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Energy Design Conference and Expo | Duluth, MN

GETTING TO NET ZERO:
SETTING AND ACHIEVING ENERGY GOALS WITH AN INTEGRATIVE PROCESS

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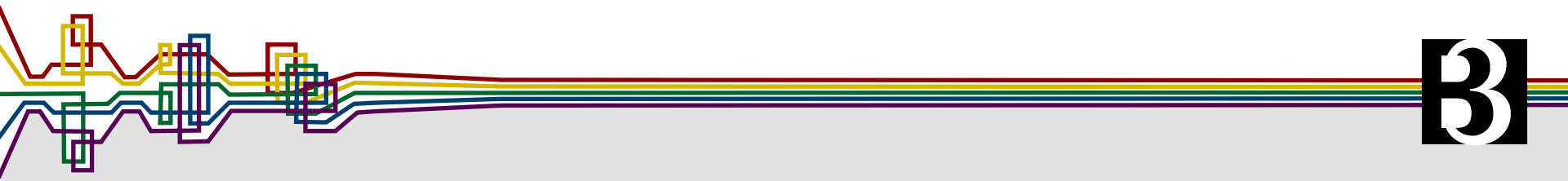


In accordance with the Department of Labor and Industry's statute 326.0981, Subd. 11,

"This educational offering is recognized by the Minnesota Department of Labor and Industry as satisfying **1.5 hours** of credit toward **Building Officials** continuing education requirements."

For additional continuing education approvals, please see your credit tracking card.

SESSION LEARNING OBJECTIVES

- Describe the objectives of Minnesota's Sustainable Buildings 2030 (SB 2030) to reduce building energy consumption and carbon emissions.
- Summarize the concept of energy use intensity (EUI) and describe how it enables the establishment of normalized energy baselines and targets for a project.
- Identify specific characteristics of an integrative process and its implications for building energy performance.
- Use the SB 2030 Energy Standard Tool to set an energy target for a project.
- Describe the benefits of utilizing early energy modeling and energy design assistance programs as tools to achieve energy targets.
- Explain the concept of commissioning and its value to improving building energy performance.
- Leverage actual performance tracking to achieve energy targets on your next building project.

SESSION OUTLINE

- SB 2030 Overview
- Tools to help achieve SB 2030
  - Integrative Process
  - Using an Integrative Process to meet SB 2030
    - Determine the average energy use for comparable buildings
    - Calculate the SB 2030 Energy Standard
    - Optimize energy use
      - Implement energy reduction strategies
      - Perform energy modeling
    - Evaluate the use of low carbon energy sources
    - Perform commissioning
    - Track actual performance using B3 Benchmarking
    - Ensure energy-efficient operations
- Case Studies

SUSTAINABLE BUILDINGS 2030 (SB 2030)

- SB 2030 Origins
  - B3 Guidelines
  - Next Generation Energy Act
  - Minnesota Climate Change Advisory Group
  - SB 2030 project team
  - SB 2030 program elements
- SB 2030 Overview
  - Required projects
  - SB 2030 Energy Standard
    - Energy Use Intensity
  - Process
  - Cost-effectiveness evaluation

B3 HISTORY IN MINNESOTA

- Hennepin County Sustainable Building Guidelines developed in 1995.
- The B3 Sustainable Building Guidelines were established in 2004 for all new state-bonded projects and were updated in 2008 to include all substantial renovations.
    - Exceed existing Energy Code by at least 30%
    - Focus on achieving lowest possible lifetime costs for new buildings
    - Encourage continual energy conservation improvements on new buildings
    - Include air quality and lighting standards that create and maintain a healthy environment
    - Facilitate productivity improvements
- The original energy requirement in the B3 Guidelines was replaced by the Energy Standard from the SB 2030 program in 2009.

NEXT GENERATION ENERGY ACT (2007)

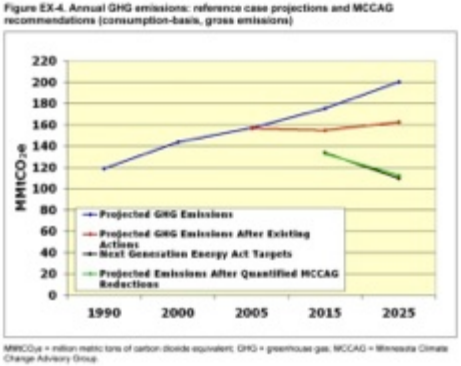
GREENHOUSE GAS REDUCTION

- **Reduce greenhouse gas emissions (from 2005 levels):**
  - **15% by 2015**
  - **30% by 2025**
  - **80% by 2050**

ENERGY CONSERVATION

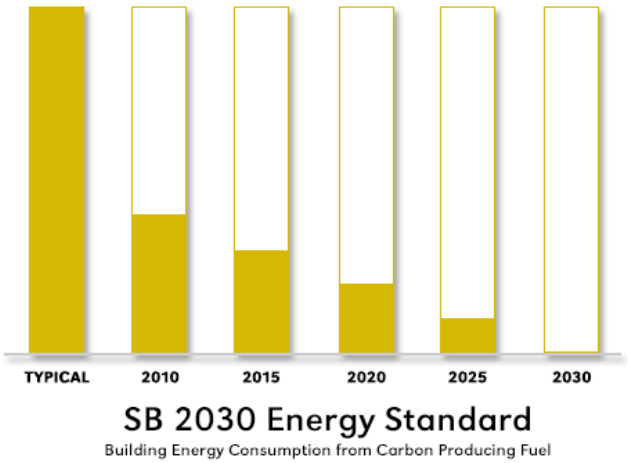
- **Statewide energy conservation goal of 1.5% of annual retail electric and gas sales**
- Expand and improve the state's conservation improvement program
- Provide research and development and technical assistance to utility companies through the Department of Commerce
- Increase energy efficiency in state buildings

MINNESOTA CLIMATE CHANGE ADVISORY GROUP



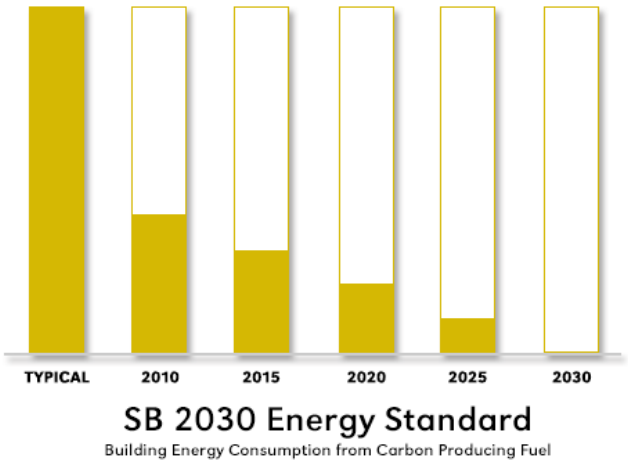
- The Minnesota Climate Change Advisory Group (MCCAG) was formed as a result of the NGEA
- MCCAG developed a comprehensive set of state-level policy recommendations to reduce Minnesota's greenhouse gas emissions
- One policy recommendation was to **"adopt green building guidelines … for all commercial and residential buildings consistent with *Architecture 2030* targets."**
- This led to the development of the Minnesota Sustainable Building 2030 (SB 2030) initiative, which was passed by the Minnesota legislature in 2008.

SUSTAINABLE BUILDING 2030



- The purpose of SB 2030 is "to establish **cost-effective** energy-efficiency performance standards for new and substantially reconstructed commercial, industrial and institutional buildings that can significantly **reduce carbon dioxide emissions by lowering energy use** …"
- These standards have become the energy use requirements for state-bonded projects through the B3 Guidelines (Minnesota Sustainable Building Guidelines).

SUSTAINABLE BUILDING 2030



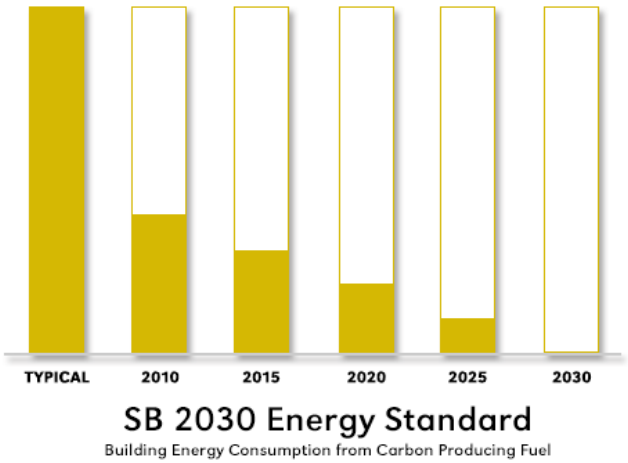
CLIENTS

- Department of Commerce
- Real Estate and Construction Services

CONSULTANTS

- Center for Sustainable Building Research
- The Weidt Group
- LHB, Inc.
- Center for Energy and the Environment
- Herzog Wheeler and Associates

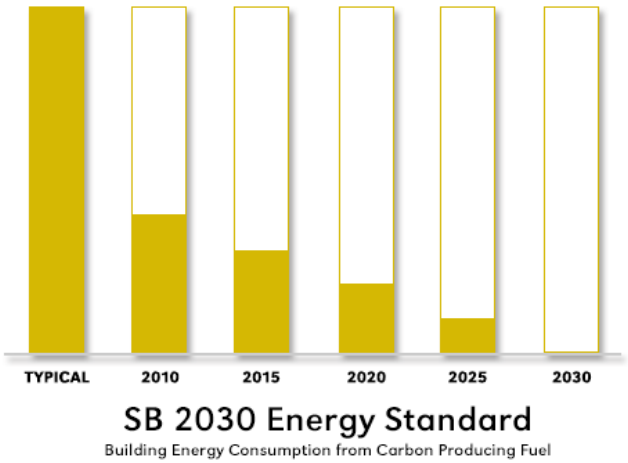
SUSTAINABLE BUILDING 2030



PROGRAM ELEMENTS

- Develop a program for setting SB 2030 Energy Standard targets and meeting them in design
- Assist in development of utility incentive programs incorporating the SB 2030 program
- Develop case study database and track building performance
- Deliver training program for design professionals
- Develop an energy efficient operations program

SUSTAINABLE BUILDING 2030

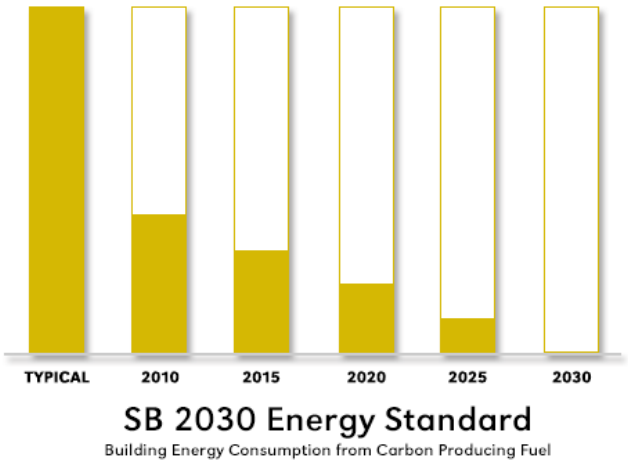


REQUIRED PROJECTS

SB 2030 is a required program for all state-bonded buildings that receive General Obligation (GO) bonds (regardless of the amount):

- All new buildings
- All substantially renovated buildings that include:
  - At least 10,000 sf
  - Replacement of HVAC system in all or part of the building
- That started Schematic Design after August 1, 2009

SUSTAINABLE BUILDING 2030



REQUIREMENT

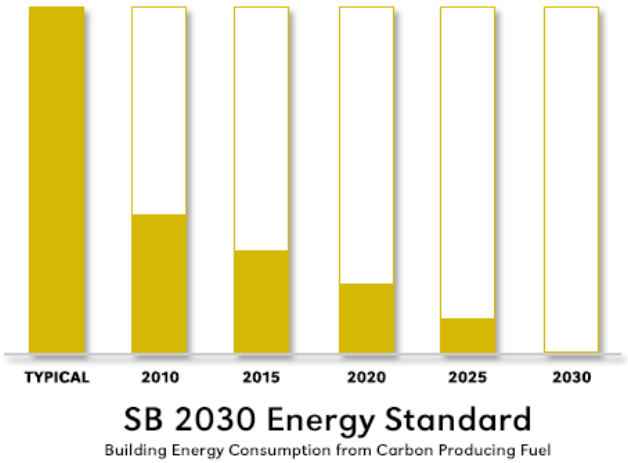
Meet energy performance targets (Energy Standards) that reduce* the use of carbon producing fuel for building operations by:

- 60% (for buildings designed) in 2010
- 70% in 2015
- 80% in 2020
- 90% in 2025
- 100% in 2030

These targets are halved for renovations of existing buildings.

*from a baseline of representative buildings in existence in 2003.

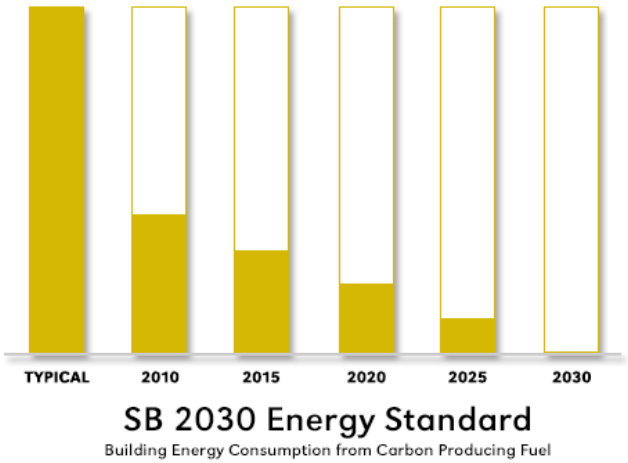
SUSTAINABLE BUILDING 2030



ENERGY METRIC

- A common metric is needed to compare different fuel types.
- Units such as barrels, cubic feet, tons, therms, and kilowatt-hours can all be converted into the equivalent number of British thermal units (Btu).
- A Btu is the amount of energy needed to raise the temperature of 1 pound of water by 1 ^{0}F
  - 1 kBtu = 1,000 Btu
  - 1 MMBtu = 1,000,000 Btu

SUSTAINABLE BUILDING 2030

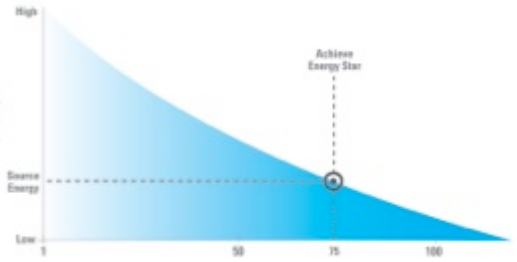


ENERGY METRIC

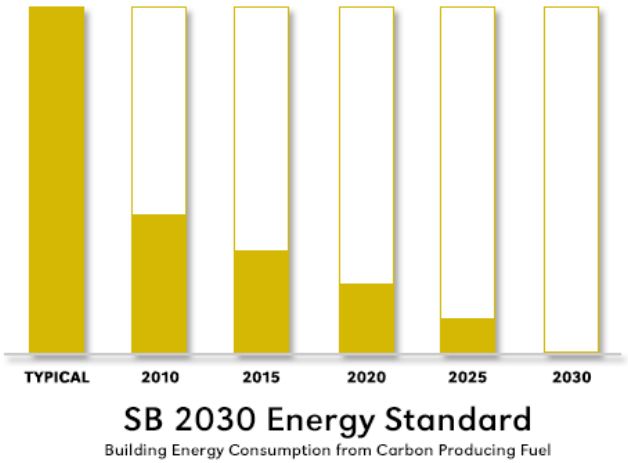
- By normalizing energy use by building area, multiple buildings can be compared to each other.
- Energy use intensity (EUI):
  - Building energy use ÷area (gross square feet)
  - kBtu/sf-year

MPG

EUI



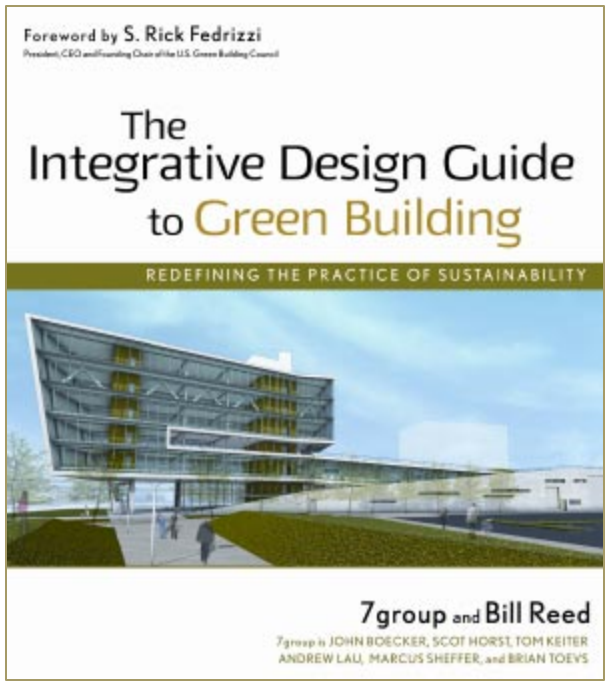
SUSTAINABLE BUILDING 2030



COST EFFECTIVENESS EVALUATION

- The majority (94%) of buildings have been able to cost-effectively meet the SB 2030 Energy Standard.
- If a building cannot meet the SB 2030 Energy Standard cost-effectively, the project team can apply for an Adjusted Energy Standard.
- Cost-effectiveness is defined here in accordance with the definition used in utility energy conservation (CIP) programs as a simple payback period of 15 years or less.
- The Adjusted Energy Standard is established with consideration of all reasonable energy conservation strategies with less than a 15 year simple payback

INTEGRATIVE PROCESS



- Definition
- Key characteristics
- Key steps
- Integrative process in green rating systems
  - ANSI
  - B3 Guidelines
  - LEED
  - Green Communities
  - Green Globes
- Benefits

EVERYBODY ENGAGING EVERYTHING EARLY

INTEGRATIVE PROCESS DEFINITION

WHY:

The goal of using an integrative process is "to design and construct projects that are cost-effective over both the short and the long terms" and that achieve "high levels of building performance, human performance, and environmental benefits" (ANSI/MTS Integrative Process (IP) 2.0 Standard)

HOW:

This is achieved through a holistic approach that brings together all project team members during the initial phases of design, engaging them in a continual discovery process that optimizes the interrelationships among systems.

- Building systems as a unified organism (not separate pieces)
- Building team as a unified organism (not solving problems in isolation)

TRADITIONAL PROCESS

http://www.themontebulldog.org/opinion/2013/09/25/telephone/#prettyPhoto

TRADITIONAL PROCESS

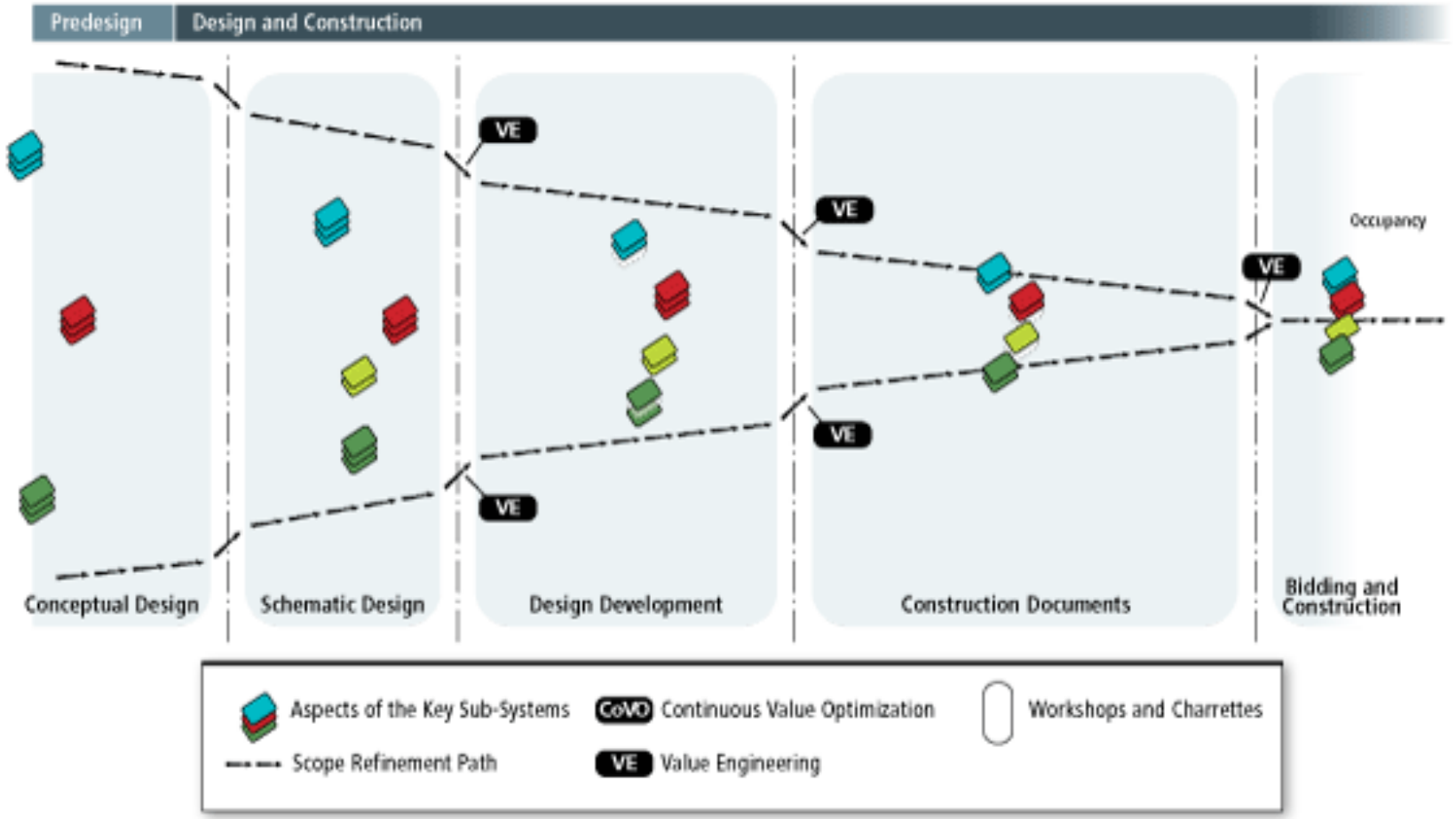


Diagram from 7group and Bill Reed, graphics by Corey Johnston

INTEGRATIVE PROCESS

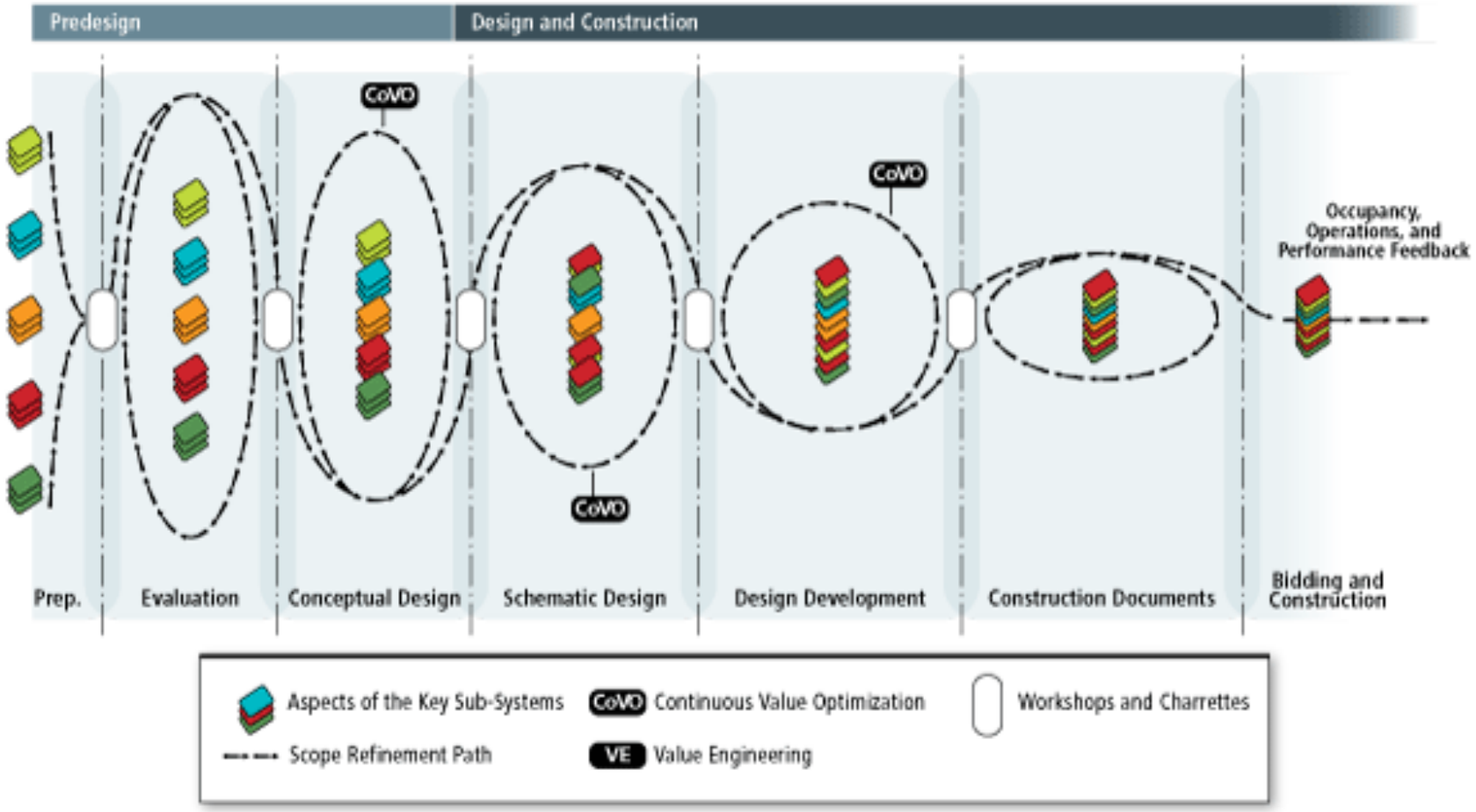
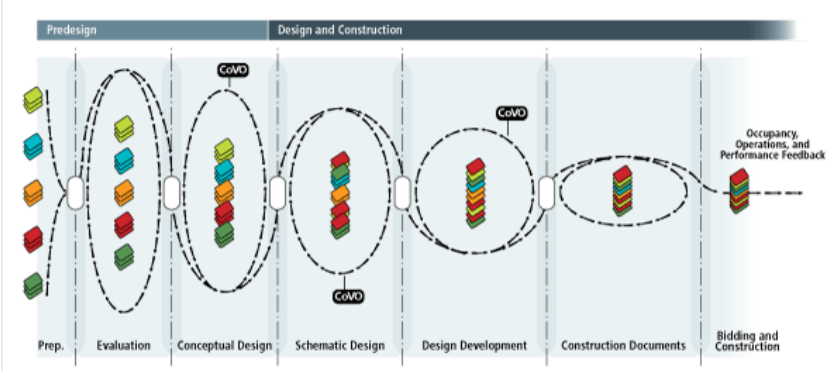
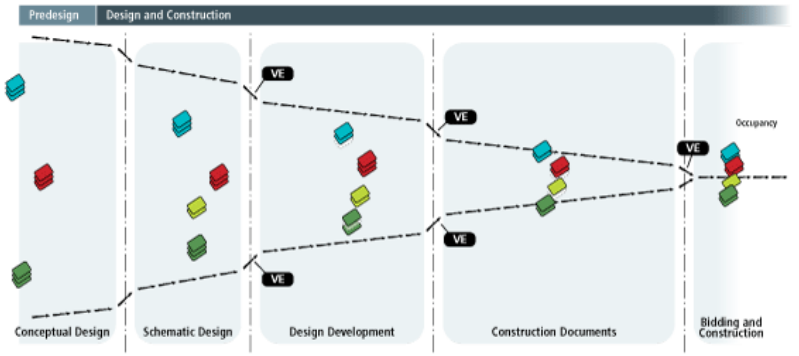


Diagram from 7group and Bill Reed, graphics by Corey Johnston

INTEGRATIVE PROCESS VS. TRADITIONAL PROCESS

INTEGRATIVE	TRADITIONAL
	
Integrated design process, with multiple disciplines working collaboratively	Linear design process, with 'hand-offs' from discipline to discipline and from phase to phase
Early collaboration that leverages expertise of each team member	Collaborators are involved as little and as late as possible
Open communication between all team members throughout design process	Limited communication other than that defined by contractual agreements
Significant time and fees allotted to discovery phase or predesign	Majority of time and fees allotted to Construction Documents and Construction Administration phases, may not include a discovery phase
Continual collaborative discovery process that optimizes interrelationships among systems	Costly conflict resolution during later phases of design and construction
Continuous value optimization	Value engineering

Diagrams from 7group and Bill Reed, graphics by Corey Johnston

INTEGRATIVE PROCESS

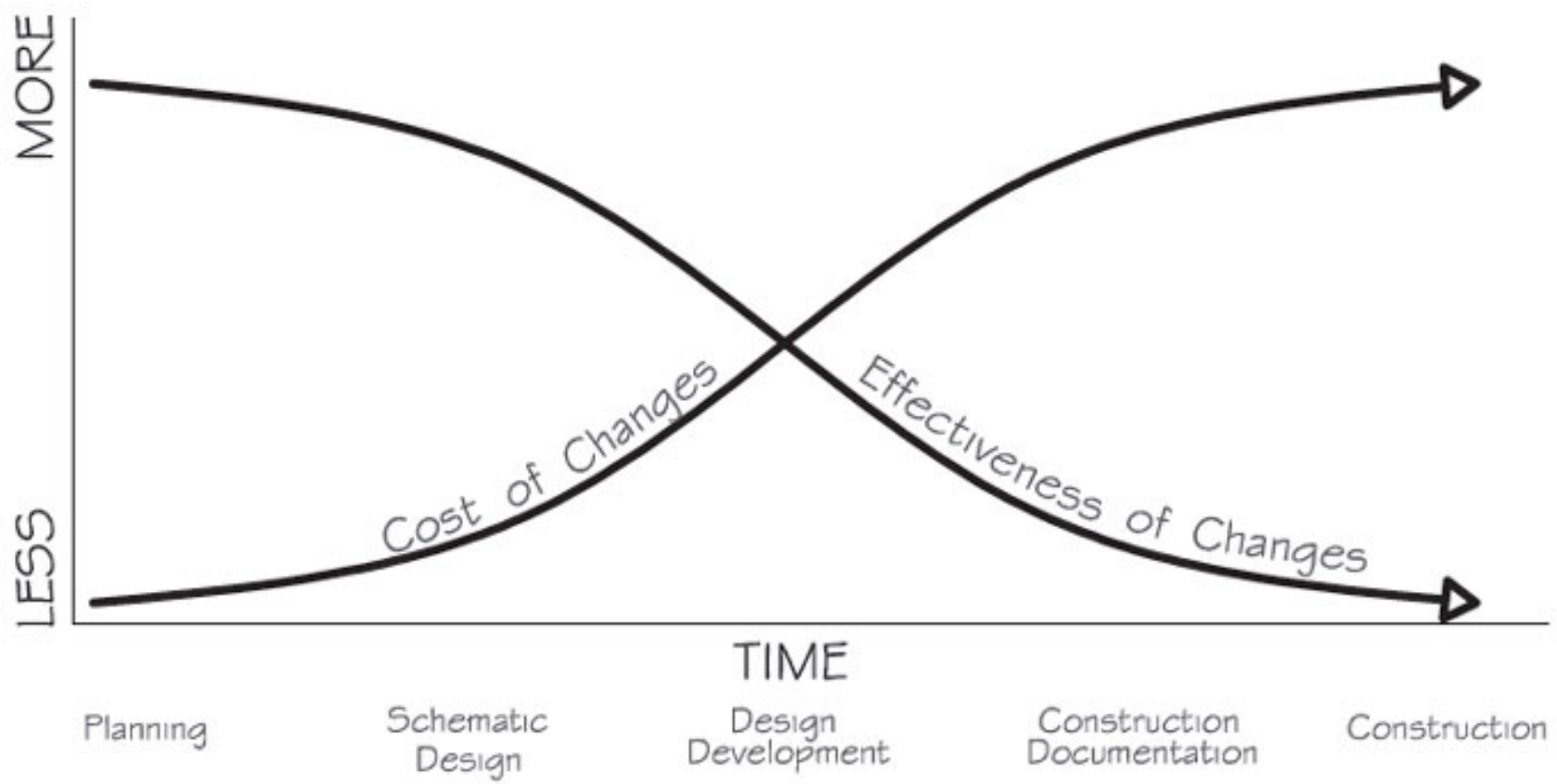
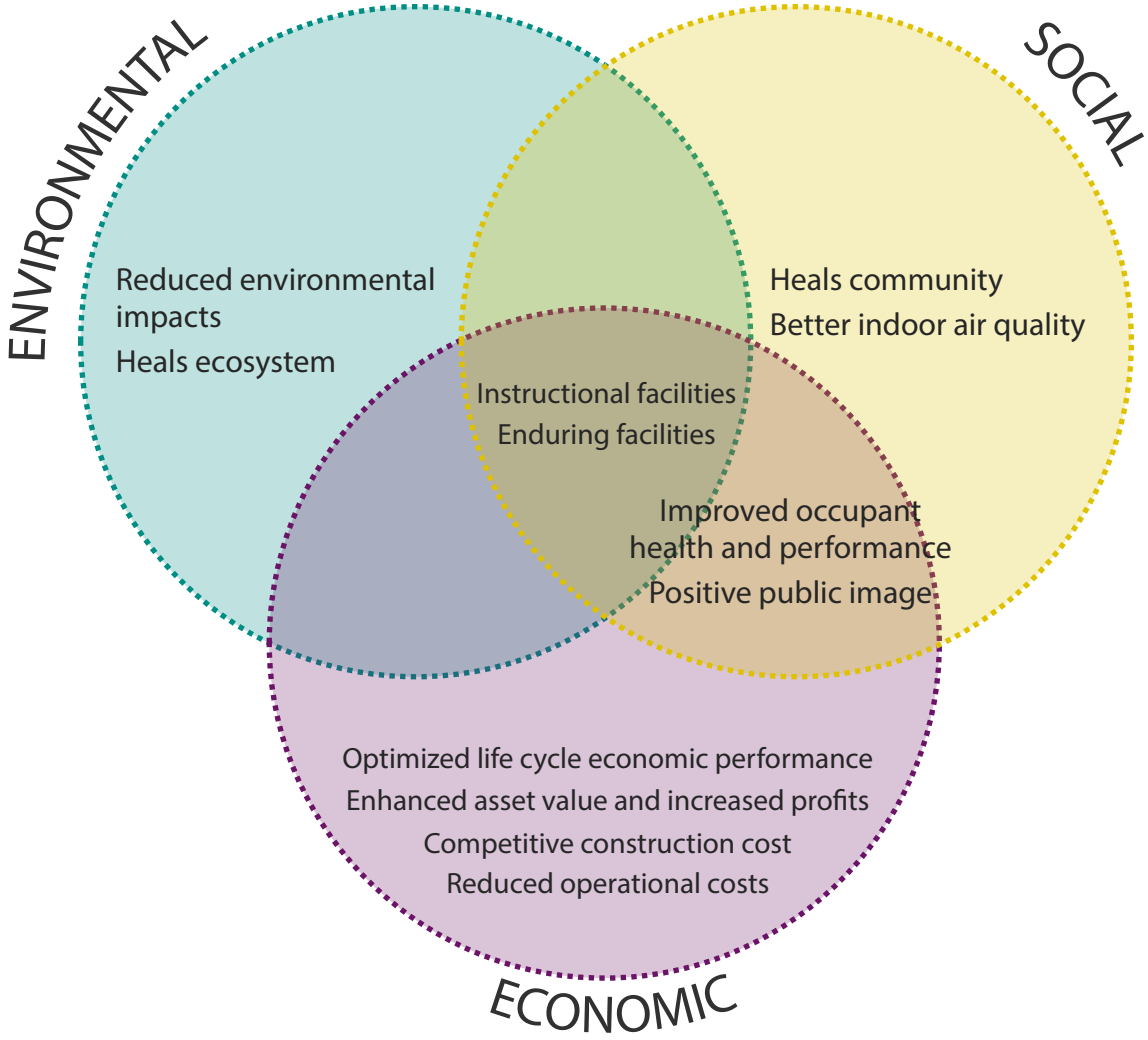


Diagram from USDA, United State Forest Service

INTEGRATIVE PROCESS IN GREEN RATING SYSTEMS

Program	Title/Credit	Requirements
ANSI	Integrative Process v2.0	(1) Workshops at key phases, (2) Performance benchmarks, metrics, and targets, (3) cost-bundling template, (4) Road Map, (5) Owner's project requirements, (6) Basis of design, (7) Life cycle cost analysis, (8) Commissioning Plan, (9) M&V Plan, (10) Standard operating procedures, (11) Recommissioning Manual
B3 Guidelines	P.3 Integrated Design Process (Required)	(1) Kick-off meeting, (2) Design Intent Document, (3) Basis of Design Document, (4) Assess safety risk for Indoor Air Quality issues, (5) Construction Air Quality Management Plan and Warranty Period, (6) Air Quality Management Plan, (7) Construction Waste Management Plan, (8) Track user complaint/work request logs
LEED	Integrative Process v4 (1 point)	(1)Owner's project requirements, (2) Basis of design, (3) "Simple box" energy modeling analysis during schematic design, (4) Preliminary water budget analysis during schematic design
Green Communities	1.1a Integrative Design (Required)	(1) Integrative design meeting(s), (2)Green Development Plan that outlines integrative design approach; Recommendations: (1) Design charrette, (2) Project goals, (3) Document compliance process for future use, (4) Building envelope and mechanical installation details and installation guides, (5) Performance-based incentives for construction team, (6) Self-verification requirements for construction team
Green Globes	3.1.1 Integrated Design Process (9 points)	(1) Kick-off meeting, (2) Qualitative and quantitative design goals, (3) Progress meetings

INTEGRATIVE PROCESS – BENEFITS



USING AN INTEGRATIVE PROCESS TO MEET SB 2030

Several of the characteristics of an integrative process are integral to the design of the SB 2030 program, such as:

- Setting measureable targets
- Re-evaluating targets at key phases
- Performing early energy modeling

Additionally, using an integrative process makes it easier to meet SB 2030 Energy Standards.

- Engage in iterative process of research and analysis, group workshops, design, and evaluation of design relative to project goals.
- Leverage the relationships between systems to improve whole building efficiency.

USING AN INTEGRATIVE PROCESS TO MEET SB 2030

DESIGN

1. Determine the average energy use for comparable buildings
2. Calculate the SB 2030 Energy Standard
3. Optimize energy use
   - Implement energy reduction strategies
   - Evaluate strategy bundles through energy modeling
4. Evaluate the use of low carbon energy sources

Use findings to inform future projects

OPERATIONS

1. Perform commissioning
2. Track actual performance using B3 Benchmarking
3. Ensure energy-efficient operations

USING AN INTEGRATIVE PROCESS TO MEET SB 2030

DETERMINE AVERAGE USE

SB 2030 ENERGY STANDARD

OPTIMIZE ENERGY USE

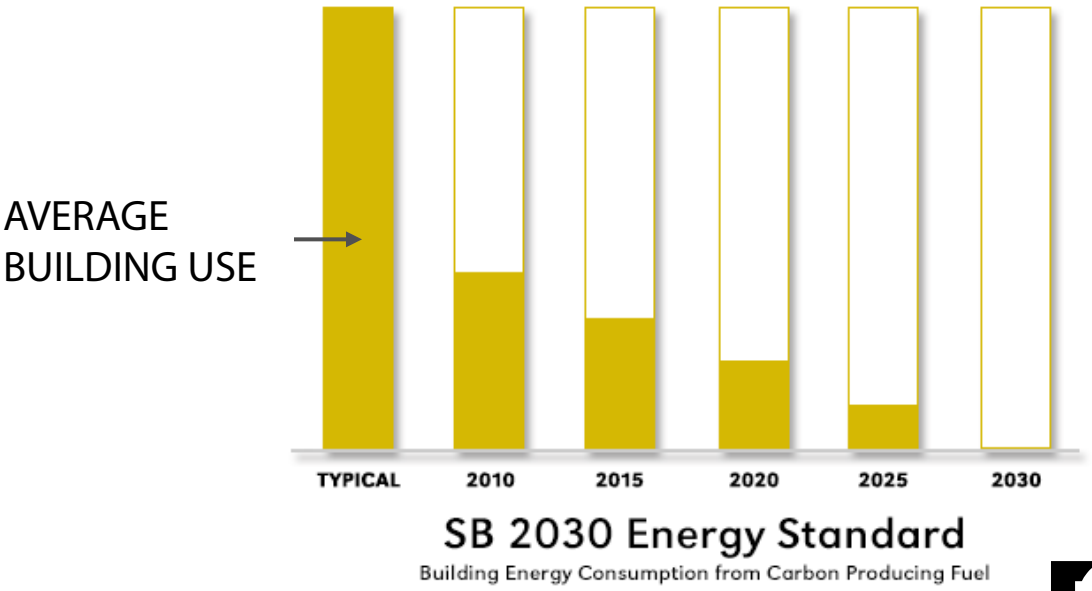
OPTIMIZE ENERGY SOURCES

PERFORM COMMISSIONING

TRACK PERFORMANCE

ENSURE ENERGY-EFFICIENT OPERATIONS

- Determining the average building energy use intensity (EUI) provides a standardized value of comparison for measurement and analysis. The "average building" may be based on other buildings within the region or on national averages.
- For SB 2030, the average building EUI sets the starting point for energy and CO_2 reduction against which each subsequent Energy Standard is calculated.



USING AN INTEGRATIVE PROCESS TO MEET SB 2030

DETERMINE AVERAGE USE

SB 2030 ENERGY STANDARD

OPTIMIZE ENERGY USE

OPTIMIZE ENERGY SOURCES

PERFORM COMMISSIONING

TRACK PERFORMANCE

ENSURE ENERGY-EFFICIENT OPERATIONS

The calculation of the average building EUI for SB 2030 prioritized the following characteristics:

- Easy to use and understand
- Accurate for Minnesota's climate
- Consistent methodology
- Comprehensive – applicable to all building types
- Specific to each building's program and use

USING AN INTEGRATIVE PROCESS TO MEET SB 2030

DETERMINE AVERAGE USE

SB 2030 ENERGY STANDARD

OPTIMIZE ENERGY USE

OPTIMIZE ENERGY SOURCES

PERFORM COMMISSIONING

TRACK PERFORMANCE

ENSURE ENERGY-EFFICIENT OPERATIONS

BUILDING-SPECIFIC AVERAGE EUI

The SB 2030 team created a web-based calculation tool that allows project designers to either use "default" building characteristics or define "customized" characteristics based on their unique building program elements.

Editable building characteristics include:

- Building location
- Building gross floor area
- Building type(s)
- Number of floors
- Space type, floor area %, and hours of use
- Fuel source types for building

USING AN INTEGRATIVE PROCESS TO MEET SB 2030

DETERMINE AVERAGE USE

SB 2030 ENERGY STANDARD

OPTIMIZE ENERGY USE

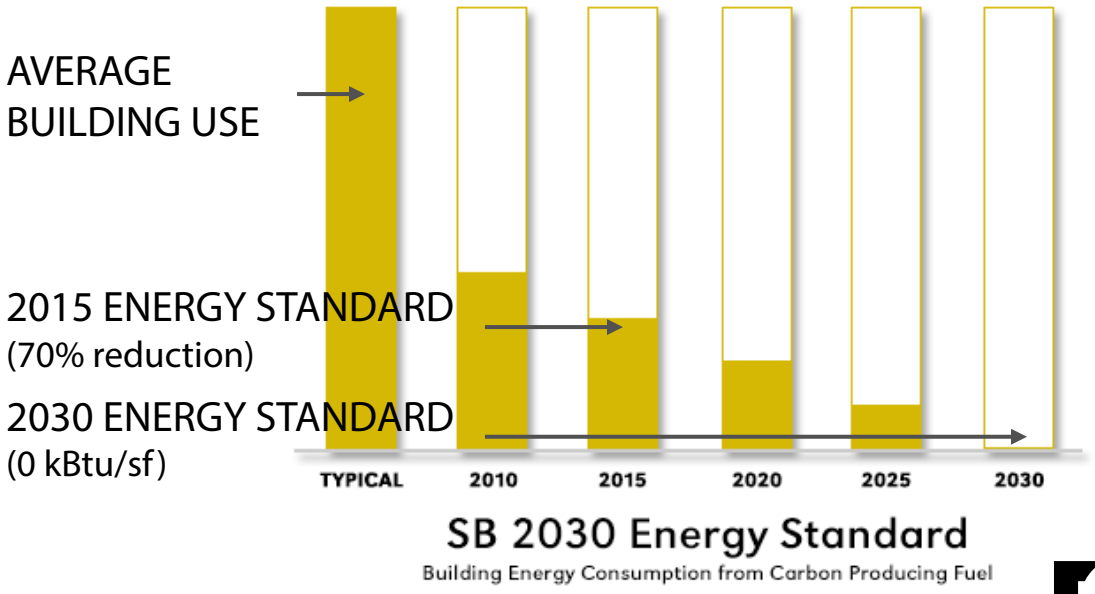
OPTIMIZE ENERGY SOURCES

PERFORM COMMISSIONING

TRACK PERFORMANCE

ENSURE ENERGY-EFFICIENT OPERATIONS

- The SB 2030 Energy Standard is the energy target that must be achieved.
- Through 2029, the SB 2030 Energy Standard is a percentage reduction from the average building use, dropping by 10% every 5 years. For projects that start Schematic Design after January 1, 2015, the SB 2030 Energy Standard is a 70% reduction.
- In 2030, this switches from a relative target to an absolute target of 0 kBtu/sf from carbon producing fuel.



Step 1: Introduction

Welcome to the latest version of the SB 2030 Energy Standards Tool developed to create a custom project specific Energy Use Intensity (EUI) Standard for commercial and institutional buildings in the State of Minnesota.

What it does

The tool will identify the absolute energy performance consumption goal that new and renovated building projects are required to achieve using the B3 Energy Guidelines. The SB 2030 EUI Standard is expressed in units of kBTU/ft²/year of site energy consumption.

How it works

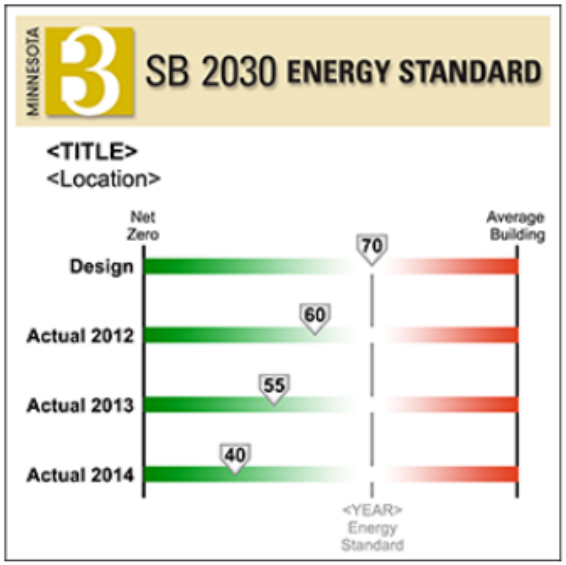
Project design professionals select and enter specific building characteristics based on their projects custom building program, operational characteristics, non-regulated energy code requirements, and building location. A web service then conducts an energy simulation based on the user's entry and calculates the required SB 2030 Standard EUI the owner and design team is required to achieve for their project.

How to use the results

The SB 2030 EUI Standard displayed on the Results page is entered by the user into the B3 Energy Guidelines tool to compare the proposed design energy consumption EUI.

To learn more about the Tools features and process, review the Information Document by clicking the information link at the bottom of the screen.

To use the import tool click on the following link: Import Tool



Step 2: Project Characteristics

Project Name *	Sample Building	
Project Organization *	Sample Organization	
Project City *	Minneapolis	
Building Area Types	○ 1 ◉ 2 ○ 3	
	1	**2**
Building Area Type	Office	Retail
Gross Floor Area *	100,000	30,000
Number of Floors *	1	1
Construction	New	New
Heating	◉ non-District ○ District	◉ non-District ○ District
Cooling	◉ non-District ○ District	◉ non-District ○ District
	Edit Characteristics	Edit Characteristics
	Edit Space Types	Edit Space Types

Step 2: Project Characteristics

Project Name *
Project Organiza
Project City *
Building Area Ty
Building Area
Gross Floor A
Number of Fl
Construction
Heating
Cooling

Project Name: Sample Building

Space Types

	Total ft²	
Allocated:	100,000	Allocation is OK
Total building:	100,000	

Building area type: 1 - Office

Space Type	Floor Area ft²	Floor Area %		Person ft²	Plug W/ft²	Vent Rate CFM/ft²	Light Hours %	Plug Hours %	Process Hours %	People Hours %
Open Office	35,000	35.0	Edit	200	1.2	0.08	66.1	49.4	49.4	25.0
Enclosed Office	25,000	25.0	Edit	150	1.2	0.09	50.7	49.4	49.4	24.3
Circulation	18,000	18.0	Edit	400	0.1	0.06	53.1	53.1	53.1	18.2
Mechanical Electrical Room	6,000	6.0	Edit	400	0.2	0.12	41.0	46.6	46.6	11.7
Storage	5,000	5.0	Edit	400	0.1	0.12	48.3	48.3	48.3	18.2
Medium Conference Room	4,000	4.0	Edit	20	1.0	0.31	45.6	41.3	41.3	19.5
Data Center	2,000	2.0	Edit	200	12.0	0.17	50.7	100.0	100.0	24.3
Lobby	2,000	2.0	Edit	100	0.3	0.11	62.0	62.0	53.1	18.2

Ok Cancel

INFORMATION

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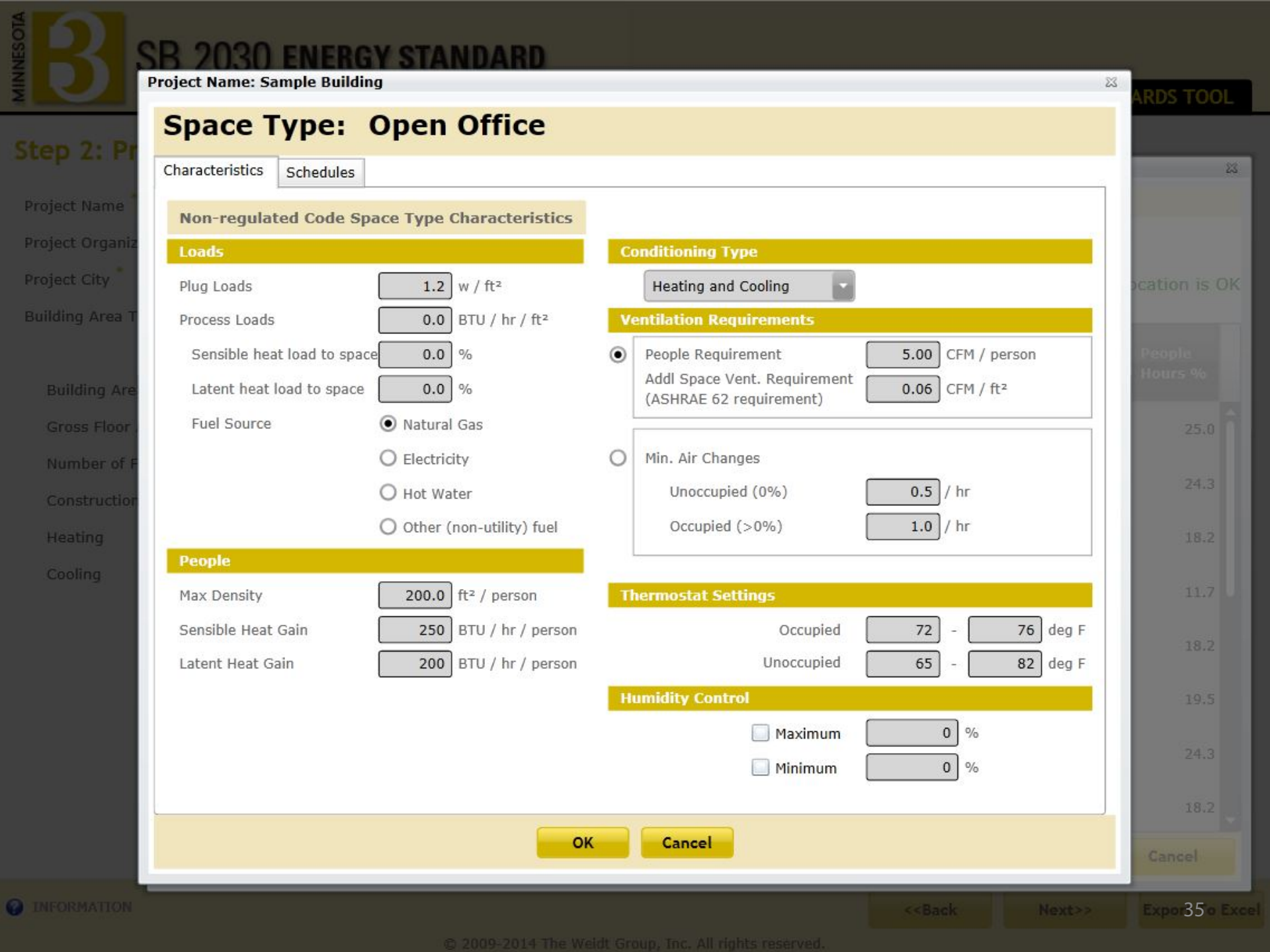
SB 2030 ENERGY STANDARD
Project Name: Sample Building
Space Type: Open Office
Characteristics
Schedules
Non-regulated Code Space Type Characteristics
Loads
Plug Loads 1.2 w / ft²
Process Loads 0.0 BTU / hr / ft²
Sensible heat load to space 0.0 %
Latent heat load to space 0.0 %
Fuel Source
Natural Gas
Electricity
Hot Water
Other (non-utility) fuel
People
Max Density 200.0 ft² / person
Sensible Heat Gain 250 BTU / hr / person
Latent Heat Gain 200 BTU / hr / person
Conditioning Type
Heating and Cooling
Ventilation Requirements
People Requirement 5.00 CFM / person
Addl Space Vent. Requirement (ASHRAE 62 requirement) 0.06 CFM / ft²
Min. Air Changes
Unoccupied (0%) 0.5 / hr
Occupied (>0%) 1.0 / hr
Thermostat Settings
Occupied 72 - 76 deg F
Unoccupied 65 - 82 deg F
Humidity Control
Maximum 0 %
Minimum 0 %
OK
Cancel
INFORMATION
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Next>>
Export to Excel
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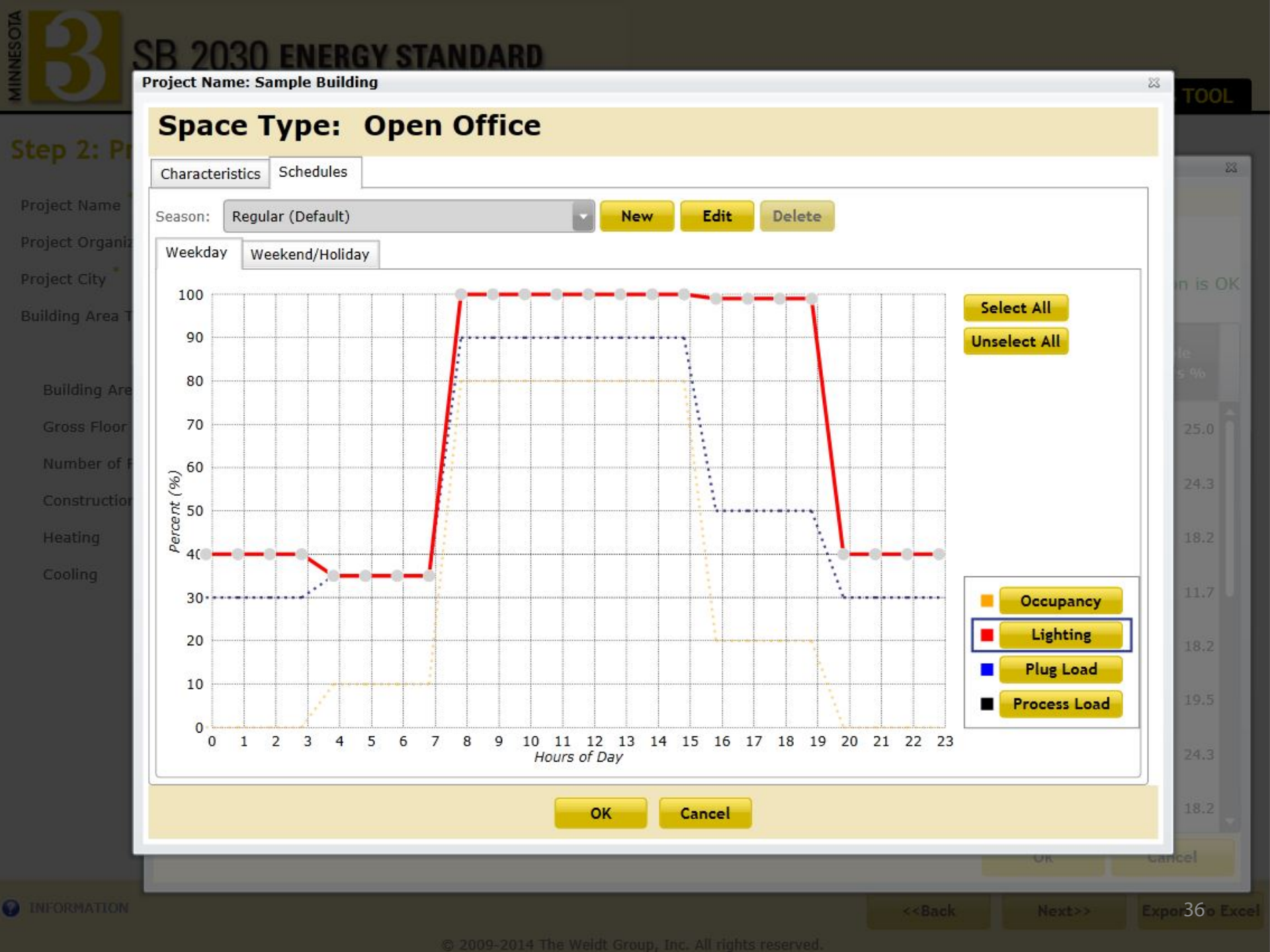
MINNESOTA
SB 2030 ENERGY STANDARD
TOOL
Step 2: Pr
Project Name
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Project City
Building Area T
Building Are
Gross Floor
Number of F
Constructior
Heating
Cooling
INFORMATION
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Export to Excel
© 2009-2014 The Weidt Group, Inc. All rights reserved.
Project Name: Sample Building
Space Type: Open Office
Characteristics
Schedules
Season:
Regular (Default)
New
Edit
Delete
Weekday
Weekend/Holiday
Percent (%)
100
90
80
70
60
50
40
30
20
10
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hours of Day
Select All
Unselect All
Occupancy
Lighting
Plug Load
Process Load
OK
Cancel
25.0
24.3
18.2
11.7
18.2
19.5
24.3
18.2

Step 2: Project Characteristics

Project Name *	Sample Building	
Project Organization *	Sample Organization	
Project City *	Minneapolis	
Building Area Types	1 2 3	
	1	2
Building Area Type	Office	Retail
Gross Floor Area *	100,000	30,000
Number of Floors *	1	1
Construction	New	New
Heating	non-District District	non-District District
Cooling	non-District District	
	Edit Characteristics	Edit Characteristics
	Edit Space Types	Edit Space Types

Running Simulation..

Step 3: Results

Project Name: Sample Building
Organization: Sample Organization
Location: Minneapolis

Building Areas:	1	2
Type:	Office	Retail
Floor Area ft²:	100,000	30,000
Floors:	1	1
Construction:	New	New
Heating:	Non-District	Non-District
Cooling:	Non-District	Non-District

Annual SB 2030 Energy Standard: **60** kBTU/ft²/yr

Annual SB 2030 CO_2: **22** lbs CO_2/ft²/yr

USING AN INTEGRATIVE PROCESS TO MEET SB 2030

- DETERMINE AVERAGE USE
- **SB 2030 ENERGY STANDARD**
- OPTIMIZE ENERGY USE
- OPTIMIZE ENERGY SOURCES
- PERFORM COMMISSIONING
- TRACK PERFORMANCE
- ENSURE ENERGY-EFFICIENT OPERATIONS

SB 2030 PROCESS

Refine SB 2030 Energy Standard as building design develops.

PREDESIGN:

- Calculate SB 2030 Energy Standard using default inputs.

SCHEMATIC DESIGN:

- Recalculate SB 2030 Energy Standard using building-specific space use areas.
- Simulate design model energy consumption and compare to SB 2030 Energy Standard (must be within 15%).

DESIGN DEVELOPMENT AND CONSTRUCTION DOCUMENTS:

- Recalculate SB 2030 Energy Standard using building-specific space use areas, fuel types, occupant loads, schedules, and settings.
- Simulate design model energy consumption and compare to SB 2030 Energy Standard (must be within 10% during Design Development and 5% during Construction Documents).

USING AN INTEGRATIVE PROCESS TO MEET SB 2030

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SB 2030 ENERGY STANDARD

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ALTERNATIVE PATH METHOD

- The Alternative Path Method can be used if the building cannot meet the SB 2030 Energy Standard cost-effectively (i.e. within a 15 year simple payback)
- This path must be applied for at the end of Schematic Design
- The Alternative Path Method will produce a SB 2030 Adjusted Energy Standard based on cost effectiveness
  - All reasonable energy conservation strategies with less than 15 year simple payback will be consider in establishing the Adjusted Energy Standard
  - Strategies will be considered as individual strategies not as bundled strategies for paybacks

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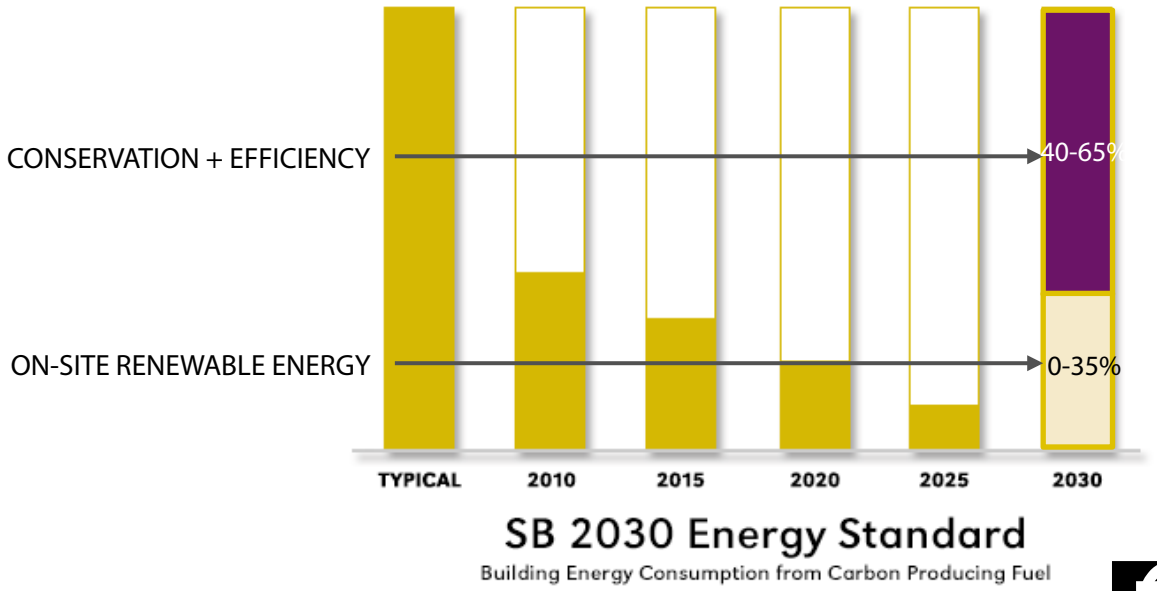
ITERATIVE PROCESS

- Select energy reduction strategies
- Evaluate strategy bundles through energy modeling

RULES OF THUMB



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IMPACT OF DIFFERENT DECISIONS ON ENERGY USE

Building design fixes the load	Efficient systems meet the load	Energy sources to fuel systems	People run the systems
Building shape	Envelope	Wood	Schedules
Building volume	Daylighting	Sun-active heat	Controls
Glass location	Lighting	Sun-photovoltaics	Maintenance
Glass area & type	HVAC	Wind generation	Setpoints
Insulation values	Controls	Solar electricity	Windows
Thermal mass	District heating	Gas co-gen	Equipment
Lighting concept	Domestic hot water	Micro turbines	Education
Mechanical concept		Fuel cells	Ongoing M&V
10% - 20%	**15% - 40%**	**1% - 5%**	**10% - 20%**
Minimize load as a first priority	Use simple, cost-effective systems	Use appropriate sources of energy	Operate the building well

USING AN INTEGRATIVE PROCESS TO MEET SB 2030

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EARLY ENERGY REDUCTION STRATEGIES

- Building shape & volume
- Building orientation
- Glass location & area
- Properties of components
  - Insulation (R-values)
    - Walls
    - Floor
    - Roof
  - Glazing
    - U-Factor
    - Visible Light Transmission
    - Solar Heat Gain Coefficient

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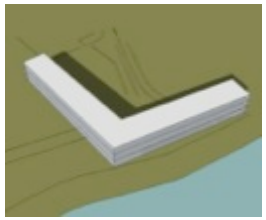
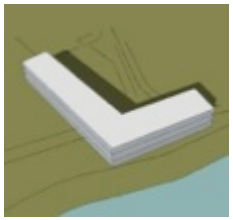
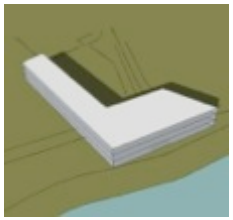
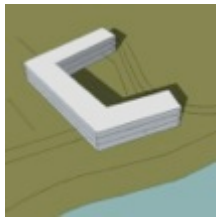
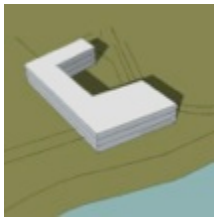
EARLY ENERGY MODELING TOOLS (MODEL-BASED)

- IES-VE
- Autodesk:
  - Green Building Studio
- Sefaira

1	2	3	4	5
				
208 kBtu/ft²/yr	130 kBtu/ft²/yr	129 kBtu/ft²/yr	208 kBtu/ft²/yr	132 kBtu/ft²/yr

USING AN INTEGRATIVE PROCESS TO MEET SB 2030

DETERMINE AVERAGE USE

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FINAL ENERGY MODELING TOOLS

While early energy modeling is essential for meeting the aggressive SB 2030 Energy Standards, more accurate energy models are required during the Construction Documents phase to verify compliance with SB 2030.

Accepted energy models must use hourly data and be based on DOE 2.1 or later, such as:

- e-Quest
- TRACE 700
- Third party DOE 2.1 or 2.2-based simulations

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ENERGY DESIGN ASSISTANCE (EDA) – XCEL ENERGY

- Free energy consulting services and predictive energy modeling
- Includes goal-setting meetings, massing studies, daylighting analysis, HVAC analysis
- Construction rebates
- Design team reimbursement
- Measurement and verification: construction document review, onsite walk-through, data logging
- Additional analysis available for B3 projects (EDA Enhanced process), starting in Predesign or early Schematic Design phase

http://www.xcelenergy.com/Save_Money_&_Energy/Business/Supplemental_Information/Business_New_Construction_EDA_-_MN

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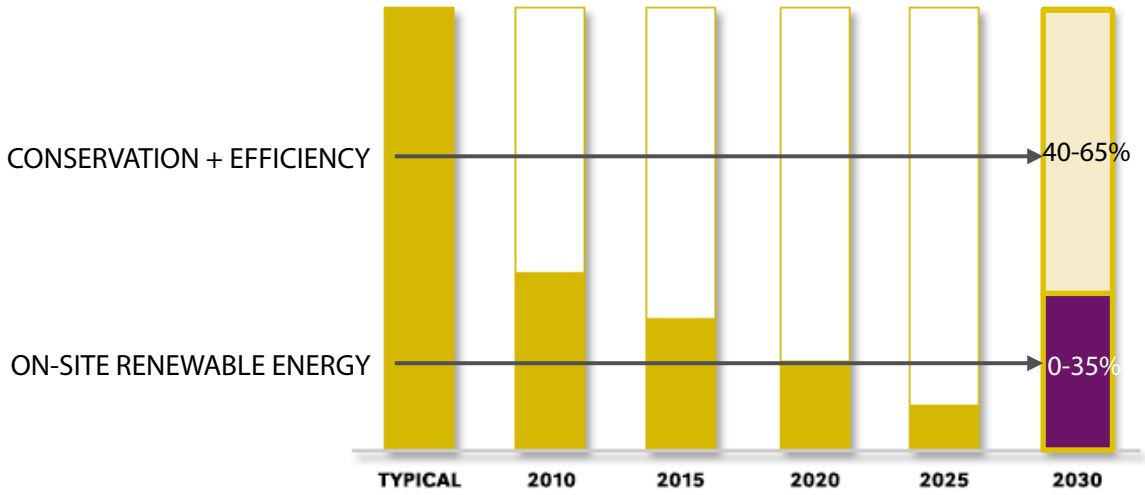
EVALUATE RENEWABLE ENERGY SOURCES

- Renewable energy resources in the United States
- On-site renewable energy



SB 2030 Energy Standard

Building Energy Consumption from Carbon Producing Fuel

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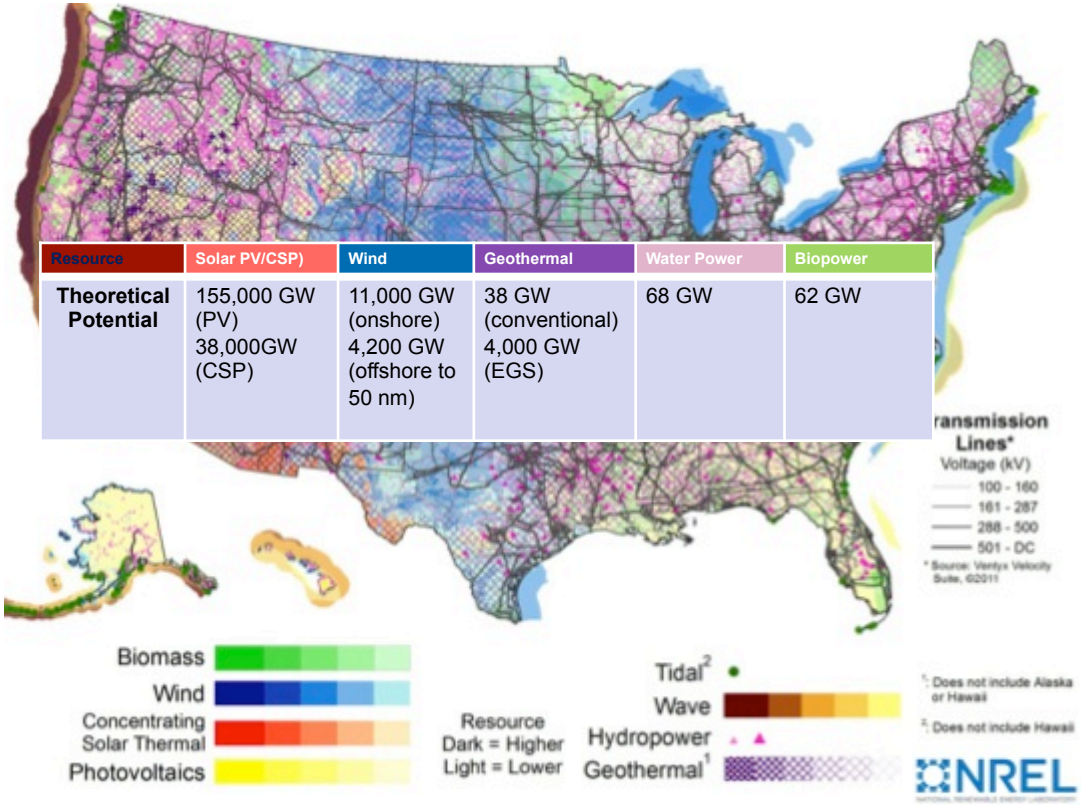
RENEWABLE ENERGY IN THE UNITED STATES

The generation potential of renewable energy in the United States far exceeds the demand.



NREL. "U.S. Renewable Energy Technical Potential" http://www.nrel.gov/gis/re_potential.html

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ON-SITE RENEWABLE ENERGY

- Determine whether the site is suited to low/no carbon energy sources such as solar, geothermal, or wind.
- Evaluate how renewable energy sources can be leveraged to optimize the relationships between systems.
- Investigate economic incentives that will help minimize the life cycle costs. http://dsireusa.org/incentives/

Necedah Visitor Center.

USING AN INTEGRATIVE PROCESS TO MEET SB 2030

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COMMISSIONING

Commissioning provides verification that the building's subsystems are correctly installed and operating to achieve the owner's project requirements.

- HVAC
- Plumbing
- Electrical
- Fire/life safety
- Building envelope
- Interior systems
- Sustainable systems
- Lighting
- Wastewater
- Controls
- Building security

The B3 guidelines require design and construction commissioning.

USING AN INTEGRATIVE PROCESS TO MEET SB 2030

DETERMINE AVERAGE USE

SB 2030 ENERGY STANDARD

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ENSURE ENERGY-EFFICIENT OPERATIONS

- MISCOMMUNICATION: Steam line was medium pressure but the installed valve was designed for low pressure steam
- RESULT: Over humidification, wasted steam, and water damage to the floor below

USING AN INTEGRATIVE PROCESS TO MEET SB 2030

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Tracking actual performance is essential to ensure that energy targets are being met and to identify opportunities for savings. SB 2030 projects are required to do this using B3 Benchmarking.

PERFORMANCE TRACKING TOOLS

Tool	Scope	Cost	Data Source	Comparisons
B3 Benchmarking	Minnesota	Free for public buildings	Utility Bills (monthly)	Benchmark, similar buildings, previous use (baseline), Energy Star buildings, and targets
Energy Star Portfolio Manager	Nation	Free	Utility Bills (monthly)	Benchmark, similar buildings, previous use (baseline), Energy Star buildings, and targets
Energy Print	Nation	Varies	Utility Bills (monthly)	Benchmark, similar buildings, previous use (baseline), Energy Star buildings, and targets
Lucid	World	Varies	Smart Meters (real-time)	Other buildings (in defined community), previous use (baseline), and targets

USING AN INTEGRATIVE PROCESS TO MEET SB 2030

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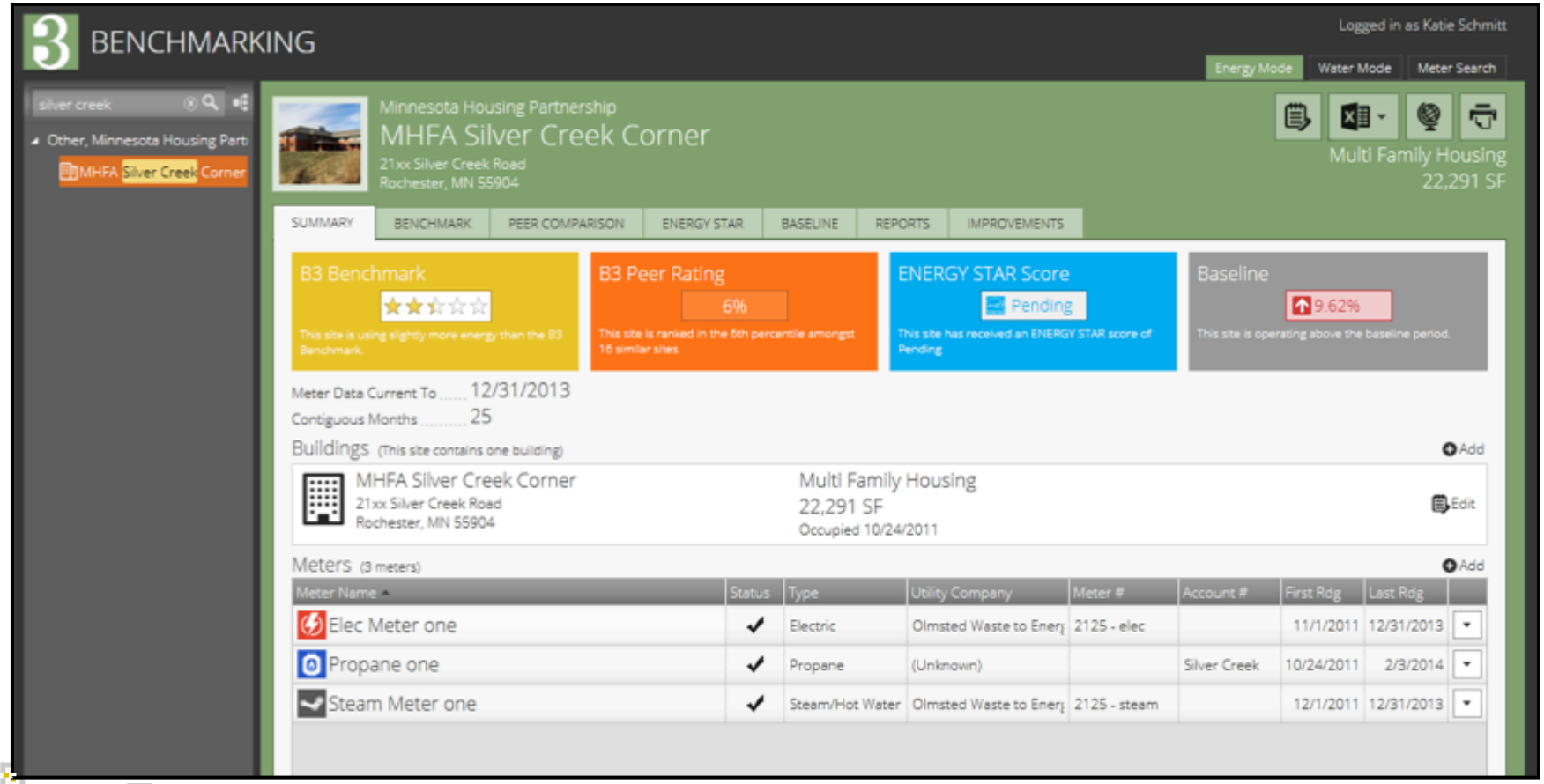
USE OF B3 BENCHMARKING TOOL

1. Define building and meters
2. Set the design model consumption goal by month
3. Enter actual monthly consumption by metered fuel type
4. Compare design goal to actual consumption
5. Investigate building systems and operational assumptions if actual energy consumption is higher than the design goal

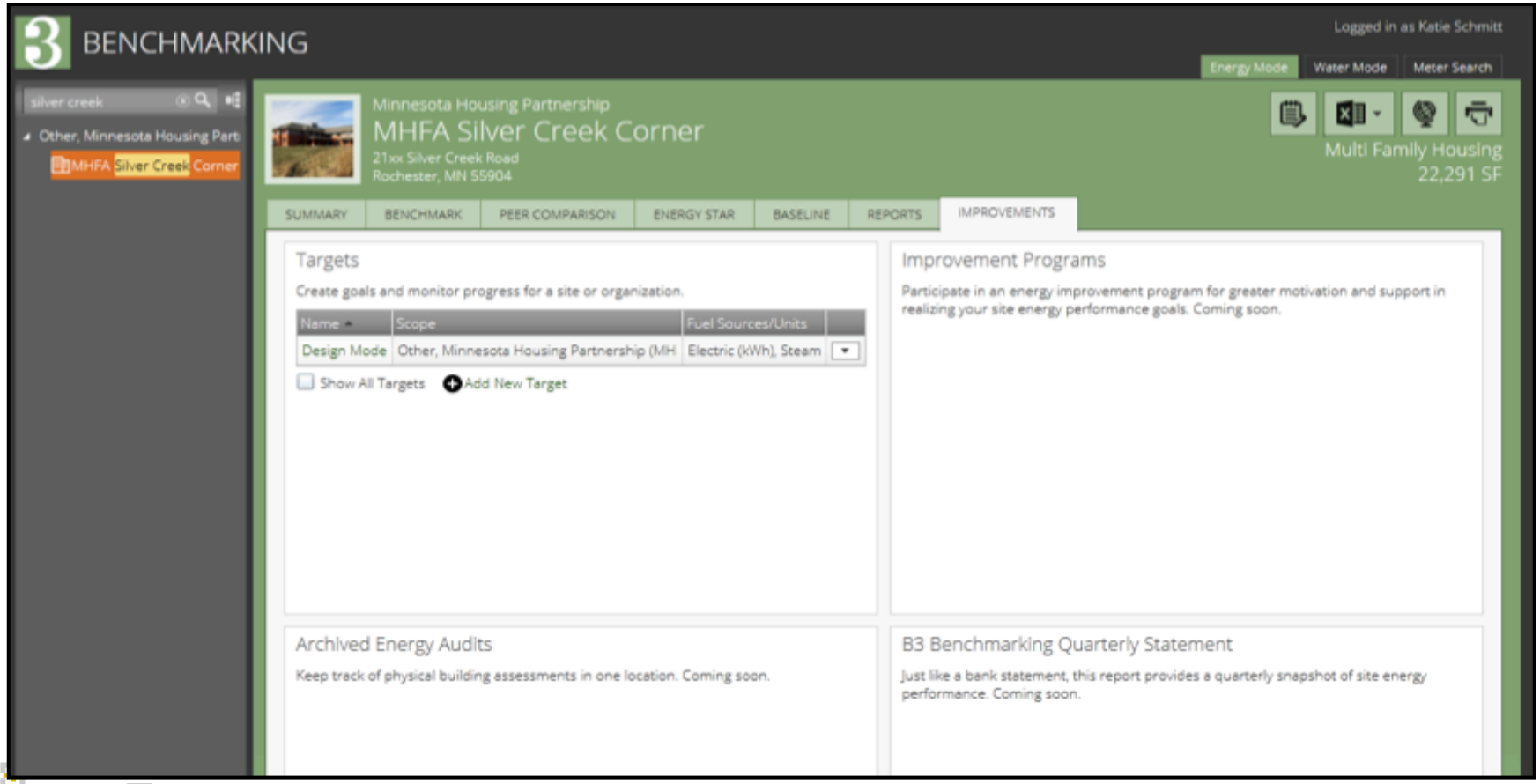
USING AN INTEGRATIVE PROCESS TO MEET SB 2030

1. Define building and meters.



USING AN INTEGRATIVE PROCESS TO MEET SB 2030

2. Set the design model consumption goal by month



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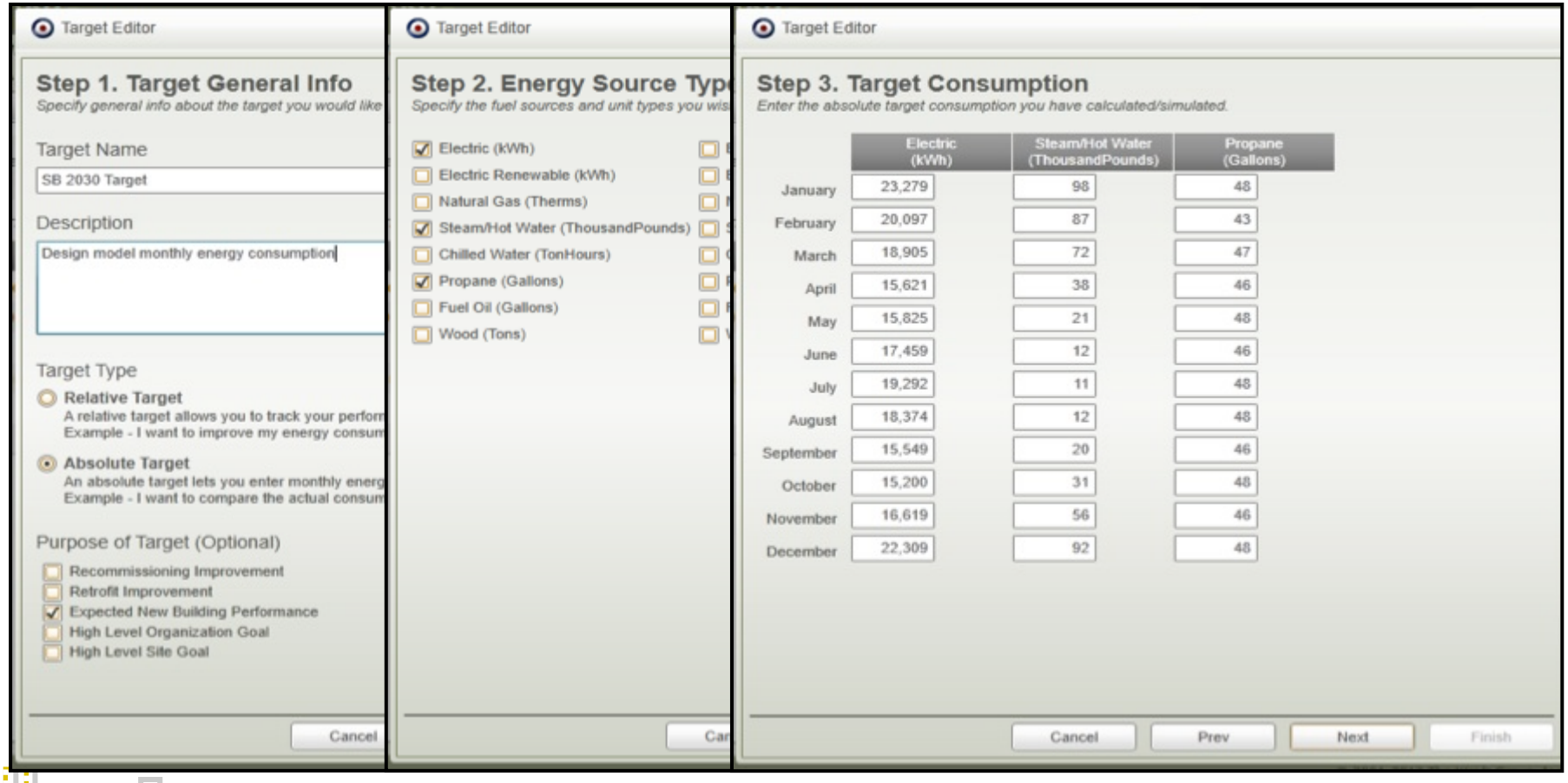
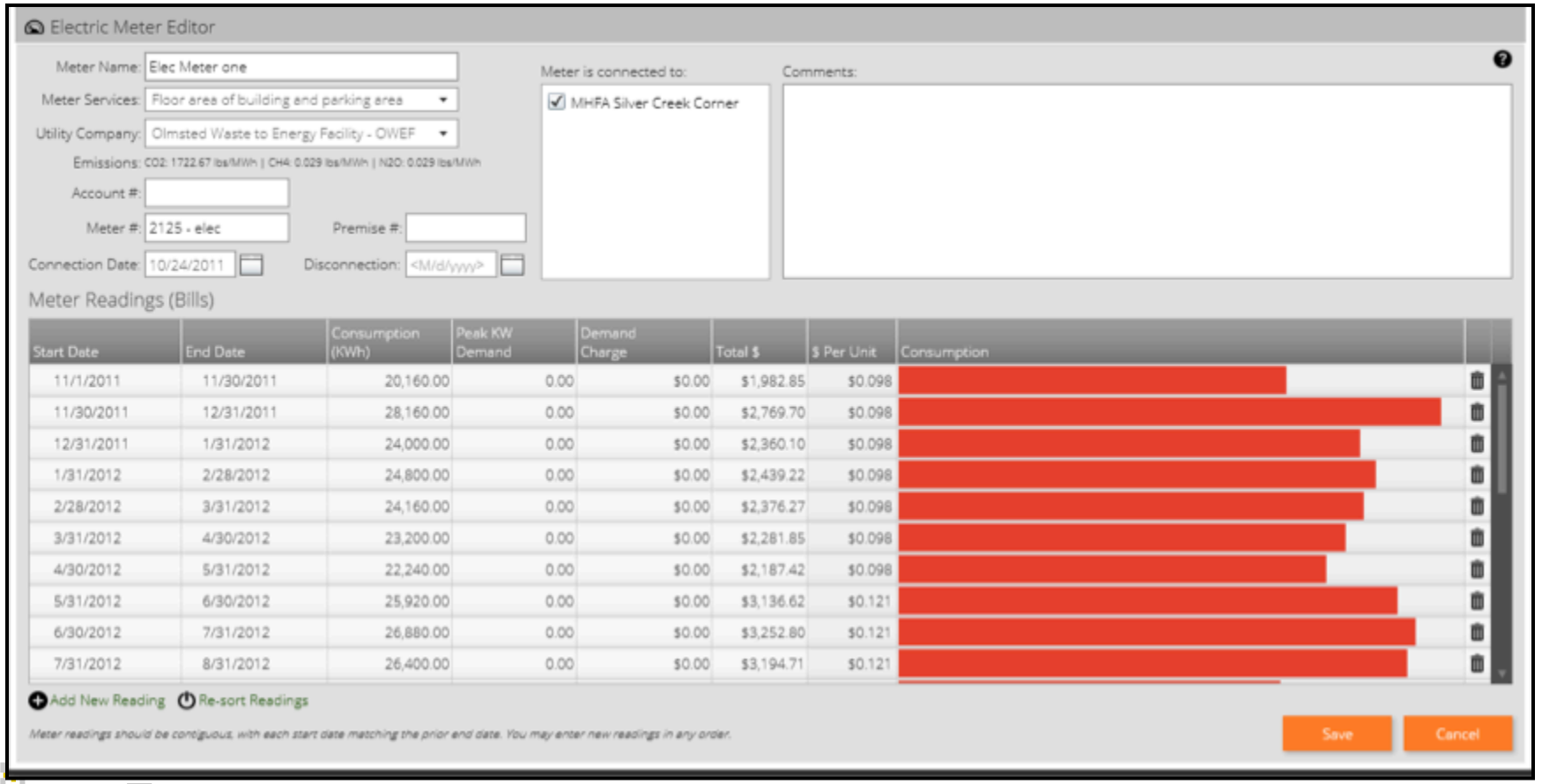


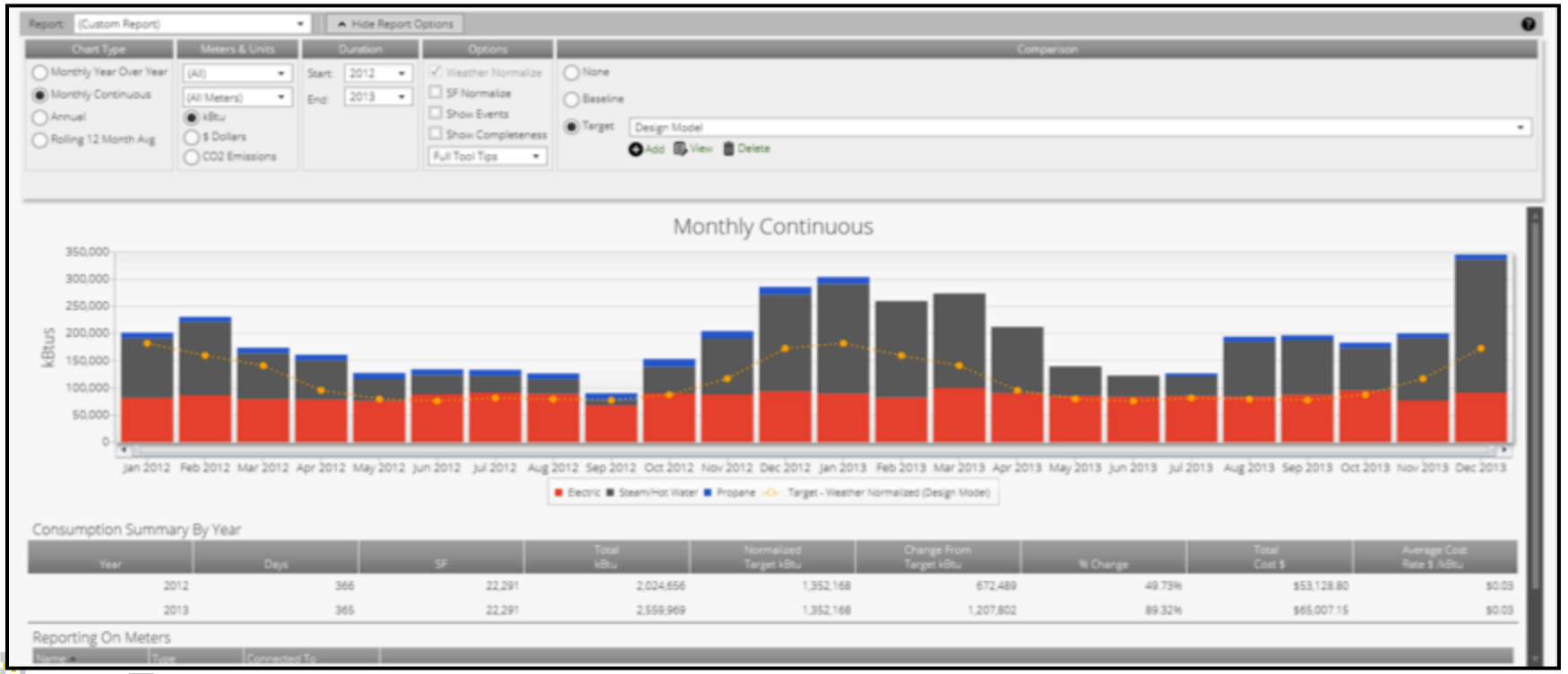
USING AN INTEGRATIVE PROCESS TO MEET SB 2030

3. Enter actual monthly consumption by metered fuel type.

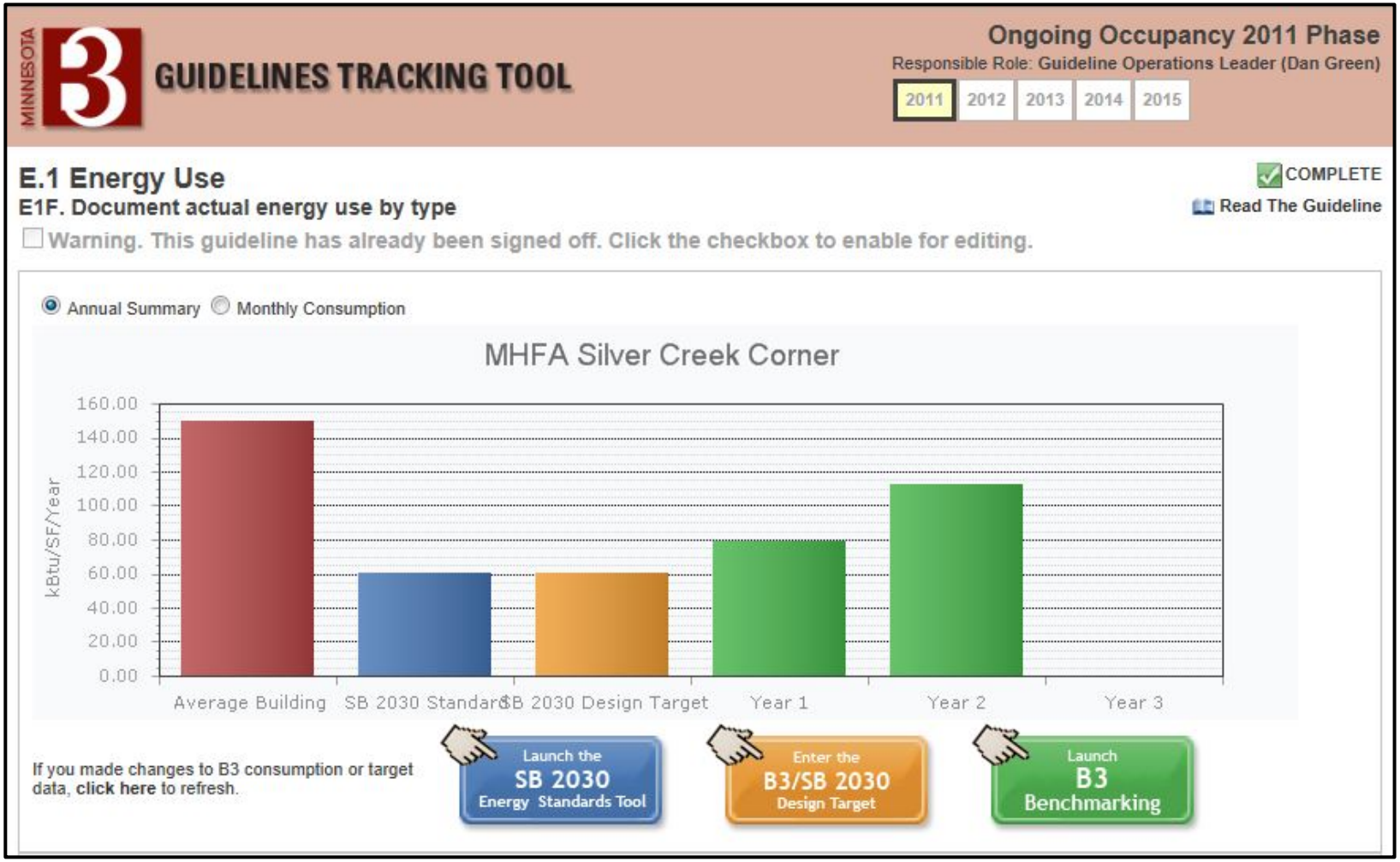


USING AN INTEGRATIVE PROCESS TO MEET SB 2030

4. Compare design goal to actual consumption.
5. Investigate building systems and operational assumptions if actual consumption is higher than design goal.



USING AN INTEGRATIVE PROCESS TO MEET SB 2030



USING AN INTEGRATIVE PROCESS TO MEET SB 2030

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PROBLEM PREVENTION & PROBLEM-SOLVING

B3 projects are required to:

- Develop an Operations Management Plan that includes:
  - Systems turnover process (from Construction to Operations)
  - Operations and Maintenance Manuals
  - Problem Response Plan
  - Maintenance Plan
  - Measurement and Verification Plan
  - Systems Operations Manual
  - Funding and Staffing Plan
- Implement Operations and Maintenance Practices
- Annually review and update Operations Management Plan

USING AN INTEGRATIVE PROCESS TO MEET SB 2030

DETERMINE AVERAGE USE SB 2030 ENERGY STANDARD

OPTIMIZE ENERGY USE

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ENSURE ENERGY-EFFICIENT OPERATIONS

EXISTING BUILDING COMMISSIONING

A systematic process for identifying opportunities to optimize performance in existing buildings.

- RETRO-COMMISSIONING: commissioning an existing building to resolve problems and enhance building performance
- RE-COMMISSIONING: commissioning a building that has already been commissioned to ensure continued operational efficiency

RESEARCH & DOCUMENT
- Facility use and hours
- Systems
- Known deficiencies
- Historical utility usage and coasts

INVESTIGATE
- Inspect systems and current operation
- Trend systems
- Measure key operational data points

ANALYZE
- Review trending data for anomalies
- Calculate potential savings
- Calculate potential costs

RECOMMEND
- Provide owner documented ECOs with estimated payback
- Provide owner list of any non-energy saving recommendations found during study

VERIFY
- Proposed addition to our scope 2014
- Verify which ECOs were implemented
- Review actual energy savings a year post implementation

USING AN INTEGRATIVE PROCESS TO MEET SB 2030

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HOBO DATA LOGGER

- Measures space temperature, humidity, and light intensity every 15 minutes for two weeks

- Place in spaces of concern & review data

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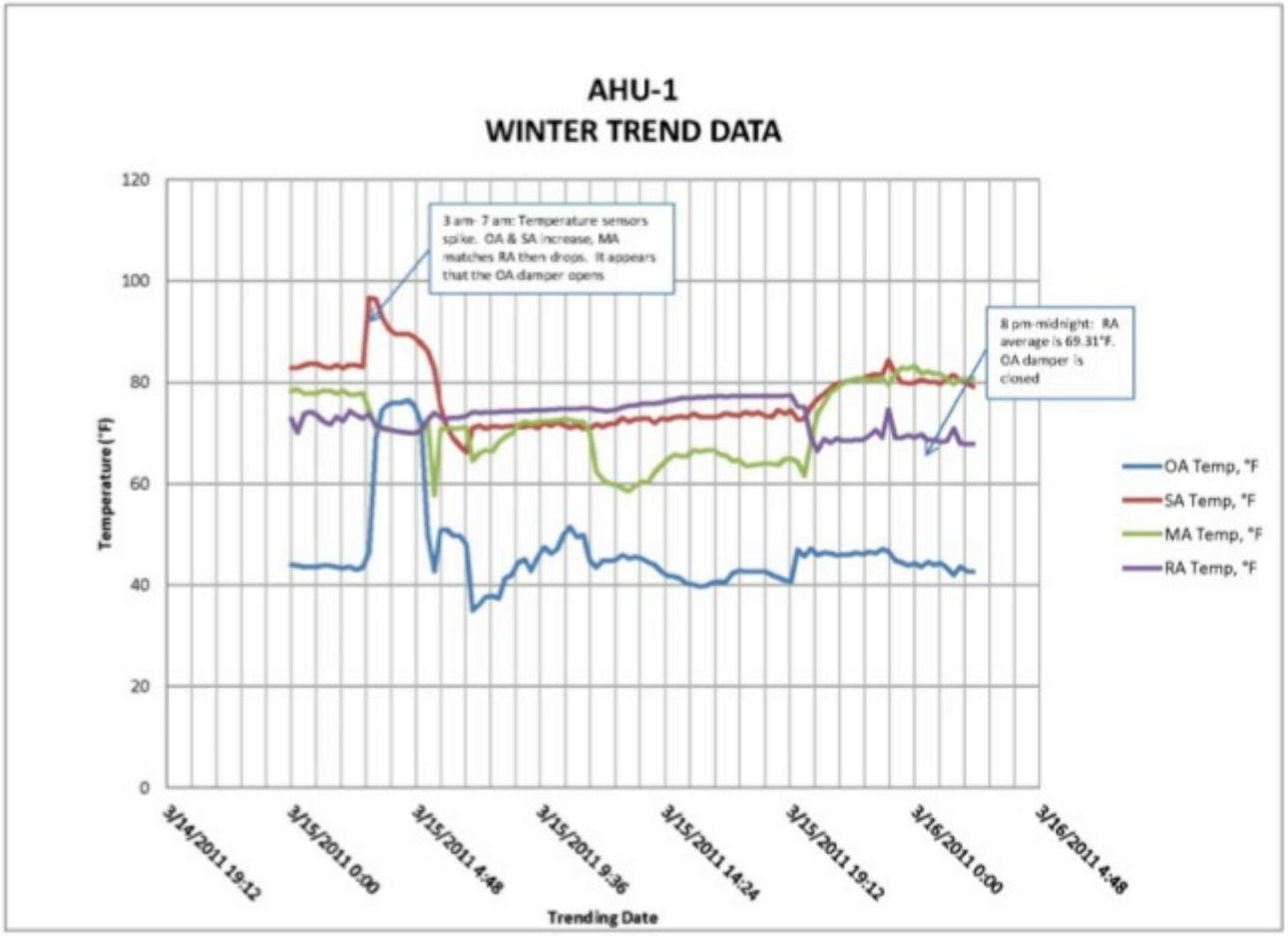
- **ENSURE ENERGY-EFFICIENT OPERATIONS**



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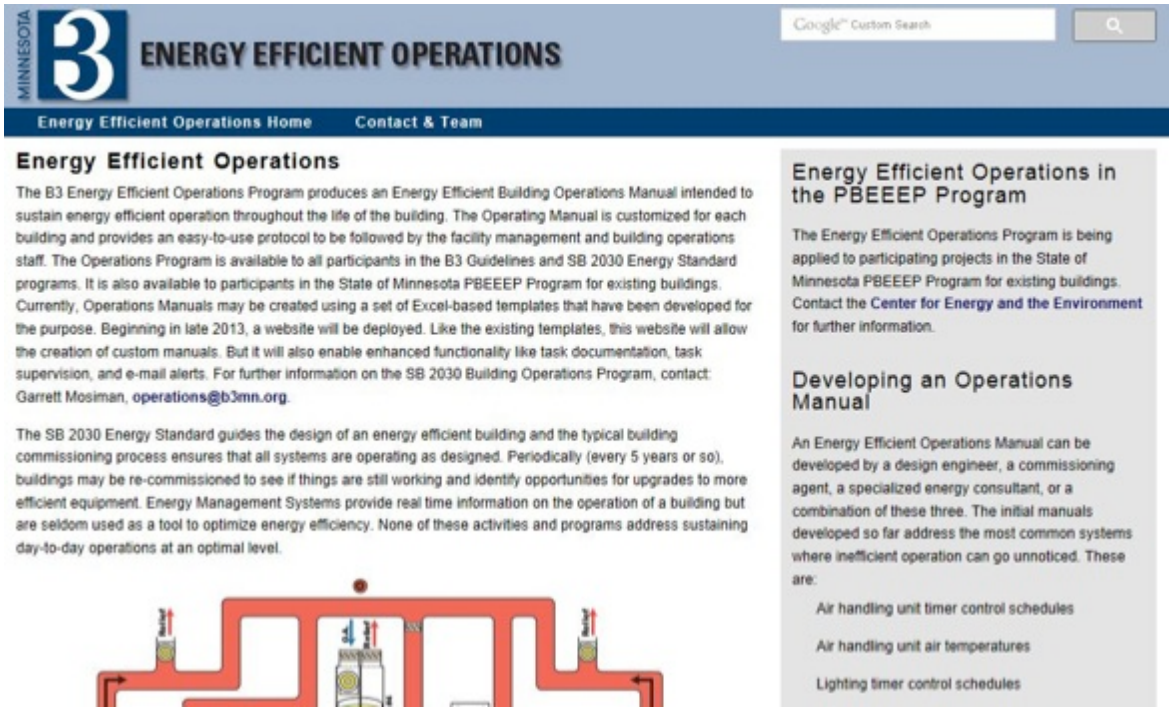
- **ENSURE ENERGY-EFFICIENT OPERATIONS**

B3 ENERGY EFFICIENT OPERATIONS

Follow a Building Operations Manual to manage and reduce energy use



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B3 ENERGY EFFICIENT OPERATIONS

- Problem: 15 to 20% of energy use is wasted and is not detectable by normal operation
- Solution: A practical, cost effective easy-to-use early waste detection method
- The necessary elements of the method are:
  - Knowledge of largest energy wasting systems
  - A simple task to detect waste
  - A calendar to perform the task
  - The capability to correct the problem

USING AN INTEGRATIVE PROCESS TO MEET SB 2030

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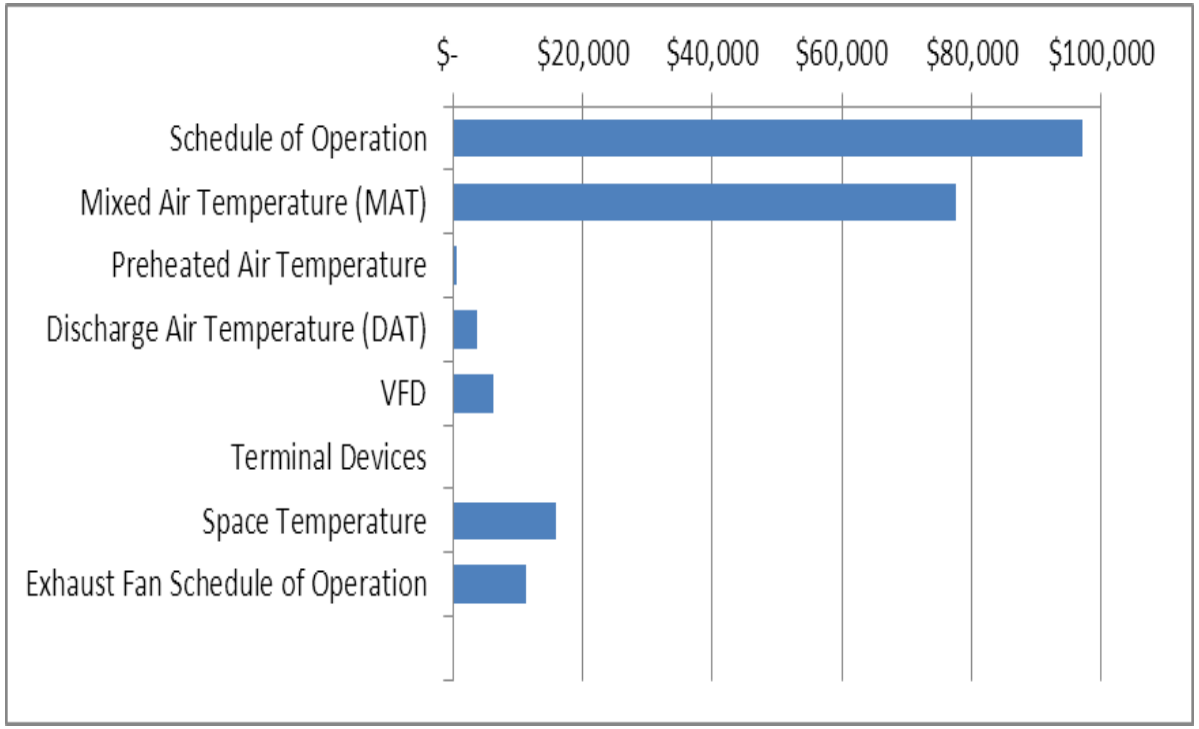
EXISTING BUILDING SAVINGS OPPORTUNITIES

(Based on PBEEP Program)



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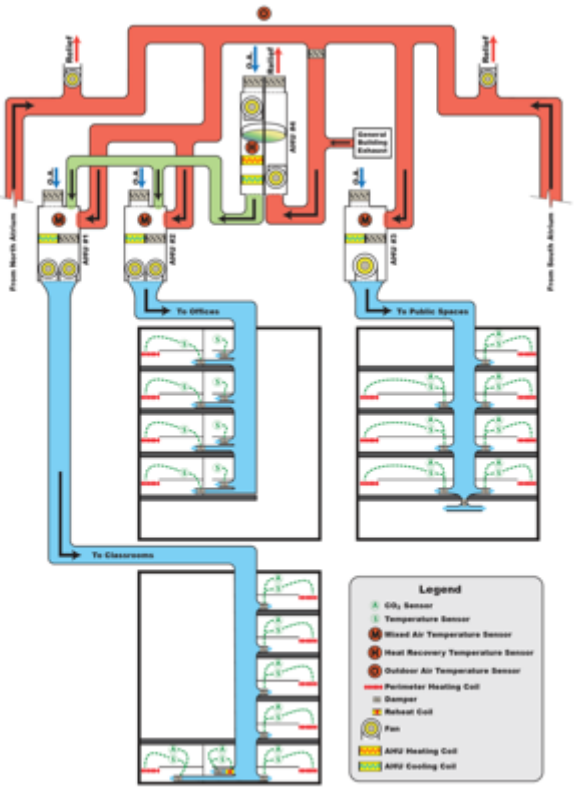
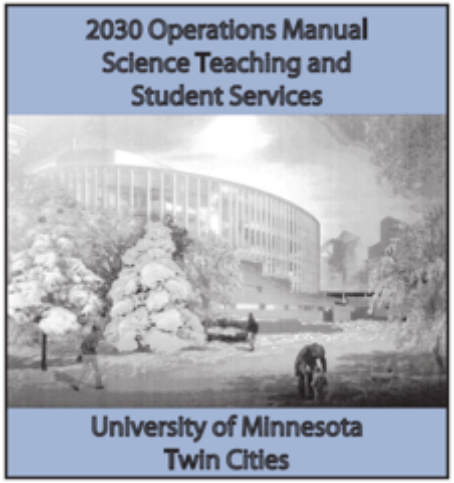


Space Conditioning System Cartoon

Science Teaching and Student Services Building
Univerisity of Minnesota
Twin Cities

SYSTEMS INCLUDED IN OPERATIONS MANUAL

- Lighting schedule
- AHU schedule
- AHU air temp
- Plug loads



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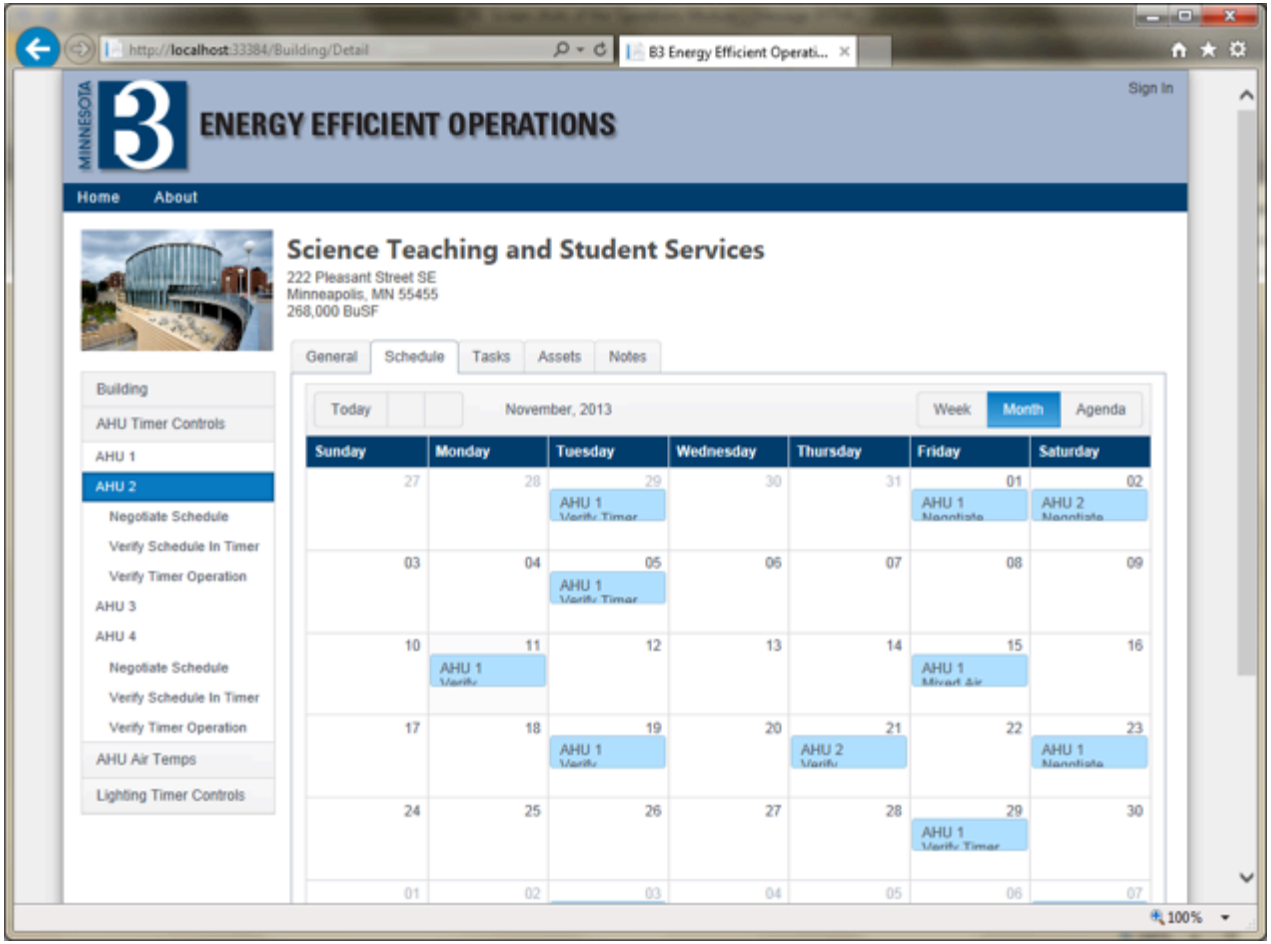
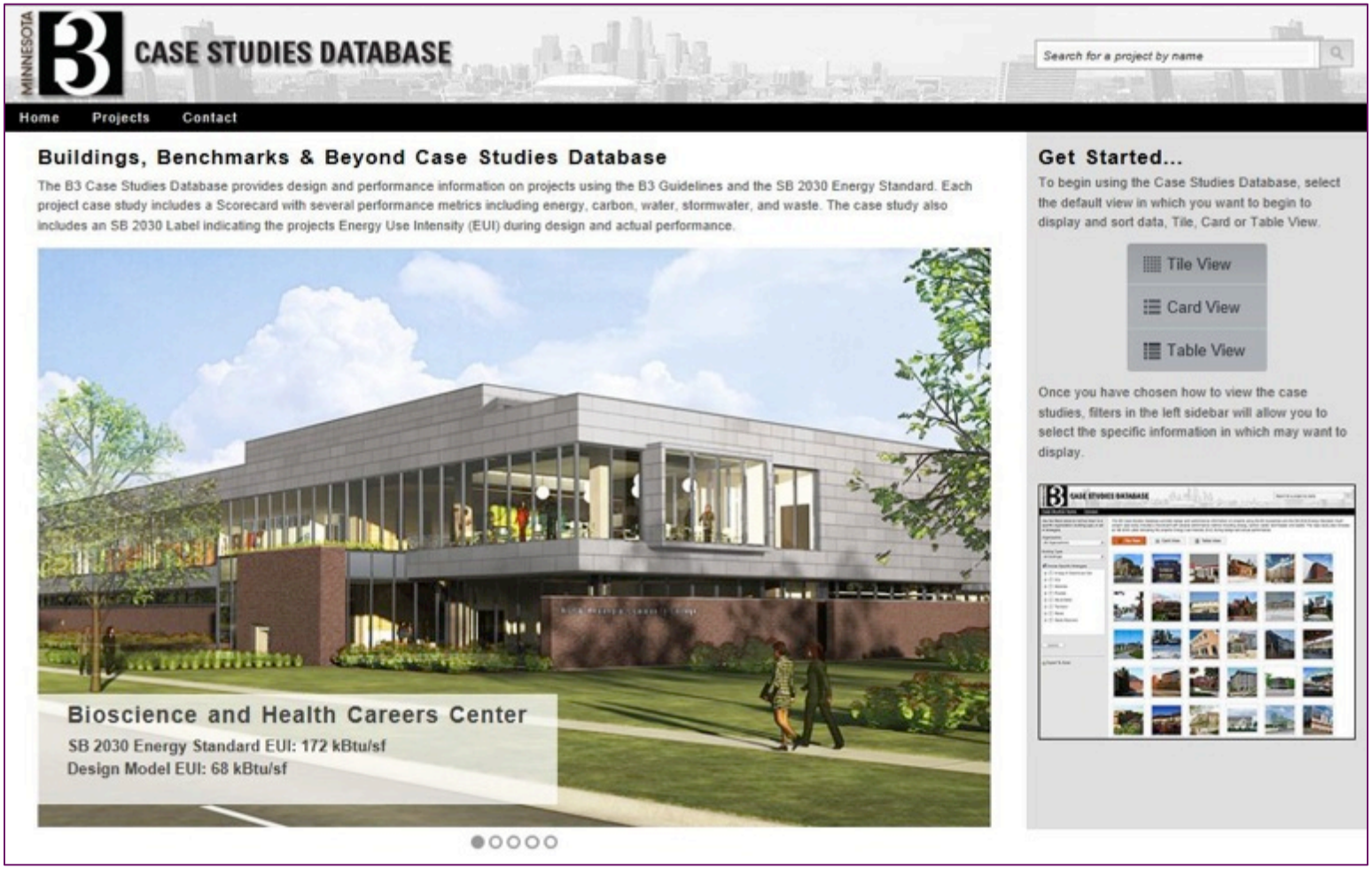


B3 CASE STUDIES DATABASE



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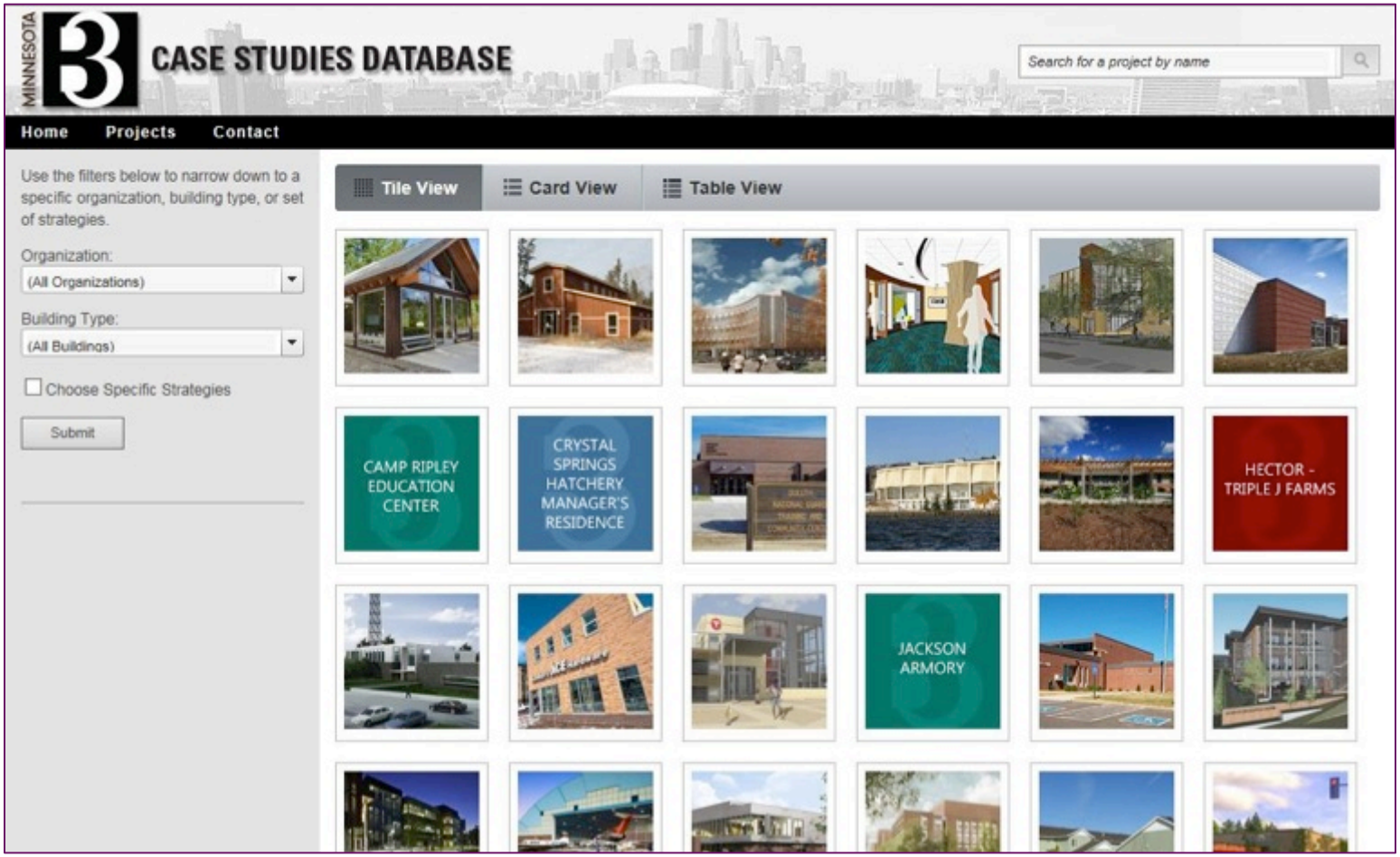

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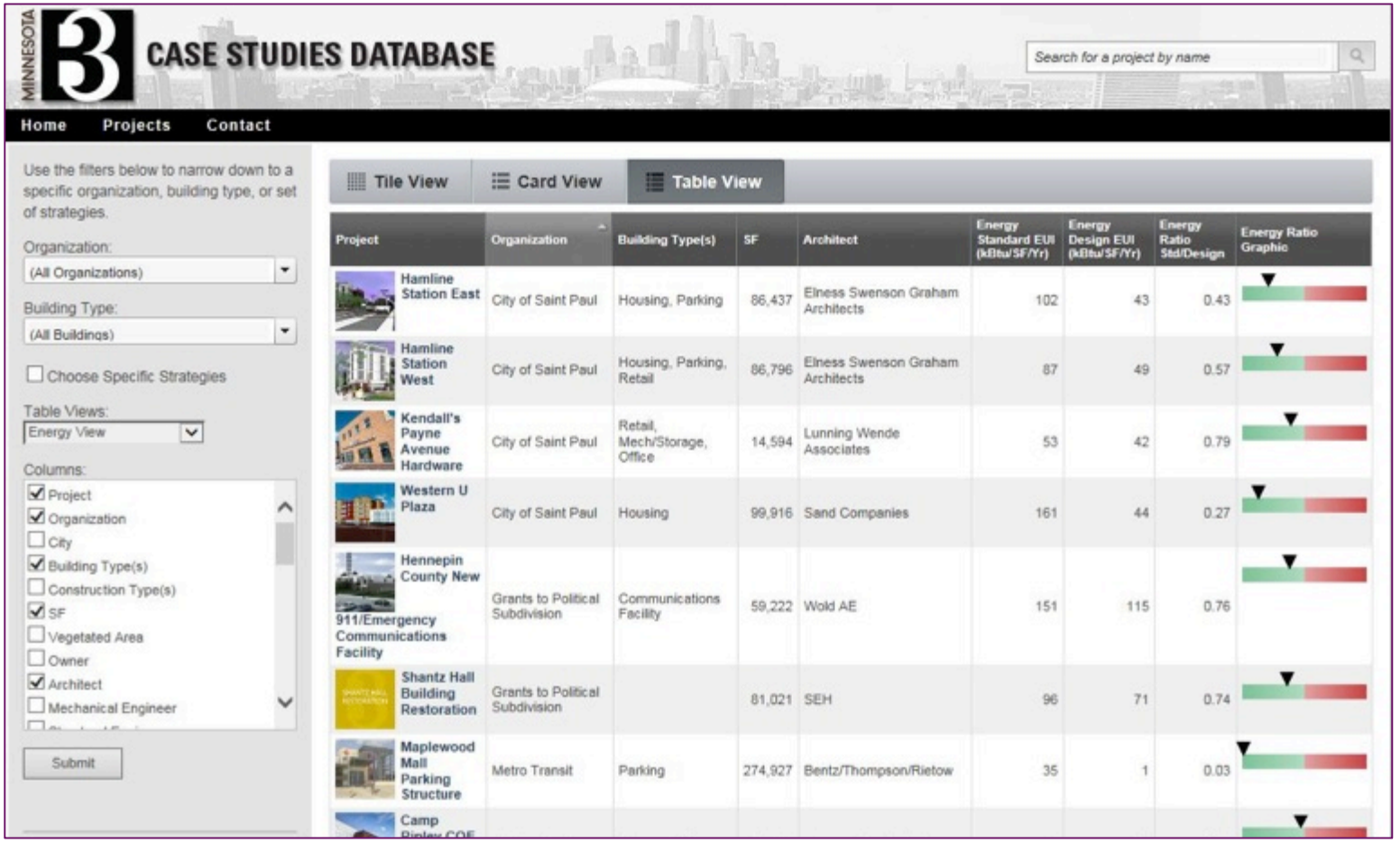

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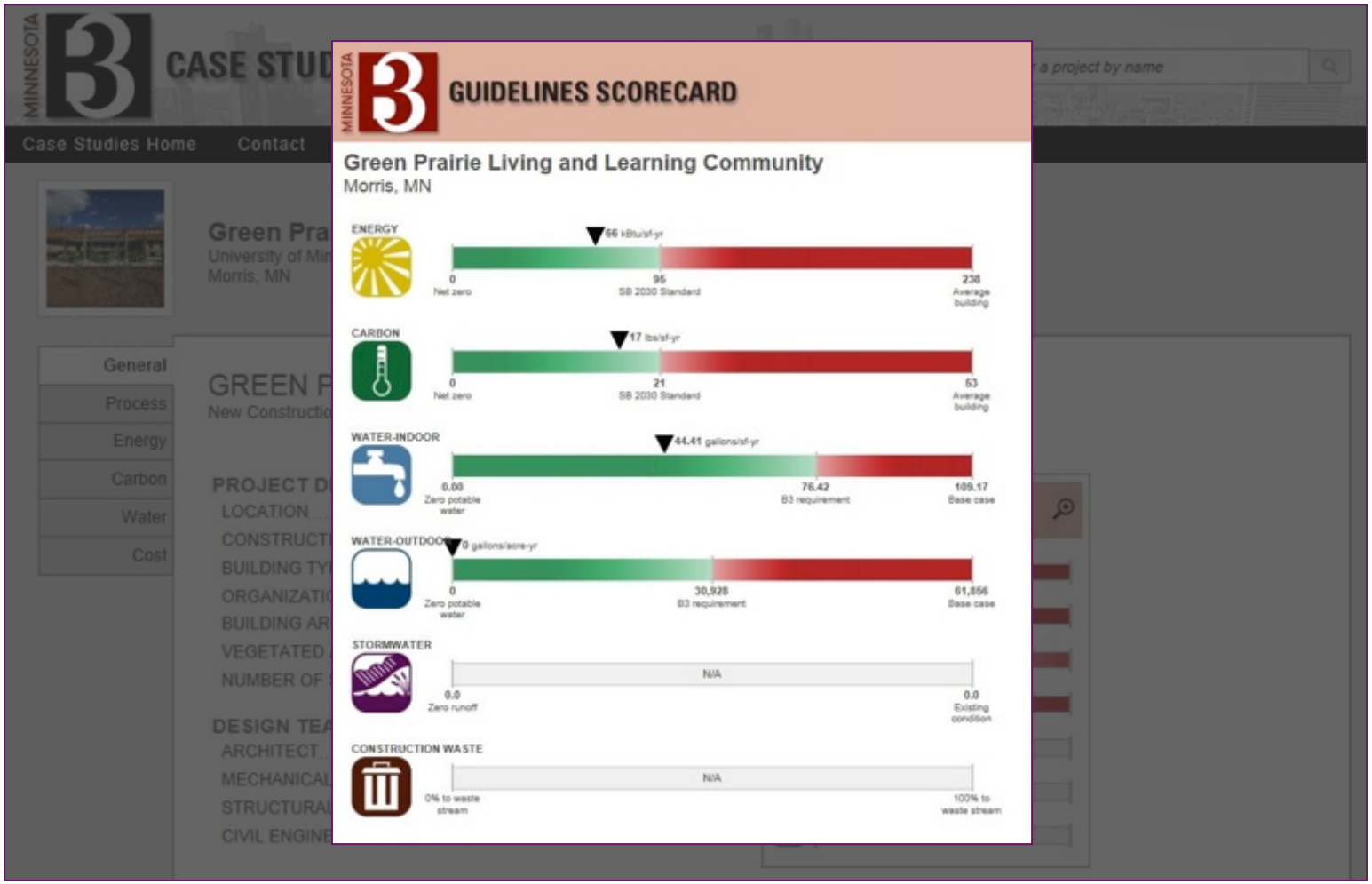
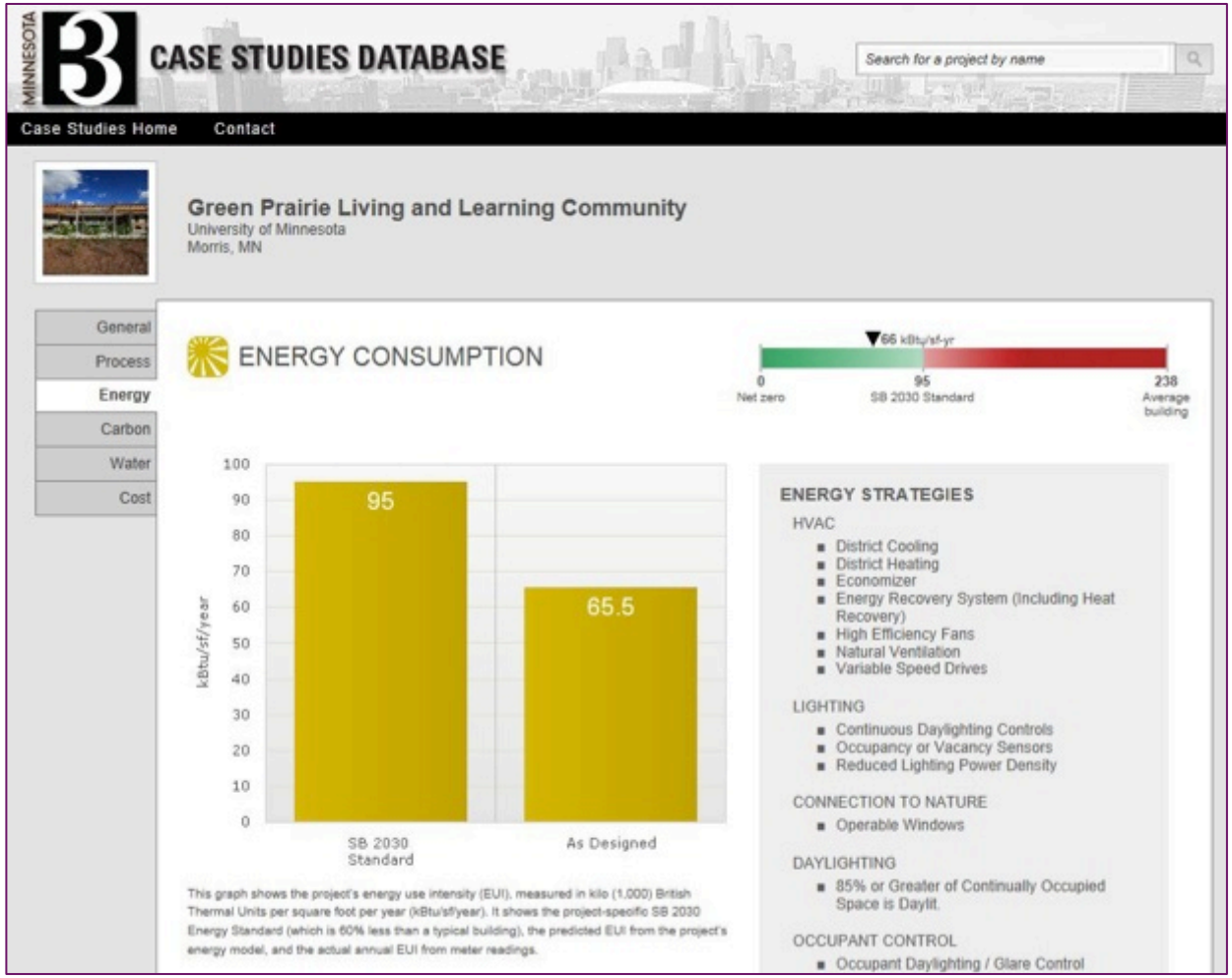


B3 CASE STUDIES DATABASE



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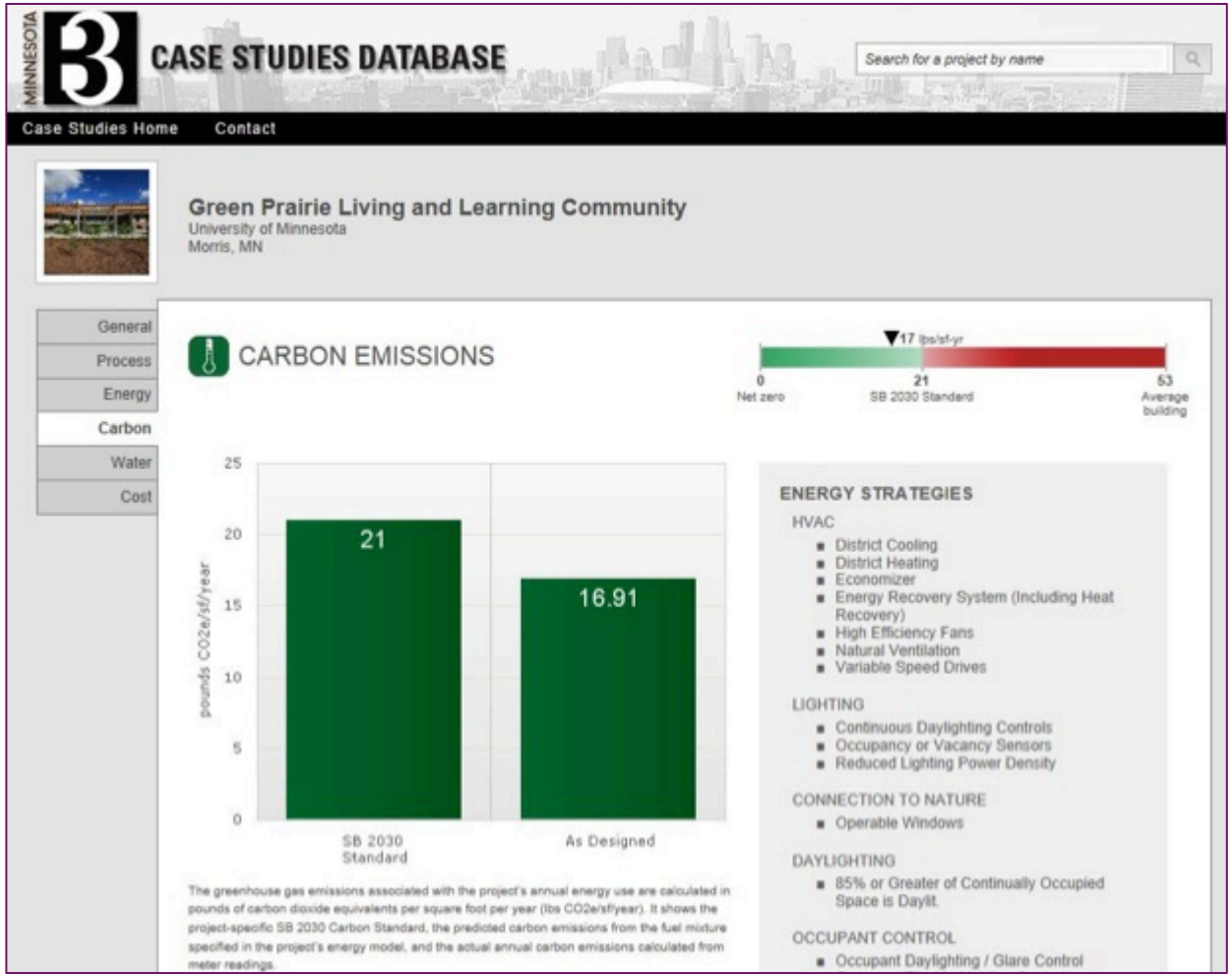

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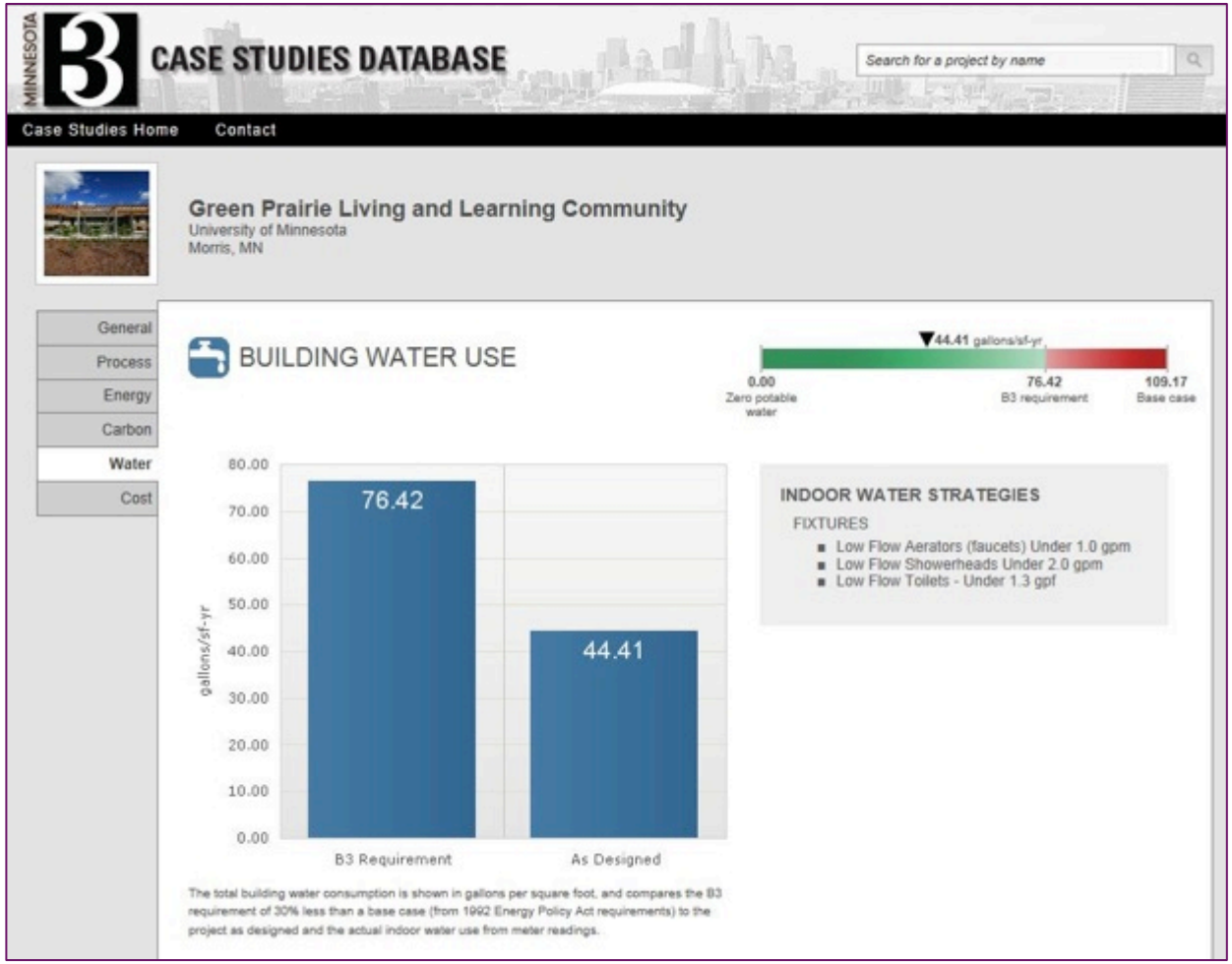

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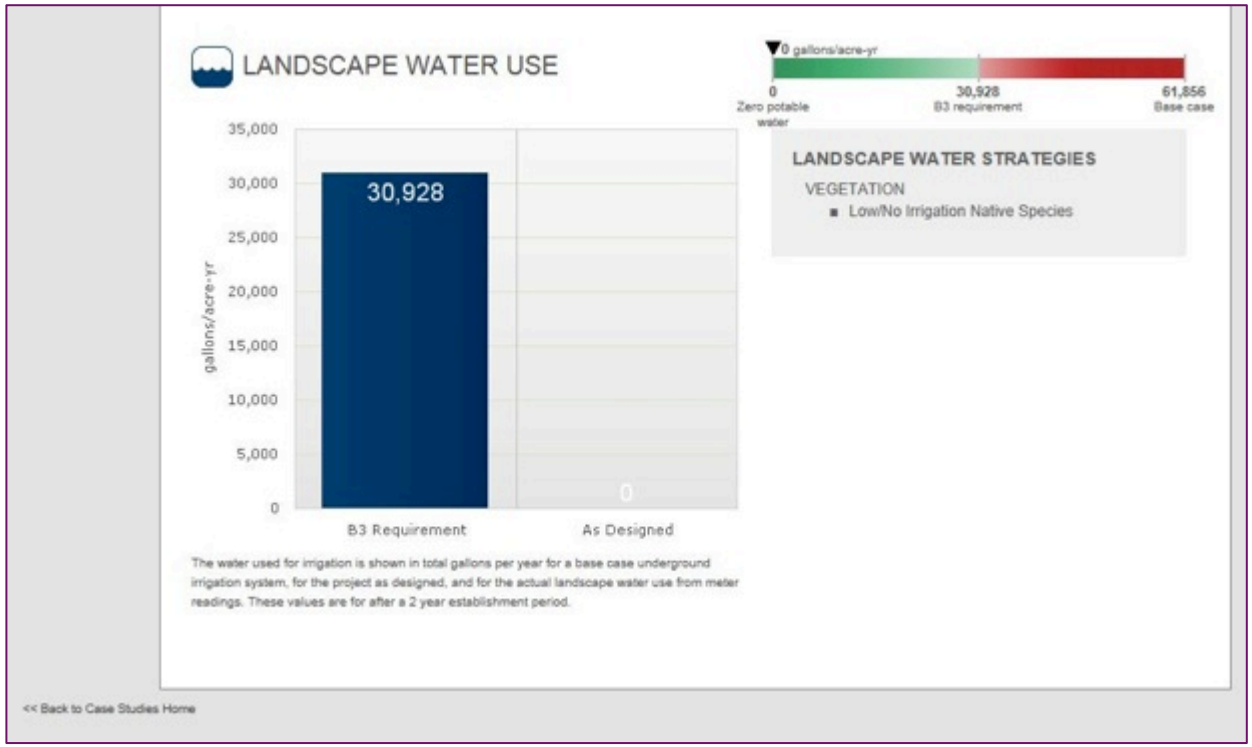


B3 CASE STUDIES DATABASE

RESULTS – SB 2030 PROJECTS











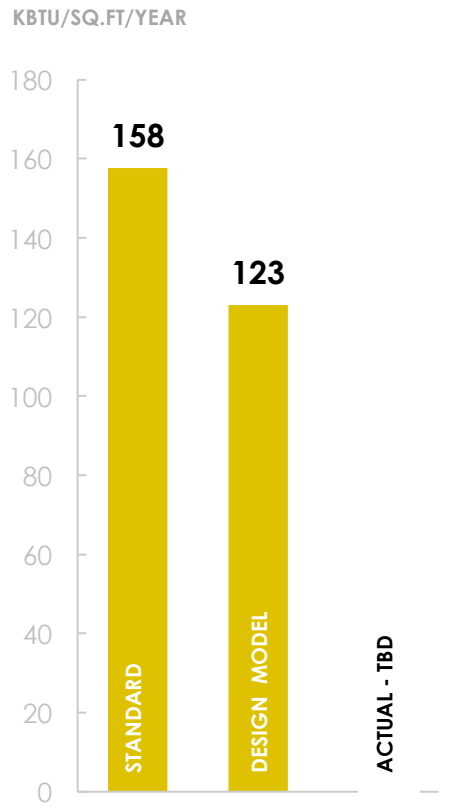




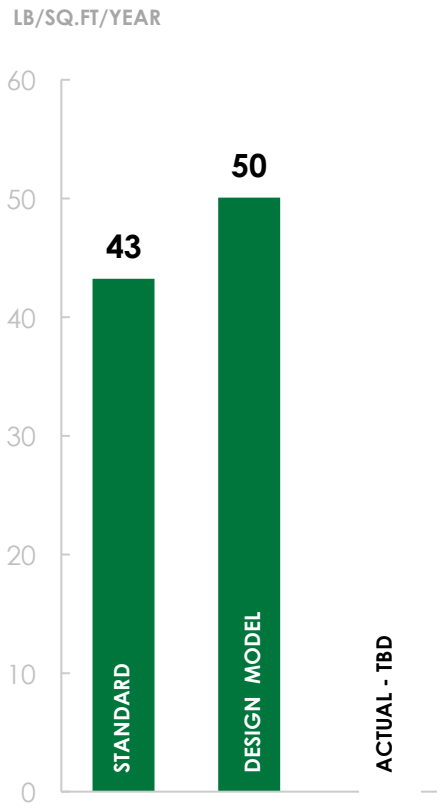


RESULTS - SUMMARY

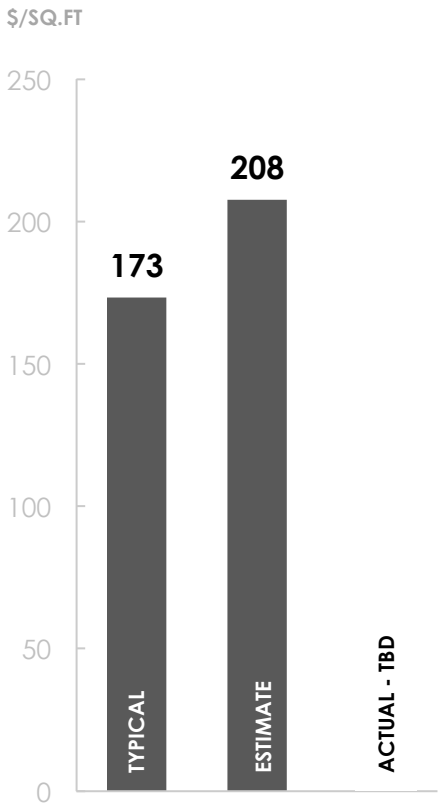
* Mean EUI of all 39 projects, weighted by area
** Mean CO2e of all 39 projects, weighted by area
*** Mean cost of 32 projects with both typical and estimates, weighted by area



ENERG * Y

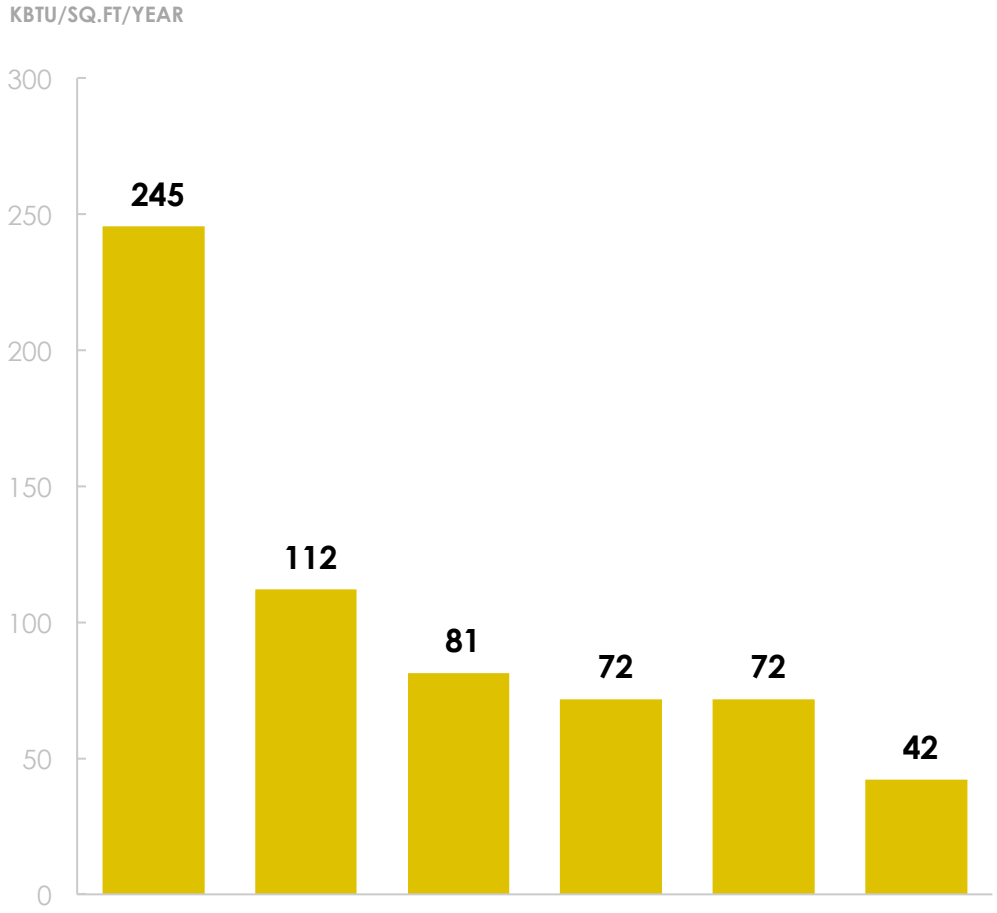


CO_2e **



COST ***

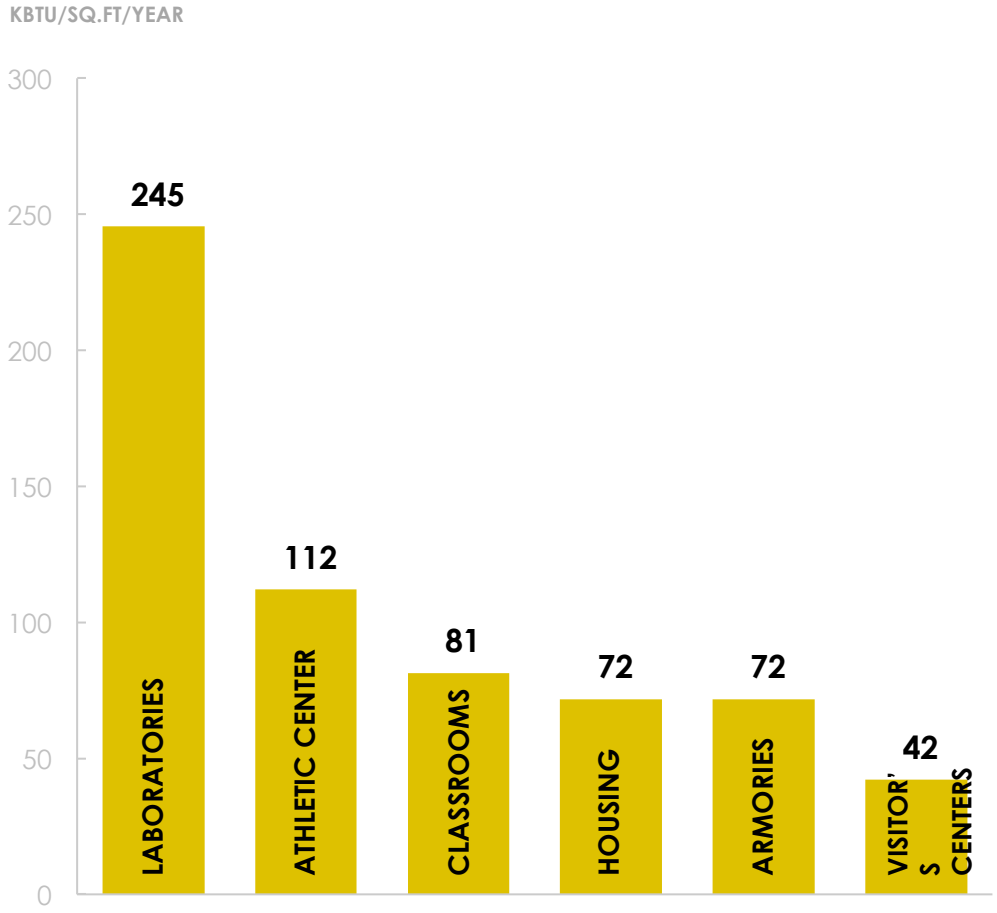
RESULTS – BY BUILDING TYPE



MATCH THE BUILDING TYPE TO ITS AVERAGE DESIGN EUI

- Classrooms (9 projects)
- Laboratories (10 projects)
- Visitor's Center (5 projects)
- Athletic Center (2 projects)
- Armories (6 projects)
- Housing (11 projects)

RESULTS – BY BUILDING TYPE



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- Classrooms (9 projects)
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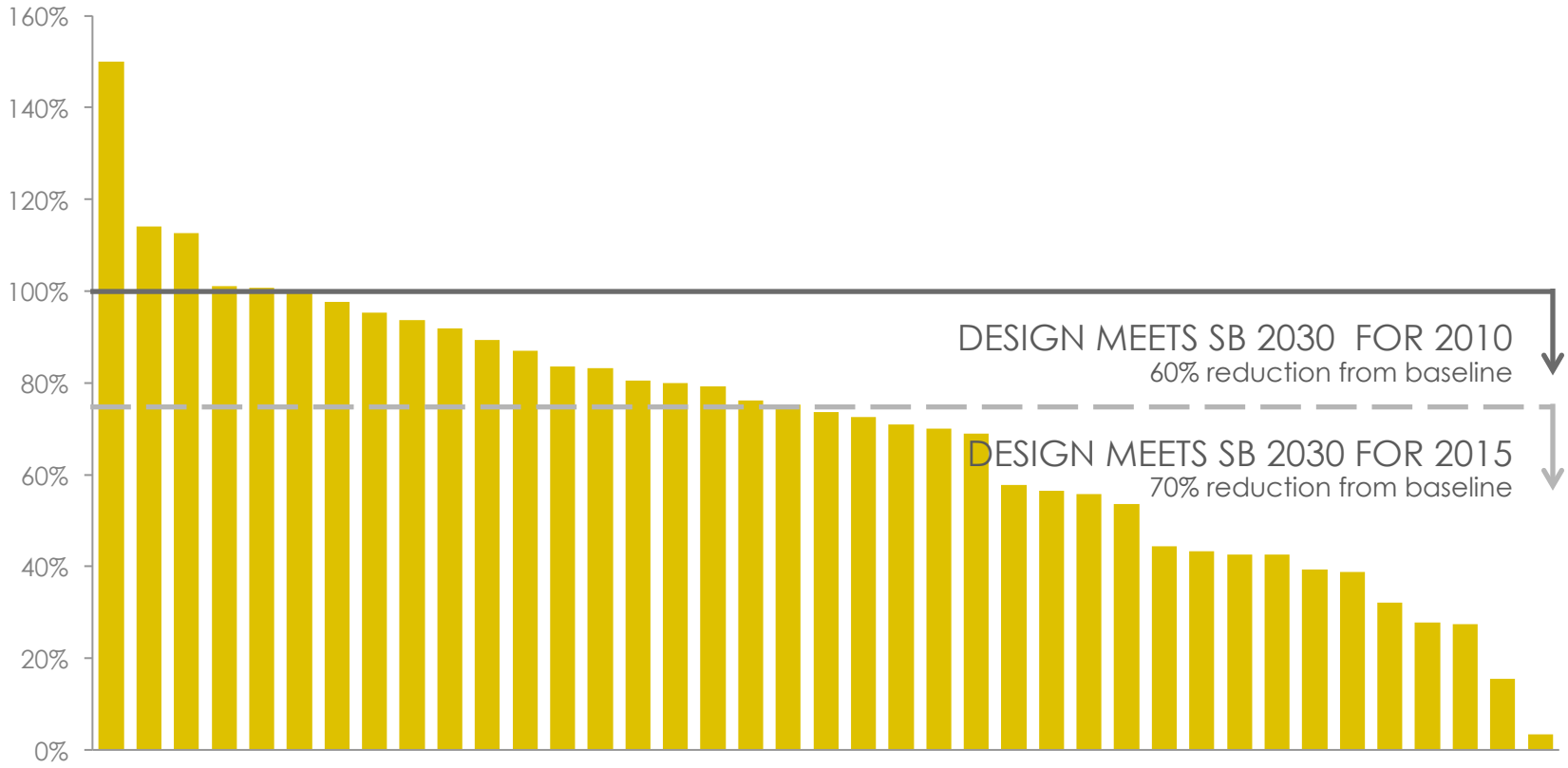
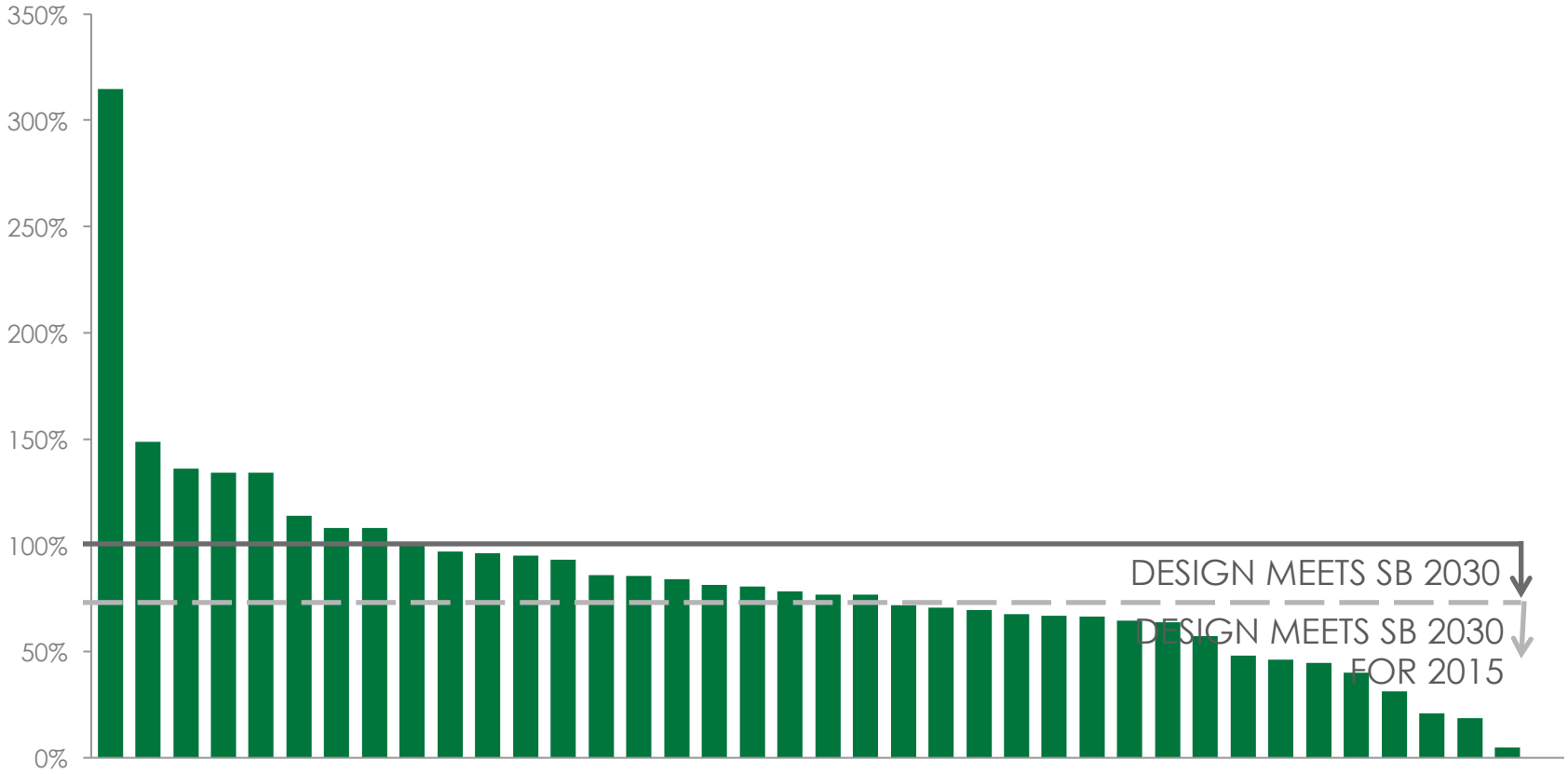
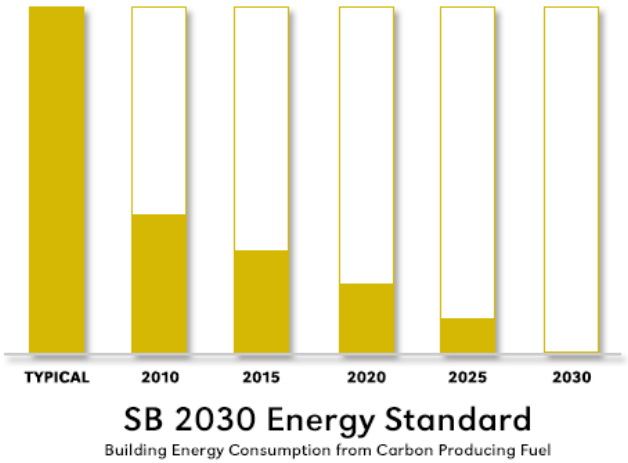
RESULTS – ENERGY (DESIGN/SB 2030 STANDARD)



RESULTS – CARBON DIOXIDE EQUIVALENTS



IMPACT OF B3 PROGRAMS



SB 2030 PROGRAM

- Savings of 327 million kBtus/year
- Savings of $5.24 million per year

B3 BENCHMARKING

- Savings of 2,644 million kBtu per year
- Potential savings of 34.4 million dollars per year

SB 2030 current to July 2014. B3 Benchmarking current to February 2015.

SUMMARY – INTEGRATIVE PROCESS TOOLS

GUIDELINES, STANDARDS, AND RATING SYSTEMS

- B3 Guidelines – P.3 Integrated Design Process
- ANSI/MTS Integrative Process (IP) 2.0 Standard
- LEED v4 – Integrative Process
- Enterprise Green Communities – 1.1a Integrative Design
- Green Globes – 3.1.1 Integrated Design Process

OTHER RESOURCES

- 7group and Bill Reed. *The Integrative Design Guide to Green Building*. Hoboken, NJ: John Wiley & Sons, 2009.
- BC Roadmap to the Integrated Design Process (BC-IDP)
- AIA – Integrated Project Delivery (IPD)

SUMMARY – SB 2030 PROCESS AND TOOLS

DESIGN

SB 2030 ENERGY STANDARD TOOL DOES THIS FOR YOU.

1. Determine the average energy use for comparable buildings

USE BUILDING-SPECIFIC INPUTS IN SB 2030 ENERGY STANDARD TOOL. REFINE THROUGH DESIGN PROCESS.

2. Calculate the SB 2030 Energy Standard
3. Optimize energy use
   - Implement energy reduction strategies

USE EARLY ENERGY MODELING TO INFORM INITIAL DESIGN DECISIONS.

   - Evaluate strategy bundles through energy modeling
4. Evaluate the use of low carbon energy sources

OPERATIONS

1. Perform commissioning

ENTER UTILITY DATA INTO B3 BENCHMARKING MONTHLY.

2. Track actual performance using B3 Benchmarking

UTILIZE B3 ENERGY EFFICIENT OPERATIONS PROGRAM.

3. Ensure energy-efficient operations