D4-71. Pathways to SB 2030: Three Minnesota Case Studies

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consulting engineers

Thursday, November 11, 2021
12:30 – 1:30 pm
Pathways to SB 2030: 3 MN Case Studies
November 11, 2021
Learning Objectives

1) Understand the **SB 2030 Energy Standard program objectives** and **compliance pathways**.

2) Compare and contrast **renewable energy strategies** from the hierarchy of options in SB 2030 that can be incorporated into project planning, design, and development.

3) Provide guidance for project design teams to evaluate **energy efficient envelope** options during project planning and design.

4) Incorporate **decarbonization strategies** into project planning, design, and development to ensure energy and carbon reductions in building operations.
B3/SB 2030 Programs and Tools

**PREDESIGN**
- Establish project-specific performance requirements.

**DESIGN**
- Refine project-specific performance requirements.
- Optimize use of resources to achieve performance requirements.
- Evaluate success of design strategies through early and repeated modeling.

**CONSTRUCTION**
- Implement construction practices that meet performance requirements.

**OPERATIONS**
- Ensure project is meeting performance requirements.
SB 2030

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

*from a baseline of representative buildings in existence in 2003

Reduction targets are now the same for new construction and renovations
Calculate the SB 2030 Standard.

Establish appropriate project budget.

Conduct energy modeling to ensure project meets the Standard.

Determine on-site target based on cost-effectiveness of energy efficiency and on-site renewables. Evaluate off-site renewable options as necessary.

Implement construction practices that meet performance requirements.

Track and report annual energy use through B3 Benchmarking.
Energy Hierarchy

- Energy efficiency
- On-site/on-campus renewables
- In-portfolio renewables
- RECs

Cost-effectiveness test
Example

- Maximize use of energy efficiency and on-site renewables

- Off-site renewables can be used to get the rest of the way to the SB 2030 Standard
Alternative Compliance Paths

- **Small Buildings Method**: a prescriptive approach available for projects under 20,000sf

- **Partial Mechanical Upgrades**: an alternative approach for renovations that are not replacing the full mechanical systems

- **Wastewater Treatment Facilities**: a process that includes benchmarking existing facility, documenting potential energy conservation measures, and providing anticipated performance metrics
Energy Standard Tool

- Calculates SB 2030 Standard using basic project information
- Can produce a design model for SB 2030 compliance
- Incorporates renewable energy generation
- Includes cost-effectiveness test
SB 2030 Analysis

DESIGN

- AVERAGE BUILDING: 243 kBTU/sf-year
- SB 2030 STANDARD: 121 kBTU/sf-year
- DESIGN: 89 kBTU/sf-year

SB 2030 v. Operational Energy

Predicted v. Operational Energy
# B3 Case Studies Database

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>City</th>
<th>Building Type(s)</th>
<th>Construction Type</th>
<th>Building Area (sf)</th>
<th>Occupancy Date</th>
<th>Design Energy - SB 2030 Standard (kBTU/sf-yr)</th>
<th>Design Energy - Design (kBTU/sf-yr)</th>
<th>Design Energy - Ratio (Design/Standard)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple Valley Bus Layover Facility</td>
<td>Minnesota Valley Transit Authority</td>
<td>Apple Valley</td>
<td>Transit Facility</td>
<td>New Construction</td>
<td>509</td>
<td>1/15/2015</td>
<td>204</td>
<td>62</td>
<td>0.30</td>
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<tr>
<td>Hennepin County Library - Brooklyn Park</td>
<td>Voluntary</td>
<td>Brooklyn Park</td>
<td>Library</td>
<td>New Construction</td>
<td>39,385</td>
<td>8/30/2016</td>
<td>70</td>
<td>29</td>
<td>0.41</td>
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<tr>
<td>Bemidji Regional Public Television Station</td>
<td>Minnesota Department of Employment and Economic Development</td>
<td>Bemidji</td>
<td>Television Station, Office</td>
<td>New Construction</td>
<td>16,789</td>
<td>3/3/2015</td>
<td>116</td>
<td>49</td>
<td>0.42</td>
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<tr>
<td>The Hormel Institute Medical Research Center</td>
<td>Minnesota Department of Employment and Economic Development</td>
<td>Austin</td>
<td>Laboratory</td>
<td>New Construction</td>
<td>63,700</td>
<td>6/1/2016</td>
<td>300</td>
<td>132</td>
<td>0.44</td>
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<tr>
<td>UMTC Mechanical Engineering Infrastructure</td>
<td>University of Minnesota</td>
<td>Minneapolis</td>
<td>Laboratory, Office, Classroom</td>
<td>Renovation</td>
<td>144,000</td>
<td>9/1/2019</td>
<td>305</td>
<td>136</td>
<td>0.45</td>
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<tr>
<td>Wells Street Houses</td>
<td>City of Saint Paul</td>
<td>Saint Paul</td>
<td>Housing</td>
<td>New Construction</td>
<td>17,241</td>
<td>1/6/2015</td>
<td>70</td>
<td>31</td>
<td>0.45</td>
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</table>

[casestudies.b3mn.org](casestudies.b3mn.org)
University of Minnesota Clinical Research Facility
University of Minnesota Clinical Research Facility

Image: Tardis by Babbel1996
Program Summary
University of Minnesota Clinical Research Facility
Program Elements
University of Minnesota Clinical Research Facility

Organizing Principles: Modules

Clinical Modules

Office Modules

Lab Modules
University of Minnesota Clinical Research Facility
Site Access for Vehicles and Pedestrians (View from Southeast)
University of Minnesota Clinical Research Facility
Site Access for Vehicles and Pedestrians (View from Northwest)
Energy and Atmosphere
### E.1 Energy Use
#### E1A. Meet SB 2030 Energy Standards

Fields in yellow are editable. Fields in blue are calculated. Fields in gray are not applicable or disabled at this phase.

If you are requesting to use the Small Buildings Method or other alternative path please contact guidelines@b3mn.org as soon as possible to begin the review process to verify specific path requirements and in order to enable the alternate path tracking tool entries. Data collected as part of the B3 and SB 2030 programs will be publicly accessible, including on the B3 Case Studies Database.

E1A2A. Click here to download the MN SB 2030 Compliance and Reporting Instructions

**E1A3B. Which method are you using to calculate your Energy Standard?**

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**E1A5K. SB2030 Energy Standard**

Note: Design Energy and Design Carbon Emissions values are referenced from consumption information collected in E.1D. Please provide consumption data before attempting compliance with E.1C in the Design and Final Design submissions.

<table>
<thead>
<tr>
<th>Design Energy Use per Square Foot</th>
<th>Design Total Energy Use</th>
<th>Design Energy Standard Carbon Footprint</th>
<th>Design Carbon Emissions per Square Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 kBtu/s.f./yr.</td>
<td>0 kBtu/yr.</td>
<td>17 lb.CO2e/s.f./yr.</td>
<td>0 lb.CO2e/s.f./yr.</td>
</tr>
</tbody>
</table>
University of Minnesota Clinical Research Facility
Energy Conservation Measures: HVAC Strategies

DOAS

Enhanced zoning, control for occupancy

Heat Recovery Chiller

CO₂ control

Active chilled beam

Radiant slab

Chilled/heated panels or sails

Displacement Ventilation

Image: Affiliated Engineers, Inc.
University of Minnesota Clinical Research Facility
Energy Conservation Measures: Run Around Loop
University of Minnesota Clinical Research Facility
Renewable Energy: UMN Solar

Image: Frank Jossi
Indoor Environmental Quality
Site and Water
University of Minnesota Clinical Research Facility
Future Land Use: 30 Year Horizon
University of Minnesota Clinical Research Facility
Stormwater Management
University of Minnesota Clinical Research Facility

Mississippi Flyway

Rufa Red Knot

Piping Plover

Mississippi Flyway

Images: Perky Pet, USFWS
University of Minnesota Clinical Research Facility

Bird Safe Glazing

Images: Viracon
What’s Next
University of Minnesota Clinical Research Facility
Existing Site Campus Diagram

Health Discovery Hub
Clinical Research for Answers + Better Health
Thank you to the University of Minnesota
Thank you to our partner ZGF and the entire team:

AEI
EVS
Damon Faber
MBJ
Walker Consultants

4RM+ULA
Kvernstoen, Rönnholm & Assoc.
Lerch Bates
Rippe Associates
CommonBond Highland Bridge
Matthew Finn, AIA
Highland Bridge Plan

Walkable neighborhood
Commercial corridor
River access
New public park
## PROJECT TEAM

<table>
<thead>
<tr>
<th>Role</th>
<th>Entity</th>
</tr>
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<tbody>
<tr>
<td>Owner</td>
<td>CommonBond</td>
</tr>
<tr>
<td>Architect</td>
<td>LHB</td>
</tr>
<tr>
<td>MEP engineer</td>
<td>Cain Thomas</td>
</tr>
<tr>
<td>Energy model</td>
<td>Cain Thomas</td>
</tr>
<tr>
<td>General Contractor</td>
<td>Ryan Companies</td>
</tr>
<tr>
<td>EDA program</td>
<td>Willdan</td>
</tr>
<tr>
<td>SB 2030 support</td>
<td>CSBR, w/ CEE</td>
</tr>
</tbody>
</table>

Rendering by Ryan Companies
APPROACH

Strategies identified for analysis:

Continuous insulation
Increased roof insulation
Window U-factor
Enhanced efficiency HVAC
Photo voltaic array
VerIFICATION

Continuous insulation
Baseline: 2x8 w/ batts
Enhanced: 3" mineral wool over 2x8 w/ batts

Roof insulation
Baseline: R-40
Enhanced: R-50
VERIFICATION

Window performance

Triple pane
U  0.22
SHGC  0.44

Double pane
U  0.27
SHGC  0.28
Enhanced efficiency HVAC in dwelling units
VRF, DOAS with full energy recovery

Magic pak

Air-source heat-pump with backup electric radiant

2-pipe fan coil fed by boiler and split dx cooling
VERIFICATION

Photovoltaic array on roof
40kw
Matched common area loading

Payback:
11 years with tax incentive
16 years without tax incentive
Windows:
Energy star for northern climates
U = 0.27, SHGC = 0.28

Walls
U = 0.051, code compliant 2x8 w/ batts in cavity

Roof
R-50 average, all above vapor barrier
Mechanical strategies

All-electric dwelling unit HVAC
Terminal equipment: Fan coil
Heating: Air-source heat-pump, electric radiant
Cooling: Air-source heat-pump
Fresh air: Duct from exterior into return air
Exhaust: Ducted range hood & bath exhaust

Common area HVAC:
High efficiency gas furnaces, High-SEER dx cooling, Electric unit heaters
Electrical & Plumbing strategies

**Hot water:**
95 eff. Gas-fired domestic water heaters, very low flow fixtures throughout

**Lighting:**
All LED fixtures
Occupancy sensors

**Appliances:**
Energy star appliances
Balance: efficiency, renewables, REC’s

12-year payback
Fan-coil, standard wall, double-pane window

On-site renewables
Very close, 15 years without tax incentives, 10 years with.
PV ready, with an alternate written into documents

Renewable energy credits
Estimated at roughly $20,000
20 kbtu/sf/year delta (42 proposed, 22 target)
Past projects  |  Looking forward

**HVAC:**
Still see plenty of HE magic paks, the system here shows a lot of promise.

**Envelope:**
Typical 4-story projects with Minnesota Housing funding will be required to use continuous insulation in 2022.

**Renewables:**
We were seeing some PV; commodities market is chewing up contingency funding.

**Dorothy Day Place:**
Very different, larger, large open spaces, mixed program, district energy, full ERV, chilled beams, all continuous insulation.

**Stryker Apartments:**
Very similar, 3 fan coils / condenser, owner-paid electric utility, commercial elec rate

**Simpson:**
Similar size, very different program, mixed program, pursuing funding for geothermal with every finger and toe crossed
Pathways to SB2030

Lessons from West Side Flats, St. Paul, Minnesota

A'21MN Conference
November 11, 2021
site plan

PATHWAYS TO SB2030: LESSONS FROM WEST SIDE FLATS
content © precipitate and kaas wilson 2021
passive house methodology (PHIUS)

**PASSIVE STRATEGIES**
REDUCE ENERGY DEMAND

- Airtight Envelope
- Super Insulated / Thermal Bridge Free
- High Performance Windows & Doors

**ACTIVE STRATEGIES**
MEET ENERGY DEMAND

- Energy Recovery
- Efficient Systems
meeting the targets: annual energy use

site | kBtu/GSF/year

Baseline: 21
2030 Target: 20
Remain: 12
Pre-Certified: 12
Solar: 12
W/ Solar: 12

80% reduction
74% reduction
85% reduction

27
W/OUT Solar

Meeting the targets: annual energy use

Site | kBtu/GSF/year

Baseline: 21
2030 Target: 15
Remain: 12
Pre-Certified: 12
Solar: 12
W/ Solar: 12

80% reduction
74% reduction
85% reduction

27
W/OUT Solar

Meeting the targets: annual energy use
project metrics

Occupants 227
GSF 97,519
iCFA 93,010
Envelope Area 88,068
Envelope Area / iCFA 0.95
iCFA / person 410
energy targets

WITHOUT SOLAR

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Heating demand</td>
<td>4.72 kBtu/ft²/yr</td>
</tr>
<tr>
<td>Cooling demand</td>
<td>3.77 kBtu/ft²/yr</td>
</tr>
<tr>
<td>Heating load</td>
<td>4.68 Btu/hr ft²</td>
</tr>
<tr>
<td>Cooling load</td>
<td>2.64 Btu/hr ft²</td>
</tr>
<tr>
<td>Source energy</td>
<td>8,017 kWh/Person yr</td>
</tr>
<tr>
<td>Site energy</td>
<td>29.86 kBtu/ft²/yr</td>
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</table>

WITH SOLAR

<table>
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<td>Cooling load</td>
<td>2.64 Btu/hr ft²</td>
</tr>
<tr>
<td>Source energy</td>
<td>3,700 kWh/Person yr</td>
</tr>
<tr>
<td>Site energy</td>
<td>17.02 kBtu/ft²/yr</td>
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</table>

screenshots from WUFI Passive
**Project Challenges**

- **Timeline**
- Passive House comes late to the table
- Starts and Stops (financing)
- Type IIIIB Construction above a Podium

Fire treated lumber

5 stories, so NFPA 285 testing required

- This was the first Passive House project for the Architect, Engineer, and Contractor
collaborative design workshops
passive house envelope: first floor
passive house envelope: garage
passive house envelope
Steel deck connection

Importance of CPHC on design team - and CPHC also reviewing site observation reports.
window details

8800 - Fiberglass Window Flashing

Head/Jamb/Sill

3" = 1'-0"

Tear Away Bead
Sealant
Min expanding foam insulation and sealant along entire perimeter of window frame - not below window frame
Interior air seal
TIP rough sill to provide positive slope to exterior - shim to keep sill sloped & window level

Window w/ nailing fin
No sealant behind nailing fin at sill, no tape over nailing fin at sill
Self adhered membrane sill flashing - under window & down front face of wall, extend across sill and up jambs to overlap jamb flashing by 6" min each side
Wrap air & vapor barrier membrane over sill flashing & seal
Air & weather barrier - cut along sill at rough opening
Air & vapor barrier - install 3M 3015 Ultra conformable flashing to tie into rough opening
typical unit hvac plan

water source heat pump
loop water system
energy recovery system (erv)