buildings from across the country



ENERGY CONSUMPTION

a





RPS 205 BENCHMARKING

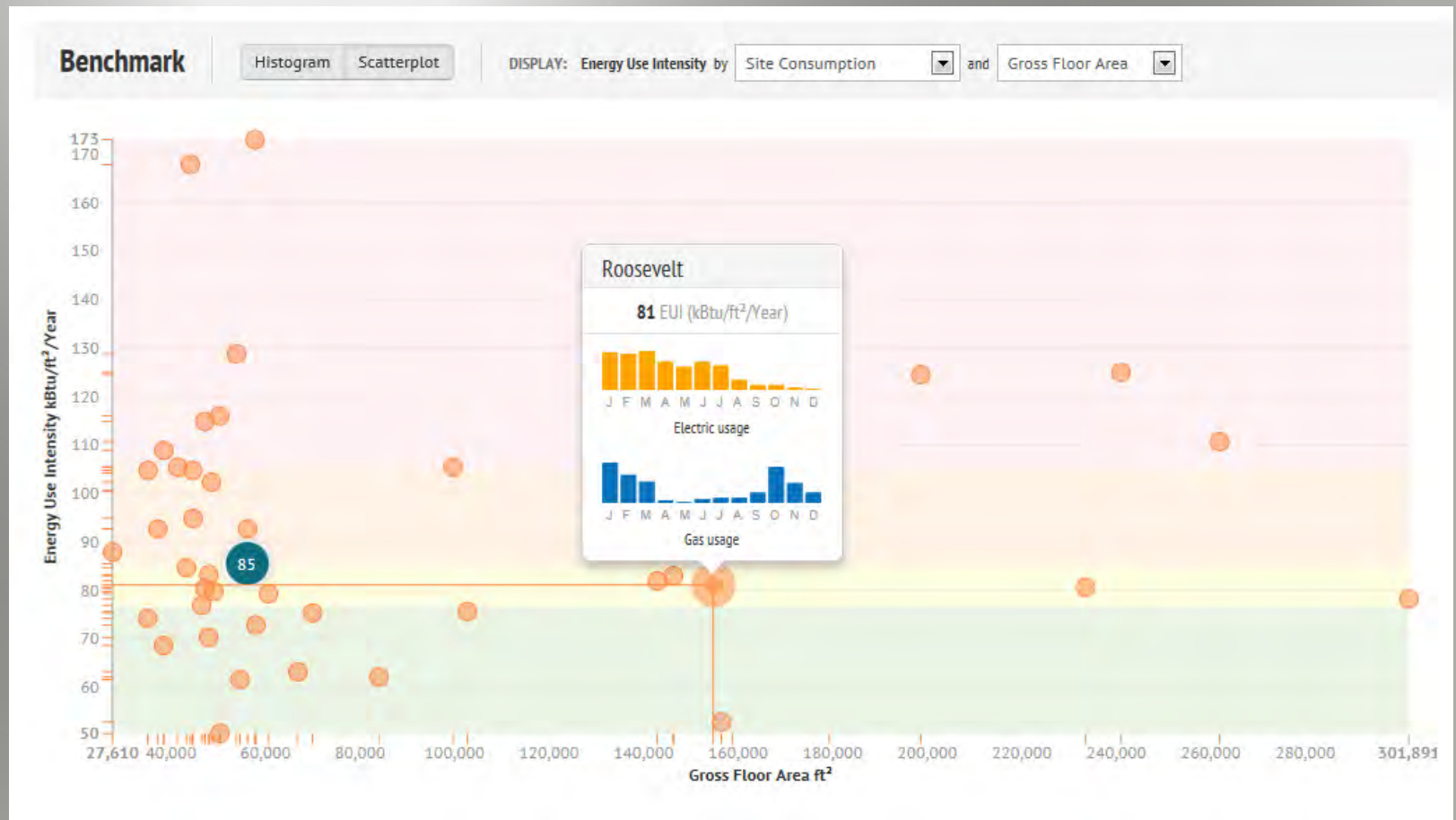
a





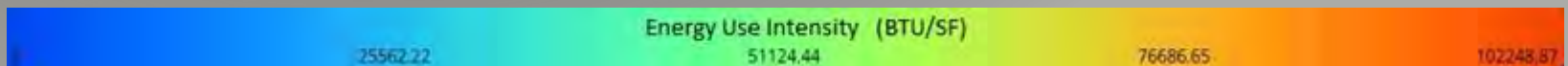
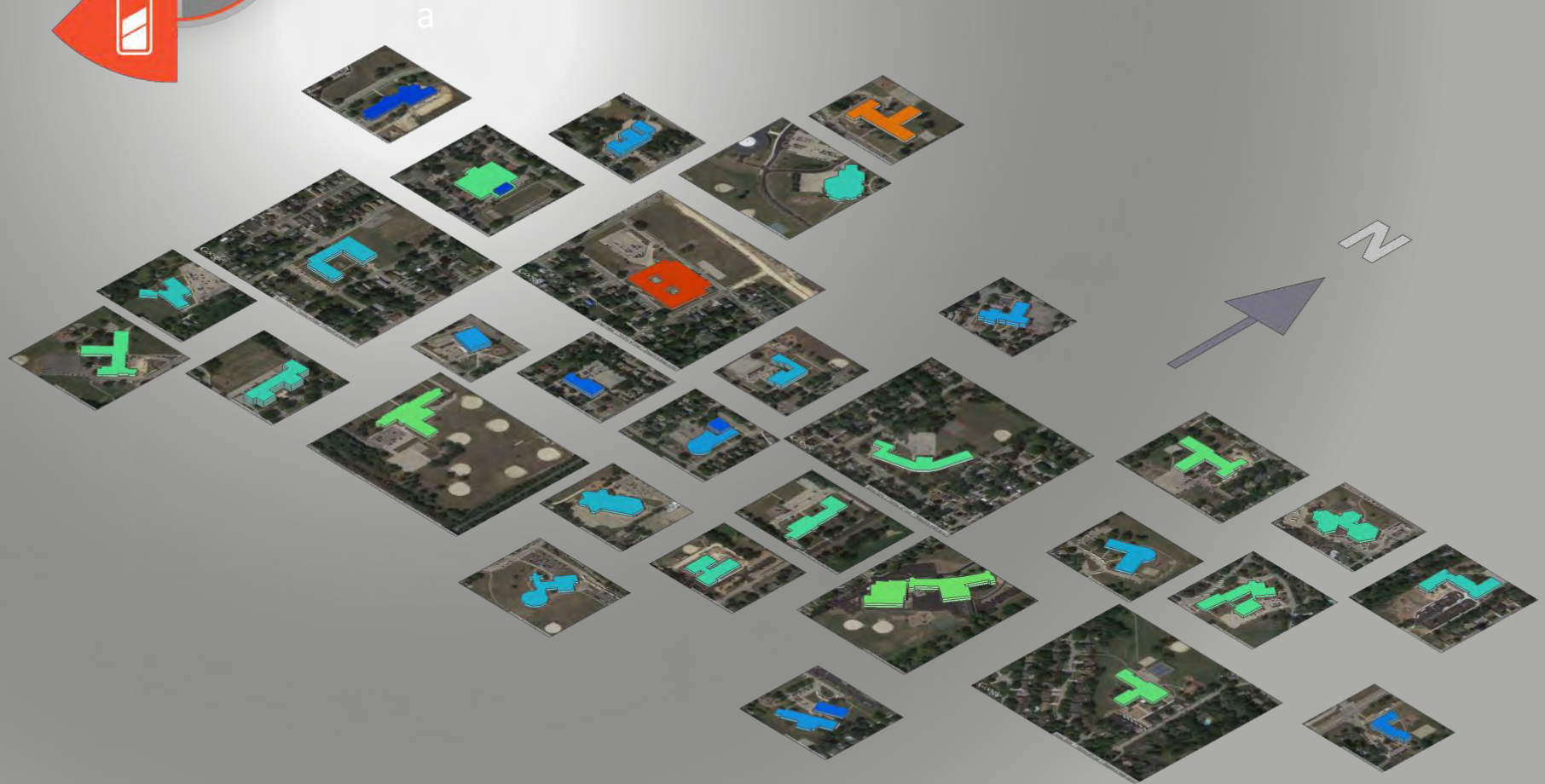
RPS 205 BENCHMARKING

a





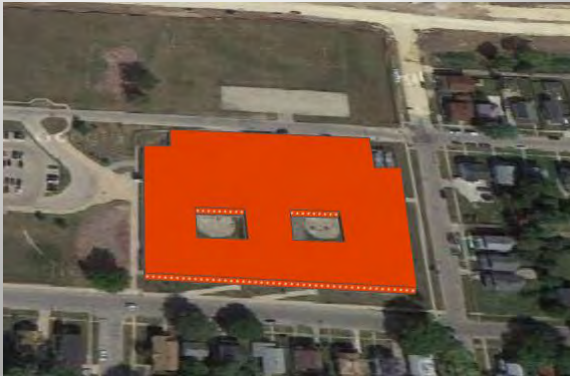
RPS 205 ENERGY PLAN





ENERGY CONSUMPTION

Ellis EUI = 105 kBtu/SF



Lewis Lemon = 75 kBtu/SF



ENERGY STAR® Statement of Energy Performance

LEARN MORE AT energystar.gov

17

Rockford-Ellis

Primary Property Function: K-12 School
Gross Floor Area (ft²): 99,600
Built: 1998

For Year Ending: December 31, 2013
Date Generated: August 22, 2014

ENERGY STAR®
Score¹

ENERGY STAR® Statement of Energy Performance

LEARN MORE AT energystar.gov

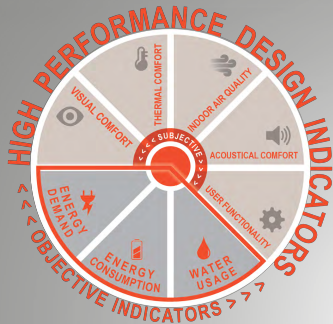
41

Rockford-Lewis Lemon

Primary Property Function: K-12 School
Gross Floor Area (ft²): 66,811
Built: 1993

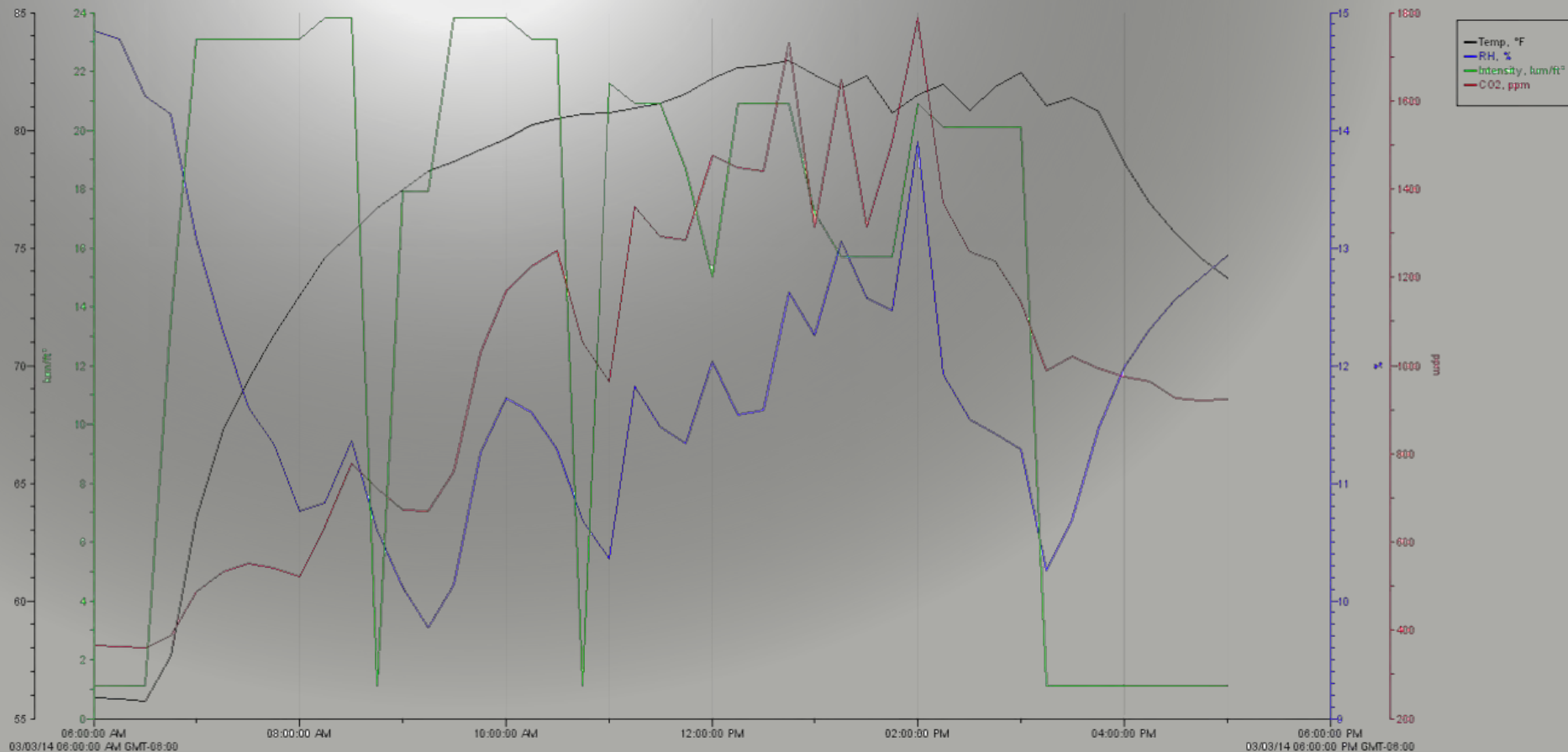
For Year Ending: December 31, 2013
Date Generated: August 22, 2014

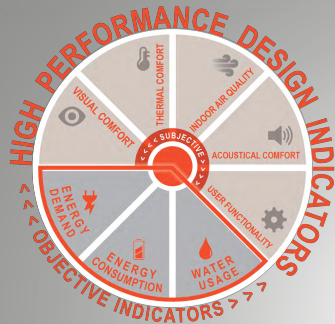
ENERGY STAR®
Score¹



DATA COLLECTION PROCESS

- Occupant Thermal Environment Survey
- Data Logging – Temp/RH/Light/CO2
- Field Measurements – Light/Acoustics



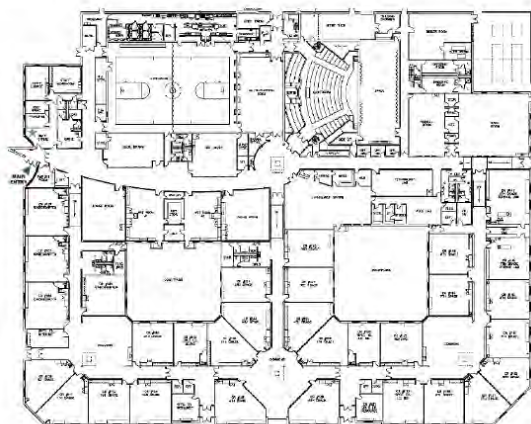


DATA COLLECTION PROCESS

Data Logging Workbook for O&M Staff and Science Students

a

Ellis ES - 222 South Central Avenue, Rockford, IL 61102



Sensor Location: ROOM _____

Logging:

Temperature ☐
Light ☐
Relative Humidity ☐
CO2 ☐

Room info:

Walls Reach Roof Deck ☐
Penetrations Sealed ☐
Mechanical System in Space ☐
Building Automation System ☐

Additional Notes: _____

DLR Group

Lewis Lemon ES - 1993 Mulberry Street Rockford



Sensor Location: ROOM _____

Logging:

Temperature ☐
Light ☐
Relative Humidity ☐
CO2 ☐

Room info:

Walls Reach Roof Deck ☐
Penetrations Sealed ☐
Mechanical System in Space ☐
Building Automation System ☐

Additional Notes: _____

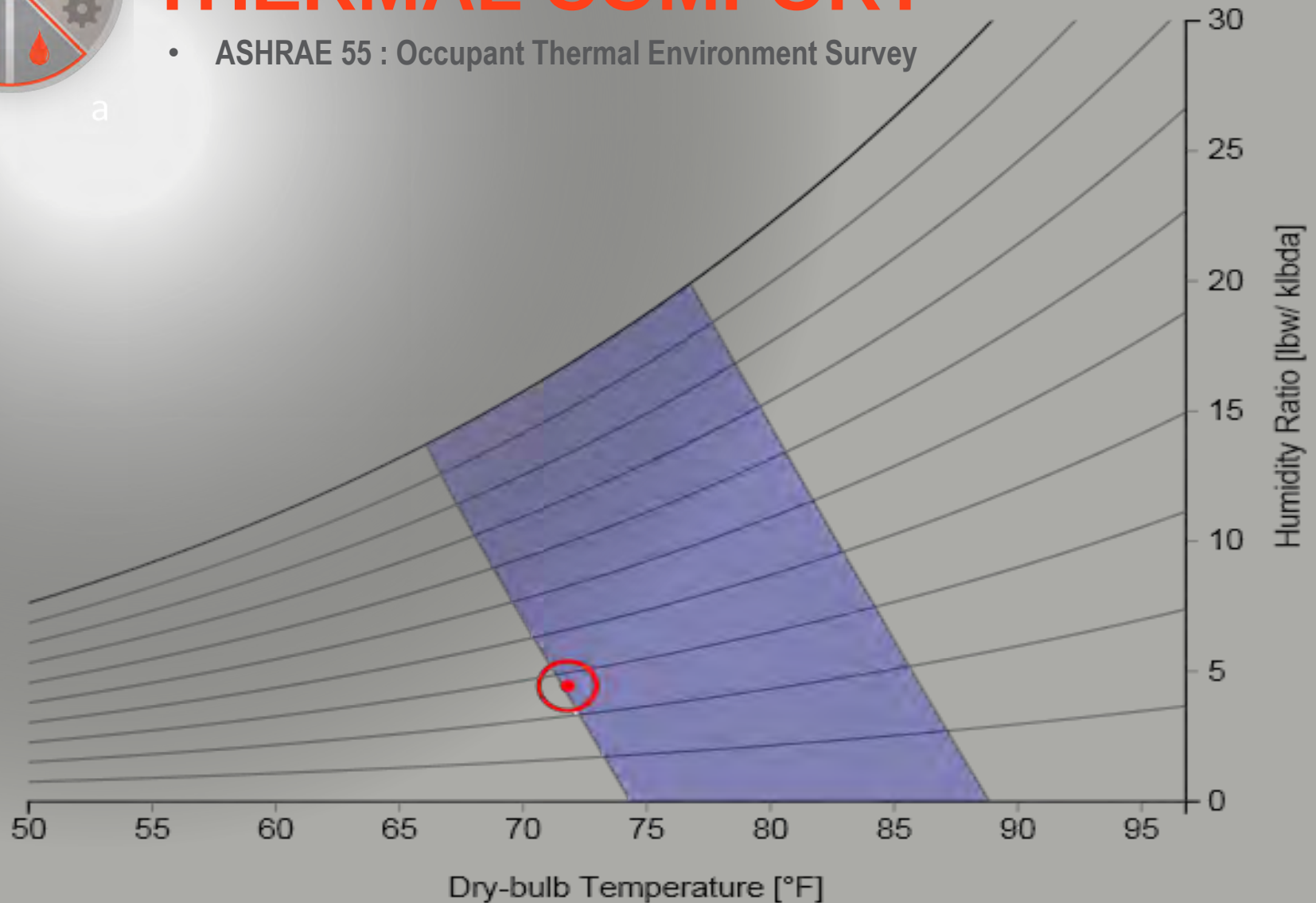
DLR Group



a

THERMAL COMFORT

- ASHRAE 55 : Occupant Thermal Environment Survey



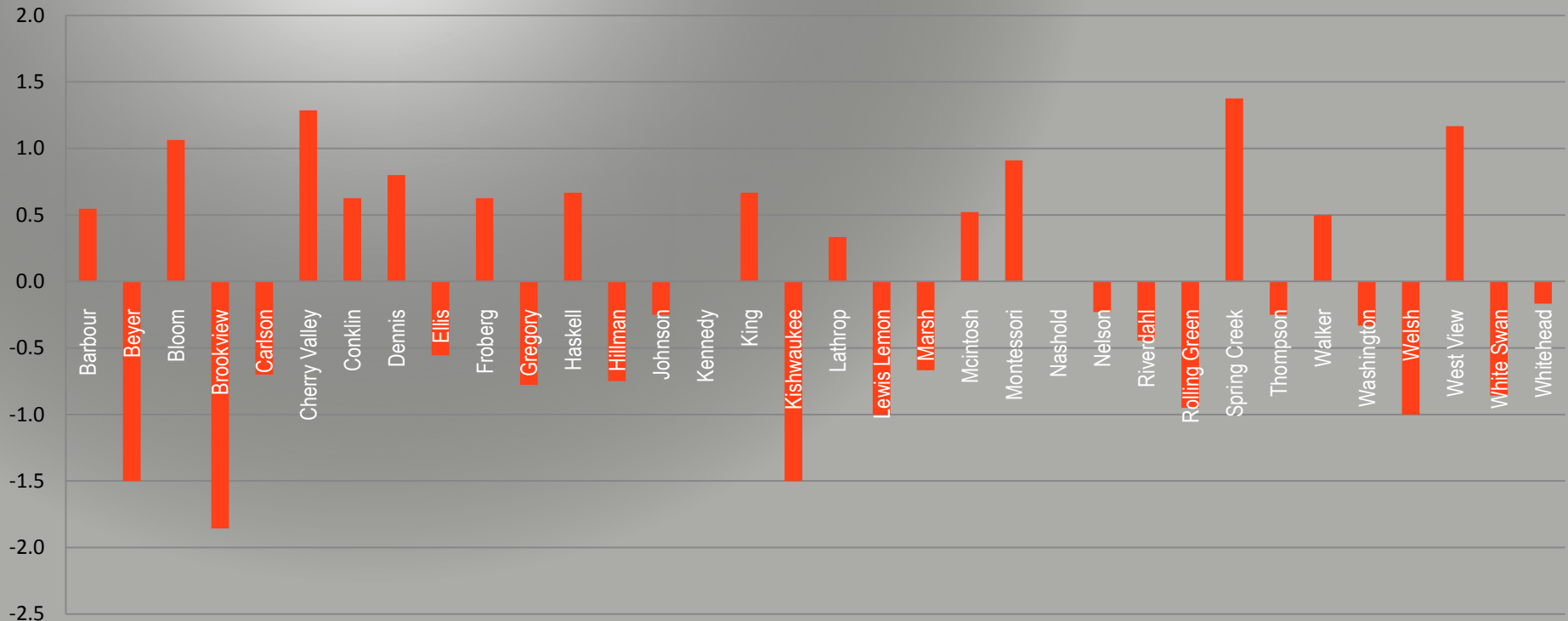


THERMAL COMFORT

- ASHRAE 55 : Occupant Thermal Environment Survey

a

Mean Vote – Elementary Schools



students
blowing temperature
degrees
kids work cold feel
year window heat
blinds water lights
light school hard time dress
conditioning vent drafty temp layers wear
cool hear control stuffy comfortable
weather times loud noisy lighting adjust
freezing outside fan blows system
heating cooling fans heater
office need warm sun
noise air hot
thermostat
classroom windows

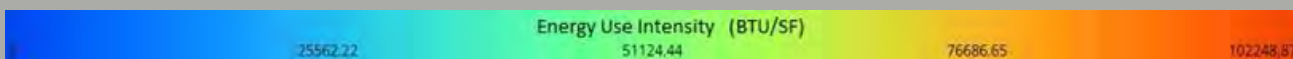
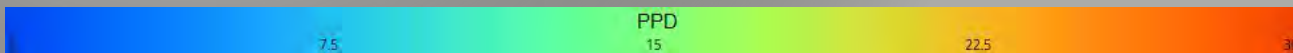


THERMAL COMFORT & ENERGY

Ellis PPD = 10%



Lewis Lemon PPD = 20%





INDOOR AIR QUALITY

ASHRAE Standard 62.1 - 2010 : Logged Data

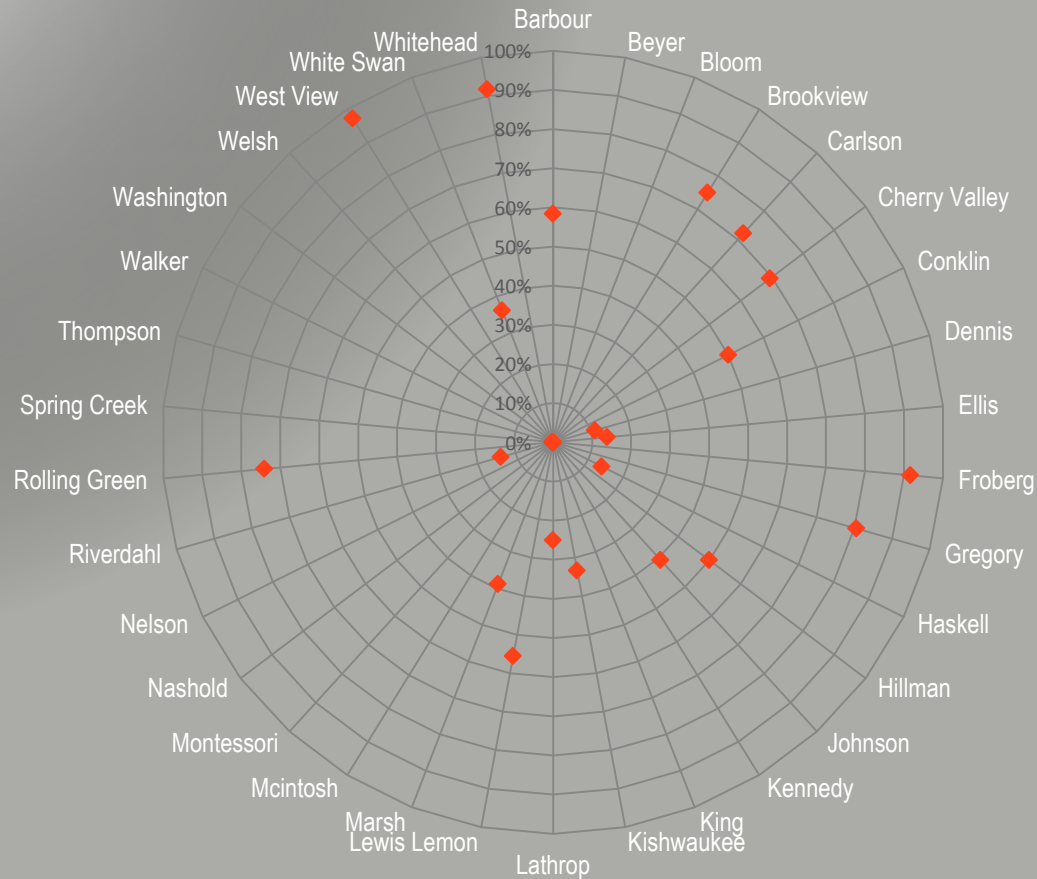
a





INDOOR AIR QUALITY

ASHRAE Standard 62.1 - 2010 : Logged Data – Hours of
Operation where CO2 levels exceeded 1000 PPM



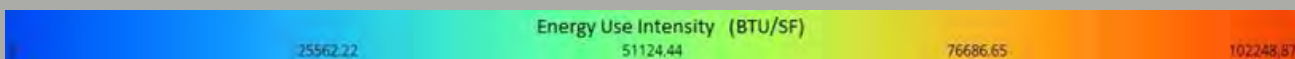
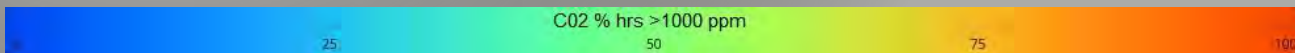


IAQ & ENERGY

Ellis CO₂ = 14%



Lewis Lemon CO₂ = 56%





VISUAL COMFORT

ANSI/ASHRAE/IES Standard 90.1 - 2010: Data Logging

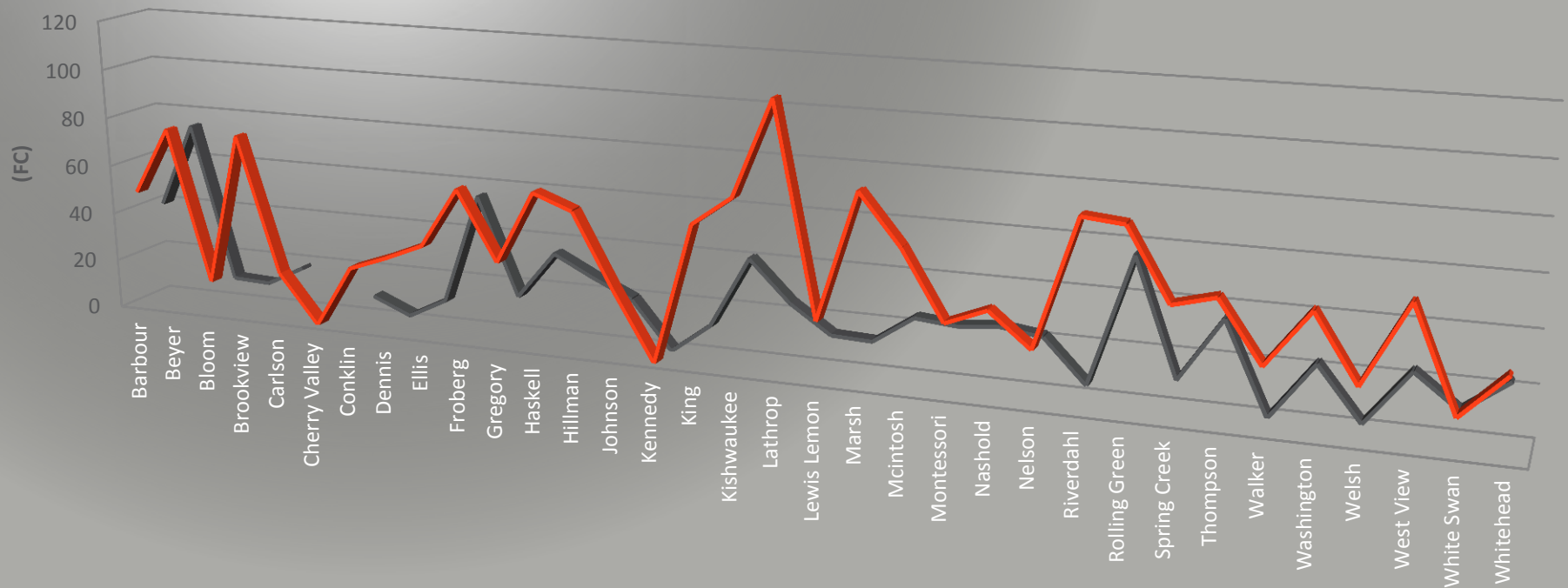




VISUAL COMFORT

ANSI/ASHRAE/IES Standard 90.1 - 2010: Data Logging

^a
Acceptable Light Levels – Too bright/too dim for optimal Student Performance

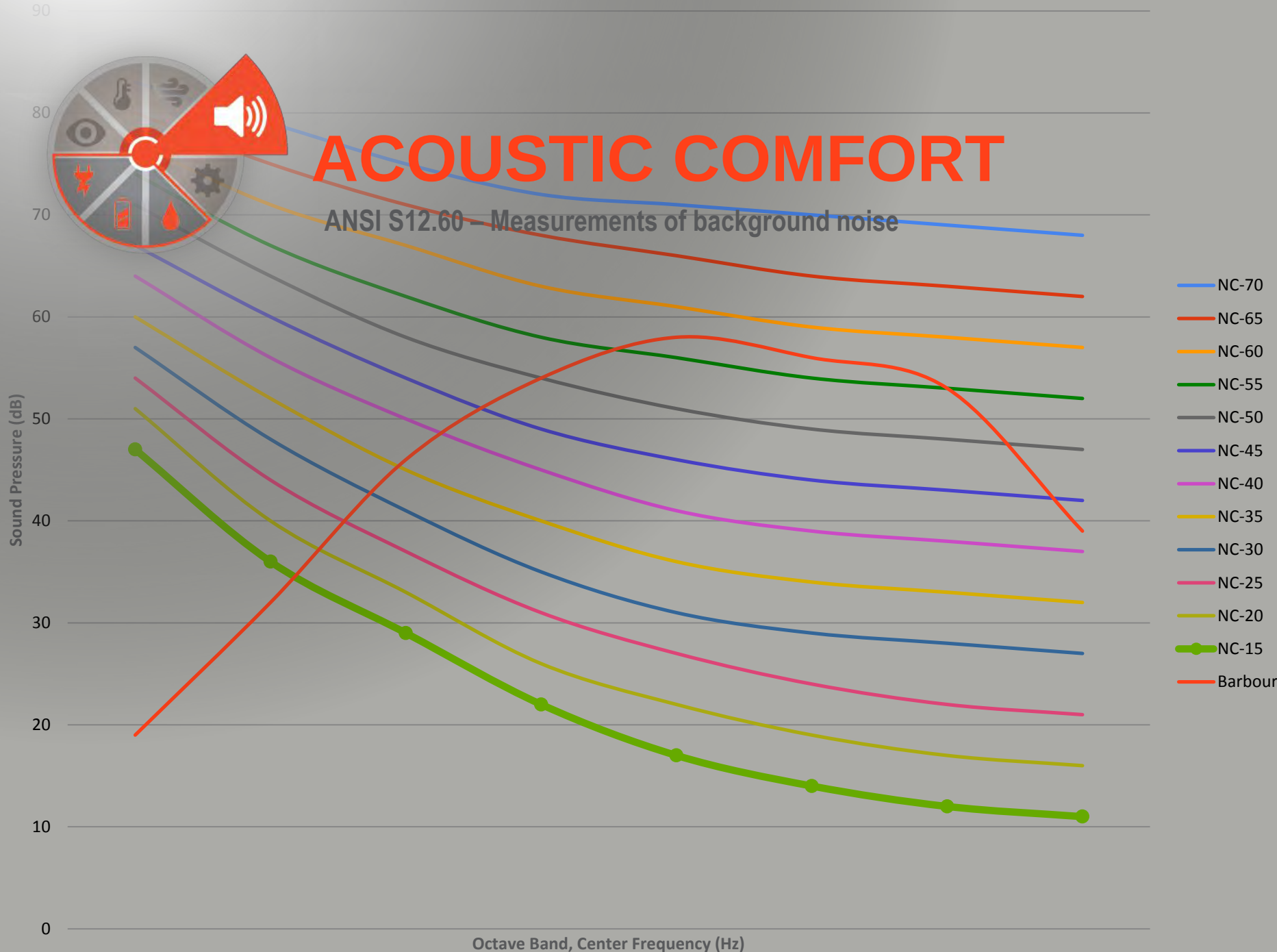


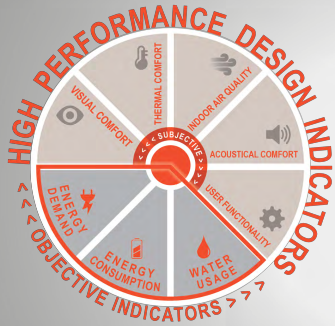


ACOUSTIC COMFORT

ANSI S12.60 – Field Measurements



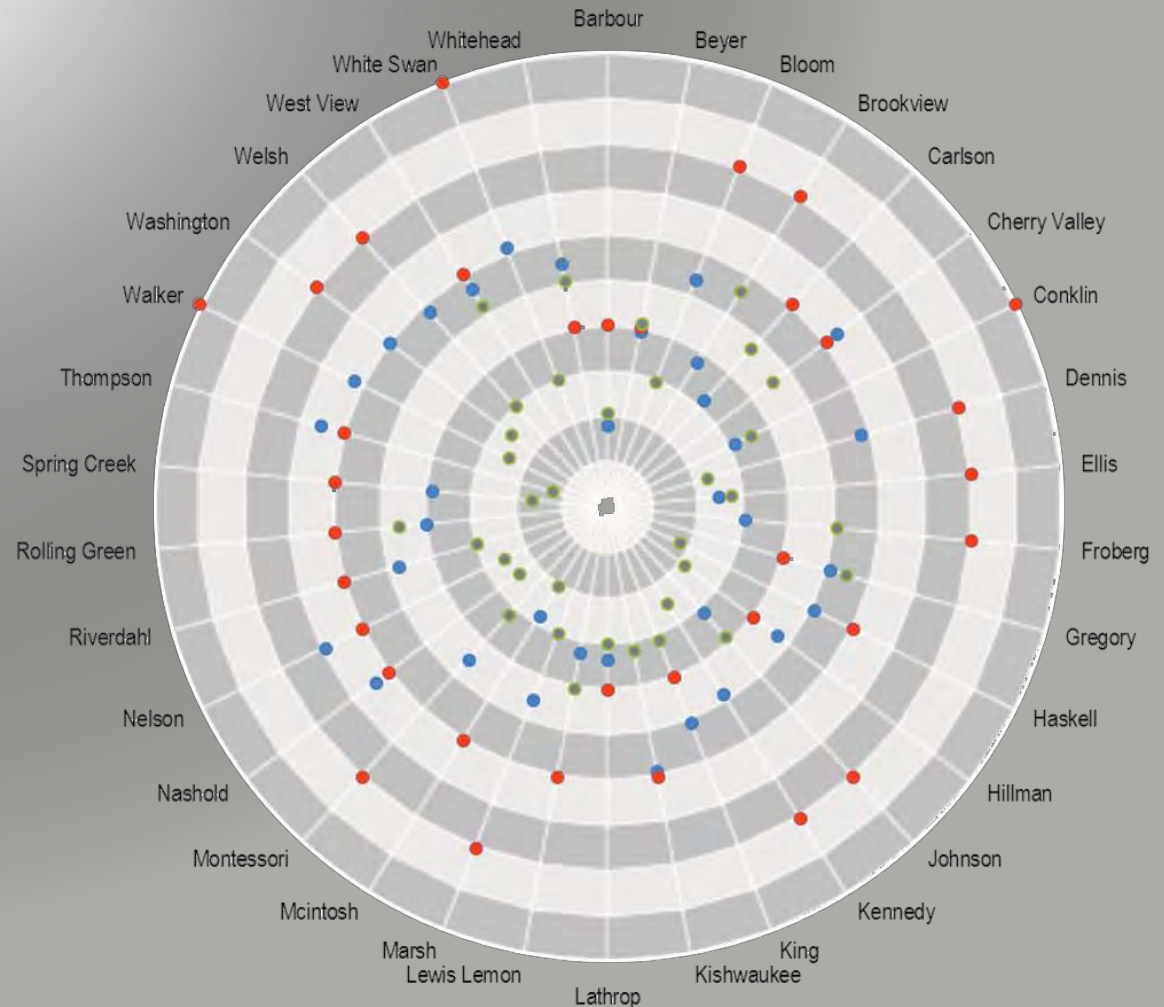




HOLISTIC PERFORMANCE

Overall Ranking

- Educational Adequacy
- Energy
- Indoor Environmental Quality
 - IAQ
 - Thermal Comfort
 - Visual Comfort
 - Acoustical Comfort





HOLISTIC PERFORMANCE

BEYER ELEMENTARY

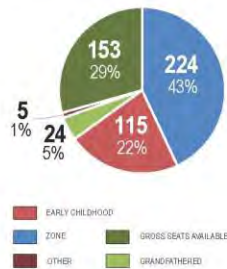
WINTER 2013
333 15TH AVENUE | ROCKFORD, IL



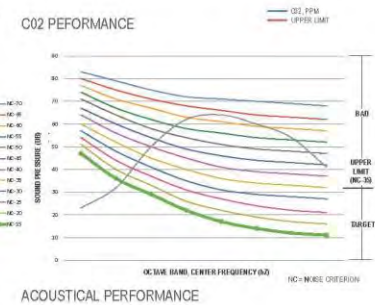
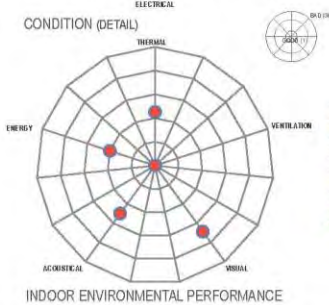
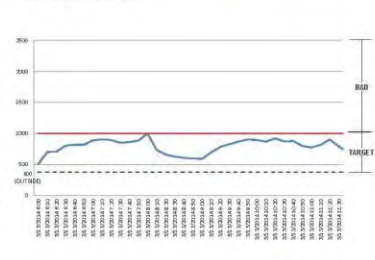
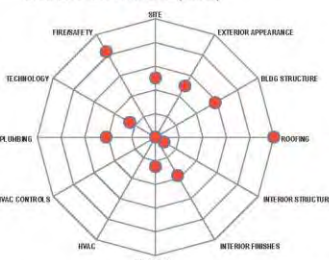
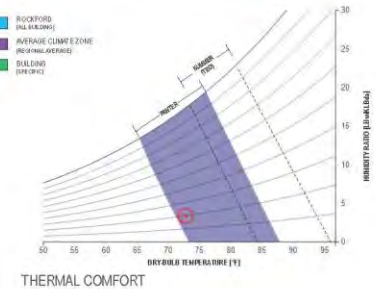
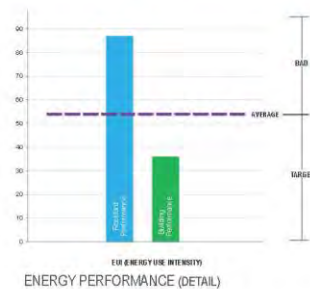
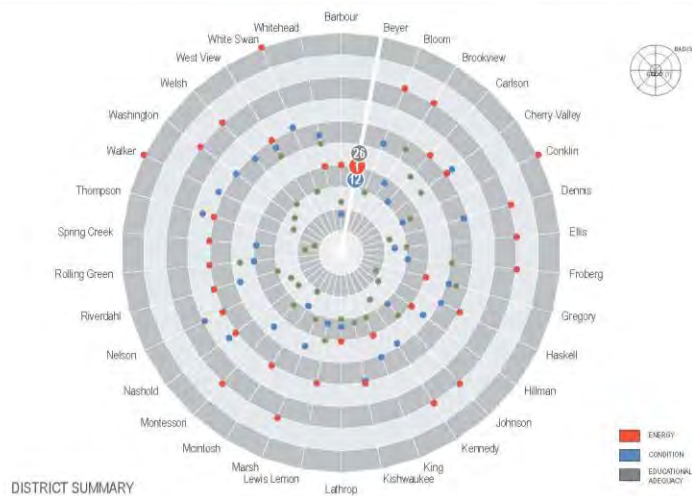
BUILDING DATA:

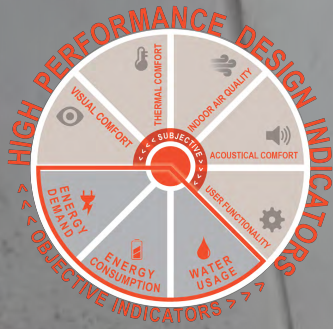
YEAR BUILT	1998
ENROLLMENT	368 STUDENTS
CAPACITY	521 STUDENTS
SQ. FOOTAGE	50,357 SF
# OF STRANDS	3 STRANDS
AVG. ENERGY USE	1,814 MMbtu
PRIMARY MECHANICAL SYSTEM	RTU
% COOLED	100%

CURRENT ATTENDANCE:



STUDENT PROXIMITY MAP



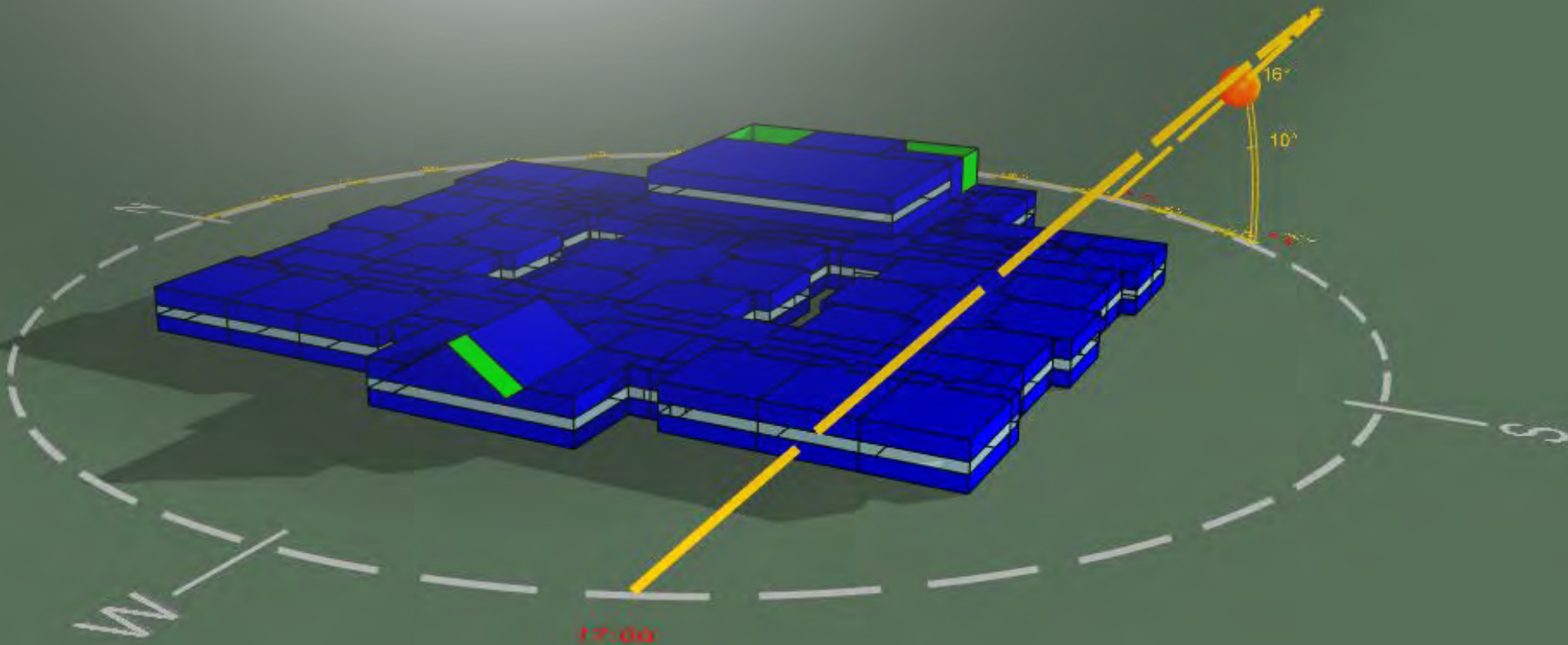


THINK HOLISTICALLY ABOUT
CAPITAL PROJECTS



RETRO-CX RESULTS

12% to 15% in Energy Savings for Retro-Commissioned Buildings
RPS District hired a dedicated Energy & Operations Planner





ENERGY CONSUMPTION

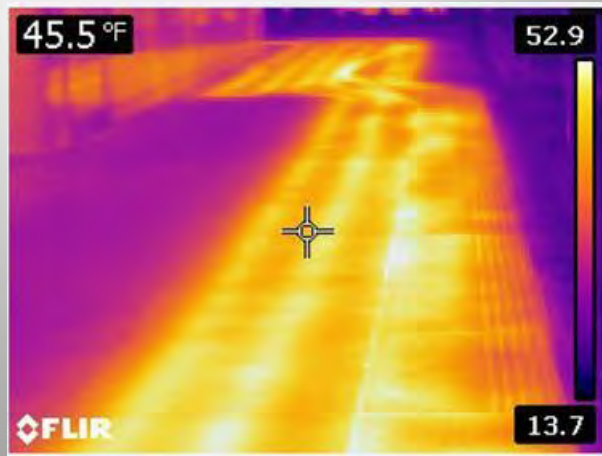
a





ENERGY CONSUMPTION

Sidewalk snow melt



THE CULPRIT:





ENERGY CONSUMPTION

Heat escaping from uninsulated pipe, valves, and fittings



Loose electrical connections



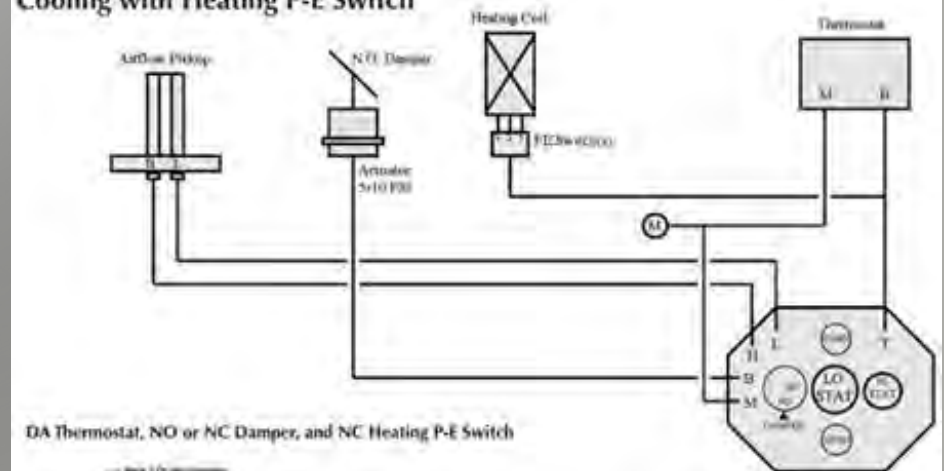


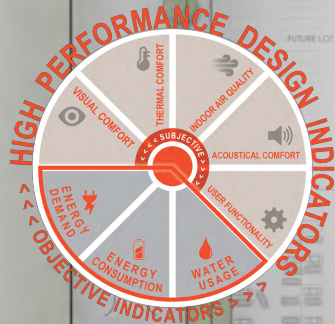
ENERGY CONSUMPTION

Retrofit to control both baseboard heating and
pneumatic VAV box with one thermostat, stop fighting!

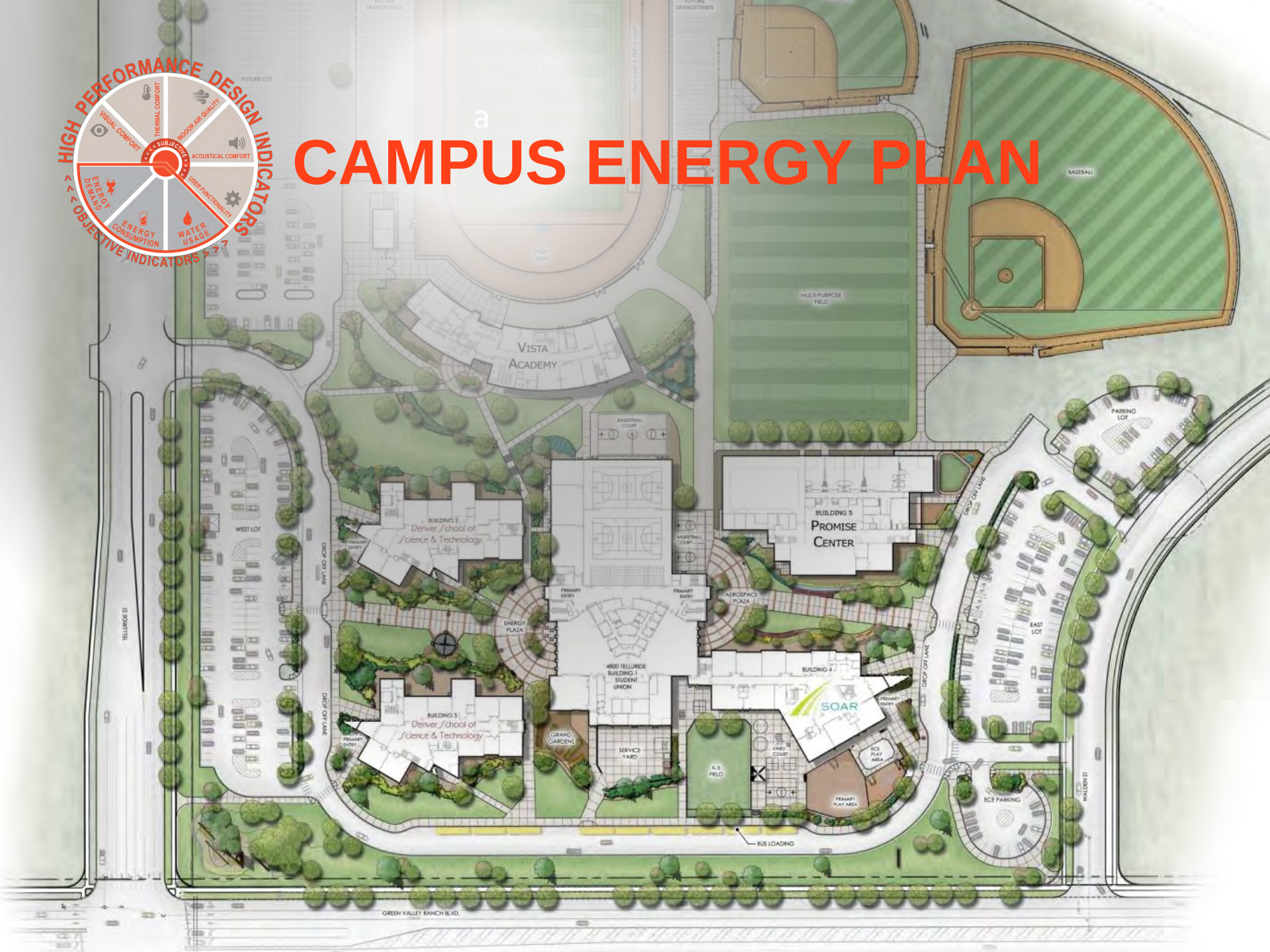


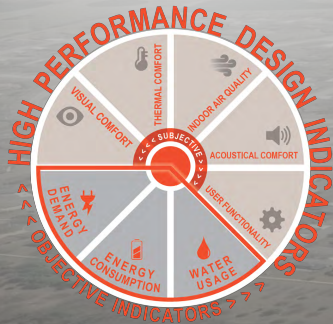
Cooling with Heating P-E Switch



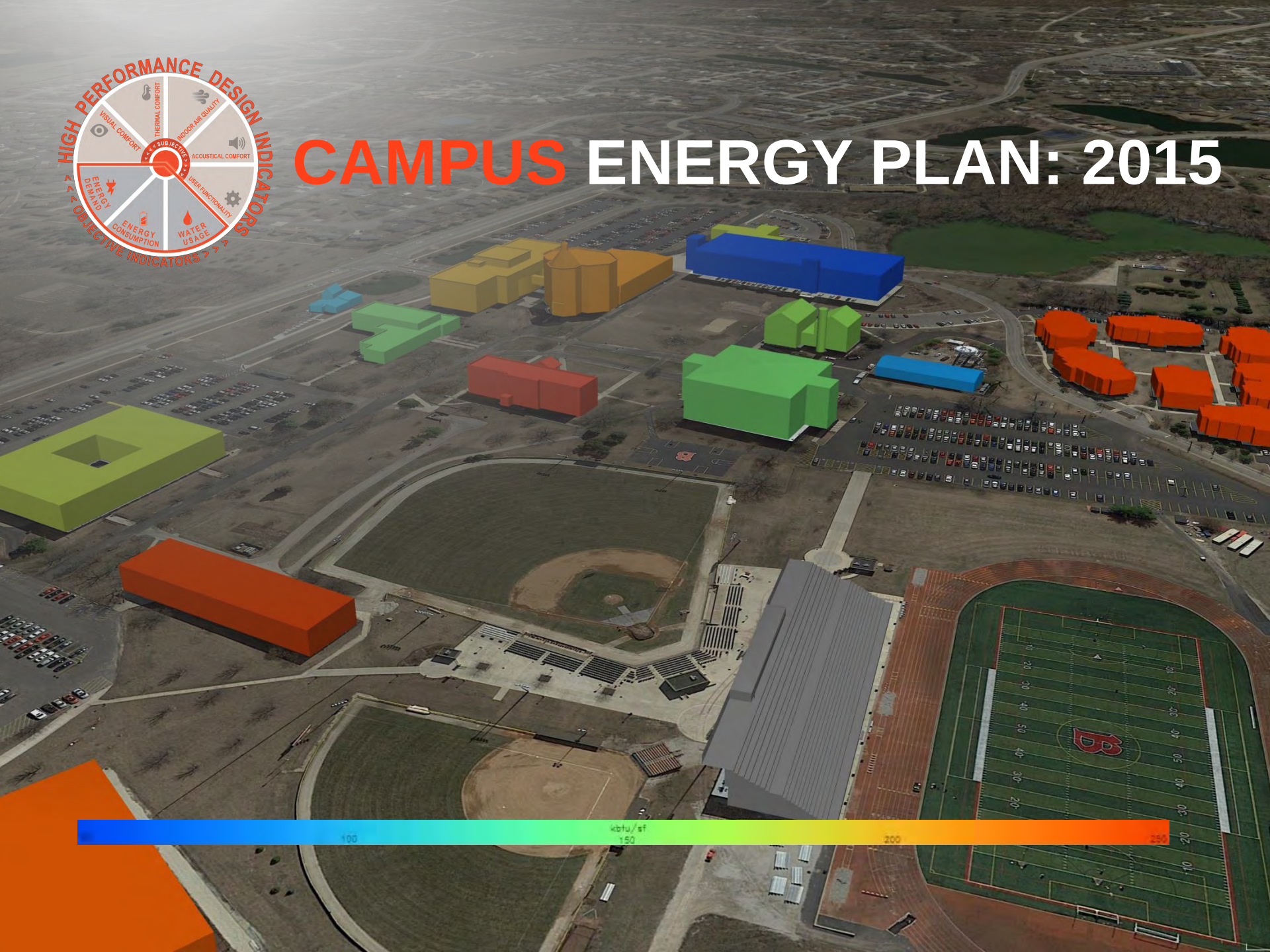


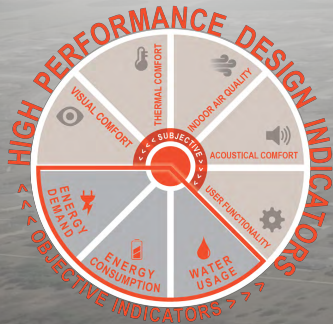
CAMPUS ENERGY PLAN





CAMPUS ENERGY PLAN: 2015





CAMPUS ENERGY PLAN: 2016



NEW BUSINESS BUILDING

Designed to ASHRAE 189.1 High Performance Building Standard



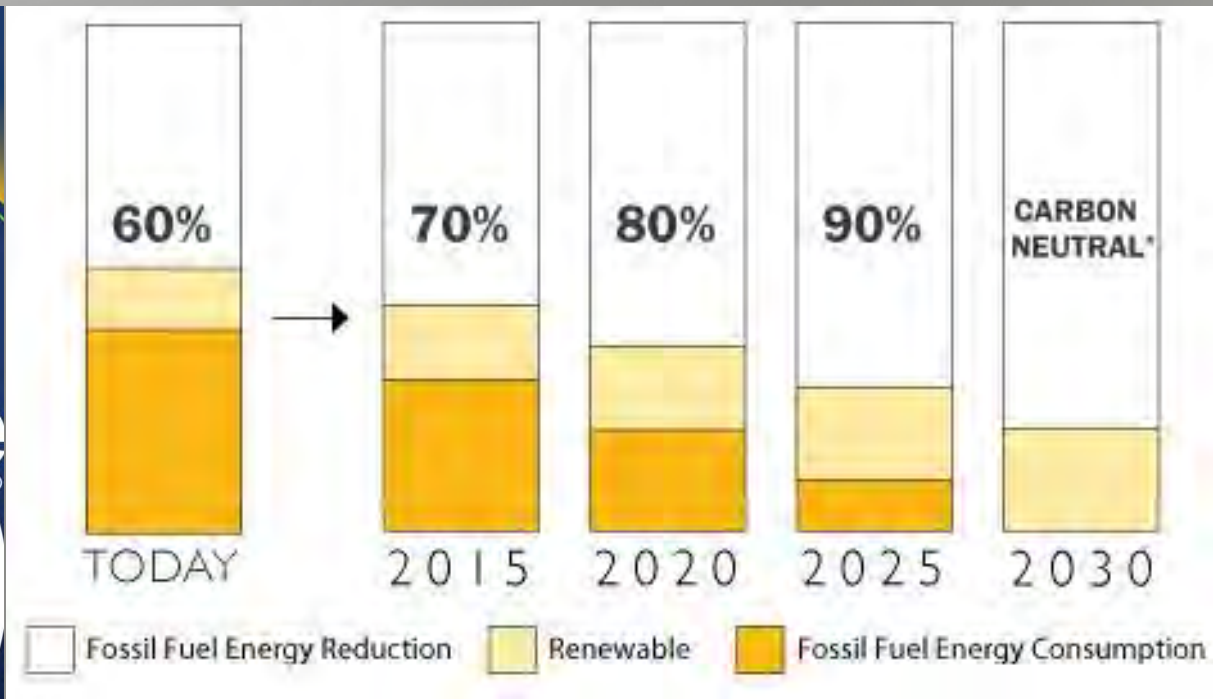
NEW BUSINESS BUILDING

Designed to ASHRAE 189.1 High Performance Building Standard





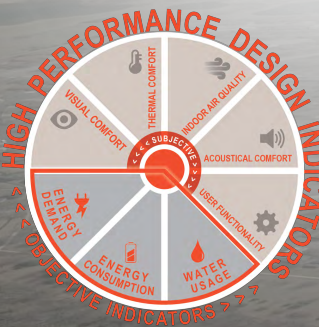
ARCHITECTURE 2030 GOALS





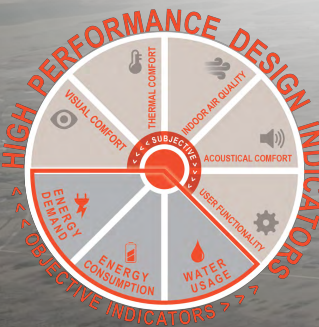
REDEFINE NET-ZERO ENERGY





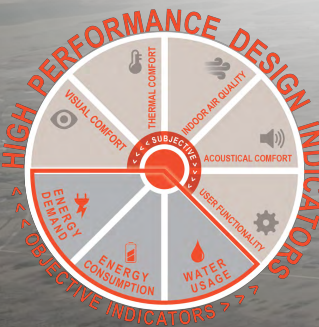
CAMPUS ENERGY PLAN: 2016





CAMPUS ENERGY PLAN: 2020





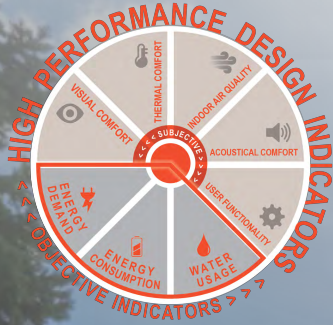
CAMPUS ENERGY PLAN: 2020





SUSTAINABLE CURRICULUM



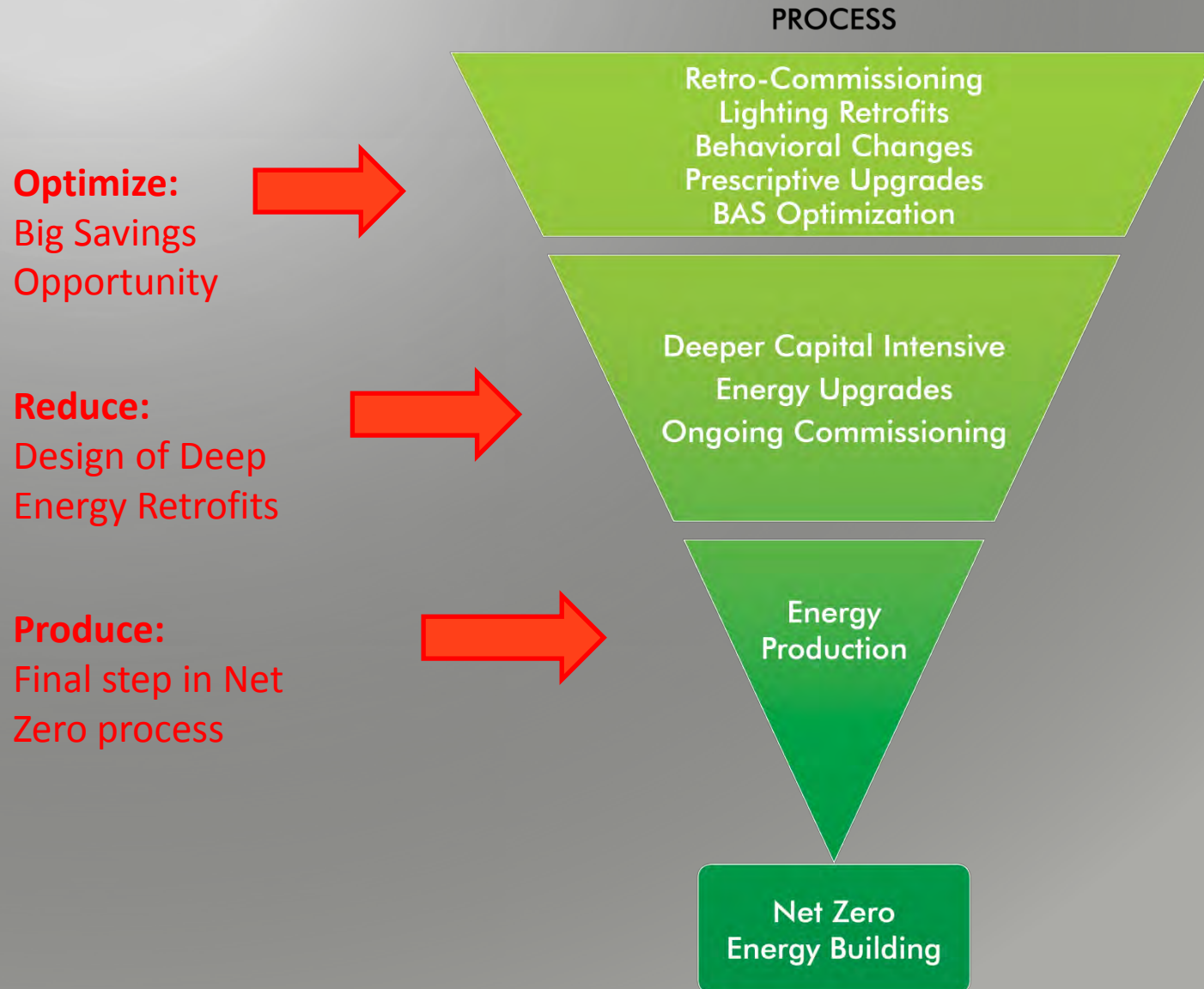


ENERGY & CAMPUS LIFE

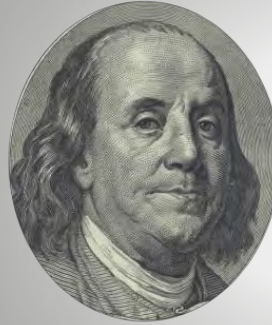


a

ENERGY REDUCTION ROADMAP

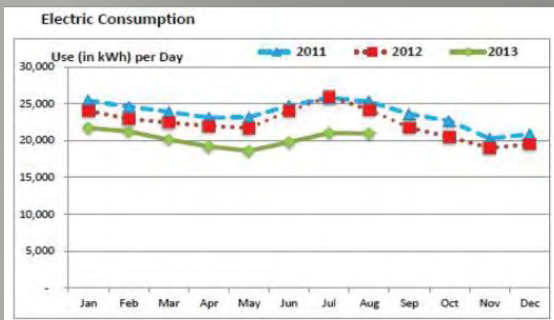


GREEN REVOLVING FUNDS



a

GREEN REVOLVING
FUNDS





DLR Group

Architecture Engineering Planning Interiors

Speakers:



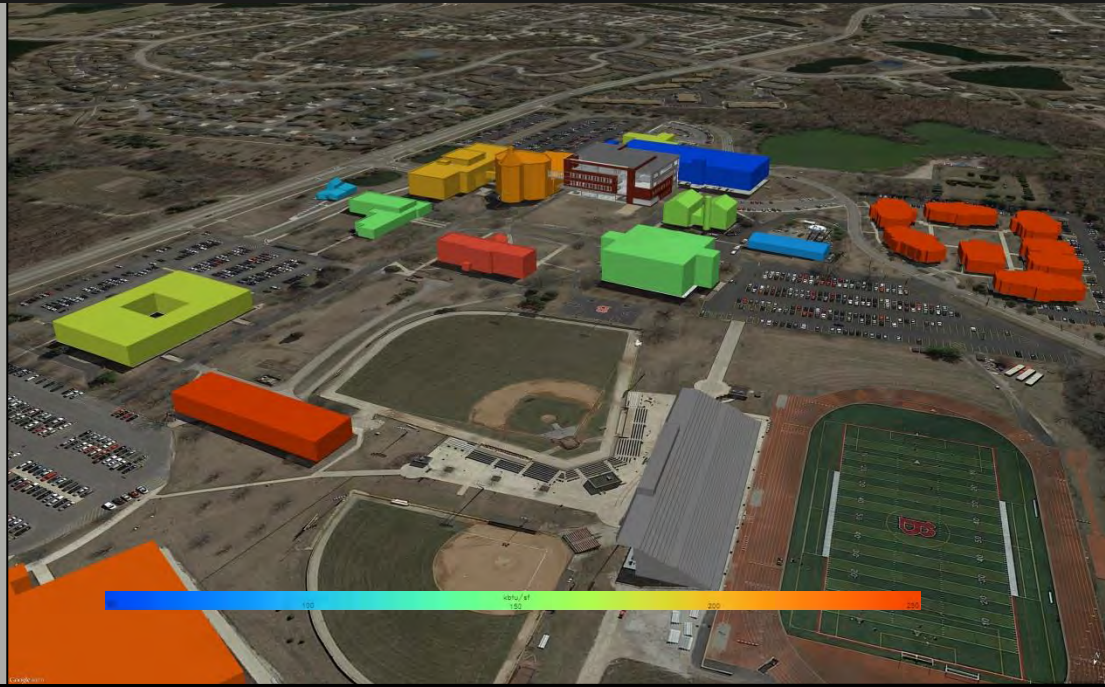
Ruairí Barnwell

Principal
Energy Services Leader



Ben Talbot

Associate
Senior Building Analyst



Contact:

Ruairí Barnwell
Ben Talbot

rbarnwell@dlrgroup.com
btalbot@dlrgroup.com