Goals That Stick: Rallying Project Teams around Building Performance

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Curated by Richard Lo (Kaplan Thompson) and Amanda Garvey (Thornton Tomasetti)

Northeast Sustainable Energy Association (NESEA)
March 1, 2022
AGENDA

1. Intro: examining goal-setting as a tool in high-performance design
2. Case Studies: stories of goal-setting and follow-through in service of design excellence
3. Your Feedback: performance goals survey
4. Moderated Discussion: industry feedback on how to set goals that lead to highly successful outcomes
5. Audience Q+A
Icebreaker

Go to www.menti.com and use the code 6657 1454

In a few words, what are you most excited about at BuildingEnergy Boston 2022?
Intro: examining goal-setting as a tool in high-performance design
Why We are Here

The problem:
Many building industry professionals are experiencing a plateau in the journey to minimize the negative impact of our work on the planet.

The hypothesis:
Clearly communicated, quantifiable performance goals with buy-in from across the team boost projects to realize their maximum potential for high-performance design.
Common Barriers

- Inadequately ambitious goals or missed opportunities leveraging the full capacity of the team in goal setting.
- Overly ambitious goals; it is taken for granted that they are “reach” goals, and it is assumed they won’t be met.
- Too many goals results in no clear, shared team target
- Lack of sustained commitment. Goals erode over time due to inadequate buy-in and belief that there is a real intention to achieve them.
- Project team members frequently don’t buy into the goals of other team members, may be singularly focused on their individual goals
Proliferation of Goal Drivers
The Question

How can we as design and construction industry professionals become better at setting goals that are ambitious, achievable, design drivers that lead to the highest possible performance outcomes?
Case Studies
Goals That Stick: Rallying Project Teams around Building Performance
NESEA Building Energy Boston 2022
1 March 2022
Erik Olsen, PE
School of Design and Environment – National University of Singapore
Architect: Serie, London + Multiply, Singapore
MEP and Architect of Record: Surbana
Client Mandate

Net Zero Energy
TYPICAL PRODUCTION ROOF
260 kWh/m²a

OFFICE, AVERAGE EUI
252 kWh/m²a

OPTIMIZED BUILDING
70 kWh/m²a
Design Studio 4th floor

<table>
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<th>2m</th>
<th>3m</th>
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% of operation hours operative temperature exceeding 29 °C (hybrid system)

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<tr>
<th>50/25</th>
<th>51%</th>
<th>34%</th>
<th>18%</th>
<th>7%</th>
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glare potential (over 1000 lx; @3m); hours of exceeding in relation to operation hours

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<th>84%</th>
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spatial Daylight Autonomy (sDA_{300lx/50%})

<table>
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<tr>
<th>50/25</th>
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<th>100%</th>
<th>100%</th>
<th>99%</th>
<th>92%</th>
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</thead>
</table>
Comfortable Comfort

Full AC

operative temperature
75°F

Comfortable Comfort

operative temperature
84°F

tempered air + elevated air speed
Reaching Net-Zero

- **Ref. Building**: 1947 MWh/a
  - Plug Loads: 209
  - Light: 112
  - Auxiliary: 369
  - Mechanical Ventilation: 821
  - FCU: 436

- **Opt. Envelope**: 1602 MWh/a
  - Plug Loads: 209
  - Light: 112
  - Auxiliary: 329
  - Mechanical Ventilation: 821
  - FCU: 130

- **High efficient A/C system**: 1200 MWh/a
  - Plug Loads: 209
  - Light: 112
  - Auxiliary: 305
  - Mechanical Ventilation: 444
  - FCU: 130

- **Hybrid system**: 820 MWh/a
  - Plug Loads: 209
  - Light: 112
  - Auxiliary: 177
  - Mechanical Ventilation: 323

- **Opt. Design Jan. 2015**: 646 MWh/a
  - Plug Loads: 158
  - Light: 59
  - Auxiliary: 142
  - Mechanical Ventilation: 218

- **Opt. Design Feb. 2015**: 497 MWh/a
  - Plug Loads: 146
  - Light: 52
  - Auxiliary: 120

- **Opt. PV production**: 500 MWh/a max. PV production, guaranteed production year 10
  - Plug Loads: 500

Legend:
- Plug Loads
- Light
- Auxiliary
- Mechanical Ventilation
- FCU
- Uncertainty
Toronto and Region Conservation Authority
Bucholz McEvoy Architects + ZAS Architects
Client Mandate

LEED Platinum
WELL Silver
CaGBC Net Zero Carbon Pilot
Net Zero Energy?
Site Section
Client Mandate + Team Suggestions

LEED Platinum
WELL Silver
CaGBC Net Zero Carbon Pilot
Net Zero Energy

Respond to the Ravine
Intuitive and Human-Focused
47-63 kWh/m² (15-20 kBtu/sf)
Operation Modes

Winter heating

Natural ventilation

Summer cooling

Extended natural ventilation
Energy Performance

Predicted Total Site EUI
53 kWh/m² / 17 kBtu/sf
“THE ARBOUR”
Schematic Design DRP
July 25th, 2018
Moriyama & Teshima
+ Acton & Ostry
Client Mandate

Low carbon: Mass timber + LEED Gold
Future Proof and Resilient
Net positive energy
Smart building
Building Level
Passive Systems

1. Fresh air enters classrooms, labs and offices from naturally operated windows.
2. Air transfers to corridors via acoustically protected transfer vent.
3. Air moves into double-height student interaction spaces (breathing rooms).
4. Air is exhausted by the solar chimney via operable openings.
1. The outdoor air is supplied to air handling units located in mechanical rooms at every floor.
2. Conditioned outside air is supplied to all occupied spaces via underfloor plenum.
3. Displacement air is supplied at low velocity from VAV diffusers in the floor.
4. Return air is transferred to the corridor and returned to mechanical rooms at each floor.
5. Energy recover of return air in the AHU.
6. Exhaust air at each floor.
Client Mandate + Team Suggestions

Low carbon: Mass timber + LEED Gold
Future Proof and Resilient
Net positive energy
Smart building

Intuitive and Human-Focused
55-60 kWh/m² (17-19 kBtu/sf)
Smart operations
Toronto Green Standard Tier 4
**Space Level**

Operation Modes

*Winter heating mode*

*Summer cooling mode*
Breathing Room
Whole Building Energy Estimate Summary

Predicted Energy Consumption Model

![Energy Consumption Graphs]

- **TEUI (kWh/m²yr)**
  - **Result**: 63.2
  - **Target**: Tier 4 (50) Tier 3 (75)

- **TEDI (kWh/m²yr)**
  - **Result**: 13.9
  - **Target**: Tier 4 (10) Tier 3 (15)

- **GHGI (kg CO2e/m²yr)**
  - **Result**: 3.9
  - **Target**: Tier 4 (2.5) Tier 3 (5.0)
Arthur L. Irving Institute for Energy and Society, Dartmouth College
Goody Clancy
Client Mandate

LEED Platinum
Dartmouth GHG Goals

A 50% greenhouse gas (GHG) emissions reduction by 2025 with no offsets, using a 2010 baseline

An 80% GHG reduction by 2050 with no offsets, using a 2010 baseline

Irving Institute Mission

The mission of the Arthur L. Irving Institute for Energy and Society at Dartmouth is to advance an affordable, sustainable, and reliable energy future for the benefit of society.

We seek to achieve this mission by developing the next generation of energy experts, leaders, and citizens and by transforming humankind’s understanding of energy systems across technological, environmental, economic, geopolitical, and cultural perspectives.
Client Mandate

LEED Platinum
80% GHG reduction by 2050 with no offsets, using a 2010 baseline

Team Suggestions

Unparalleled Energy Performance
Humane Spaces
Expression of Performance
Building as a Research Tool
Open Office Climate Concept

Natural Ventilation Mode

Mechanical Cooling/Heating Mode
Whole Building Climate Concept

Cooling

Mechanical Ventilation Mode - Cooling

Double Skin Facade - Cavity Roof
Mechanical Ventilation: Cooling Mode

- Shading closed
- Facade vented to let heat out
- Vent out of top facade or roof

- Air exhausts through the AHU for heat recovery
- Exhaust air bleed-off for option with flat skylight with shading
Whole Building Climate Concept
Natural Ventilation
Energy Performance

Base Case
ASHRAE 90.1-2010

- Triple Grazing R-28 Overall Wall: 25
- Heat Recovery: 5
- Reduced Lighting Power: 7
- 57 kBu/gsf

Improved Envelope

- Improved HVAC + Lighting: 17
- Exterior Shades, ceiling fans, natural ventilation: 4
- 46 kBu/gsf, 23% saving over Base

Improved HVAC + Lighting

- Advanced Measures: 7
- 28 kBu/gsf, 51% saving over Base

Advanced Measures

- PV Production: 9
- 27 kBu/gsf, 53% saving over Base

- Heating
- Cooling
- Fans & Pumps
- Lighting
- Plug Loads
- PV Production
Energy Performance
Getting to 18 kBu/sf

Advanced Measures
- Heat pump heating: 7
- Less use of A/C: 2
- Shorter operation hours: 2
- Reduced Plug loads: 8

Additional Improvements
- Heating: 2
- Cooling: 1
- Fans & Pumps: 2
- Lighting: 6
- Plug Loads: 7

27 kBu/gsf
18 kBu/gsf
36% saving over Advanced Measures
69% saving over Base
A closer look: How teamwide buy-in to performance goals impacted project execution
Case Study: Arthur L. Irving Institute of Energy and Society at Dartmouth College

Project Stakeholders

**DESIGN TEAM**
- Acoustical Consultant
- Architect
- Civil Engineer
- Code Consultant
- Energy Modeler
- Envelope Consultant
- FFE Consultant
- High-performance Consultant
- Landscape Consultant
- Lighting Designer
- MEPFP Engineers
- Spec Writer
- Structural Engineer
- PV Designer

**CLIENT TEAM**
- Design Review Committee
- Donor Group
- Facilities Group
- Institute User Group
- Project Management

**CONSTRUCTION TEAM**
- Construction Manager
- Product Engineers
- Subcontractors
Case Study: Arthur L. Irving Institute of Energy and Society at Dartmouth College

<table>
<thead>
<tr>
<th>OPPORTUNITIES</th>
<th>VISION</th>
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<th>STRATEGIES</th>
<th>COMPONENTS</th>
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<td>Energy Use Intensity EUI&lt;20</td>
<td>Optimize occupant comfort</td>
<td>Minimize mechanical cooling need</td>
<td>Express energy performance through design</td>
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<tr>
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<td></td>
<td>Optimize occupant comfort</td>
<td>Maximize use of passive systems</td>
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<tr>
<td>Team</td>
<td></td>
<td>Minimize mechanical cooling need</td>
<td>Find renewable energy sources</td>
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<td></td>
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<td>Streamline building operations</td>
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<td>Robust thermal envelope</td>
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<tr>
<td>Site</td>
<td>Optimizing occupant comfort</td>
<td>Maximize use of passive systems</td>
<td>Natural ventilation system</td>
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<tr>
<td>Team</td>
<td>Minimizing mechanical cooling need</td>
<td>Find renewable energy sources</td>
<td>Radiant heating &amp; cooling</td>
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<tr>
<td></td>
<td>Expressing energy performance through design</td>
<td>Streamlining building operations</td>
<td>Daylighting</td>
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<td>Photovoltaic (PV) array</td>
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<td>High-performance windows</td>
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<td>Maximize use of passive systems</td>
<td>Natural ventilation system</td>
<td>Thermal vent</td>
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<td>Team</td>
<td></td>
<td>Minimize mechanical cooling need</td>
<td>Find renewable energy sources</td>
<td>Radiant heating &amp; cooling</td>
<td>Automated exterior shades</td>
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<td></td>
<td>Express energy performance through design</td>
<td>Streamline building operations</td>
<td>Daylighting</td>
<td>Louvers &amp; screens</td>
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<td>Photovoltaic (PV) array</td>
<td>Radiant ceiling panels</td>
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<td></td>
<td>Window control system</td>
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<td></td>
<td>Double-skin façade</td>
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<td></td>
<td>Integrated fans</td>
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<td></td>
<td>Skylights</td>
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<td></td>
<td>Radiant floor slab</td>
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<td></td>
<td>Building automation system</td>
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<td>Workspace layout</td>
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<td></td>
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<td></td>
<td>Interior Shades</td>
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</table>
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**OPPORTUNITIES**

- Program
- Site
- Team

**VISION**

- A global benchmark for high-performance design
- Optimize occupant comfort
- Minimize mechanical cooling need
- Express energy performance through design
- EUI < 20

**GOALS**

- Reduce heating & cooling loads
- Maximize use of passive systems
- Find renewable energy sources
- Streamline building operations
- Daylighting
- Express energy performance through design
- Reduce heating & cooling loads
- Maximize use of passive systems
- Find renewable energy sources
- Streamline building operations
- Daylighting

**PRIORITIES**

- Robust thermal envelope
- Natural ventilation system
- Radiant heating/cooling
- Streamline building operations
- Daylighting
- PV array

**STRATEGIES**

- Natural ventilation system
- Radiant heating/cooling
- Express energy performance through design
- Reduce heating & cooling loads
- Maximize use of passive systems
- Find renewable energy sources
- Streamline building operations
- Daylighting
- PV array

**COMPONENTS**

- High-performance windows
- Thermal vent
- Automated exterior shades
- Louvers & screens
- Radiant ceiling panels
- Window control system
- Double-skin glass façade
- Integrated fans
- Skylights
- Radiant floor slab
- Building automation system
- Workspace layout
- Interior Shades
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**Team Members by Design Decision**

**SELECTED COLLABORATIVE DECISIONS BY PHASE**

<table>
<thead>
<tr>
<th>PROJECT DESIGN PHASES</th>
<th>SELECTED COLLABORATIVE DECISIONS BY PHASE</th>
<th>CLIENT TEAM</th>
<th>DESIGN TEAM</th>
<th>CONSTRUCTION TEAM</th>
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<tr>
<td>CD</td>
<td>DEVELOP PERFORMANCE GOALS &amp; NV CONCEPT</td>
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<td>⬤</td>
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<tr>
<td></td>
<td>SELECT DOUBLE-SKIN GLASS PAVILION SCHEME</td>
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<td></td>
<td>ESTABLISH NV DESIGN REQUIREMENTS</td>
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<td>CONFIGURE WORKSPACES TO SUPPORT NV</td>
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<td>⬤</td>
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<tr>
<td></td>
<td>DEFINE NV OPERATING MODES &amp; REQUIREMENTS</td>
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<td>ADJUST GLASS PAVILION SCOPE</td>
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<td>⬤</td>
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<tr>
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<td>INCORPORATE CEILING FANS</td>
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<td>⬤</td>
<td>⬤</td>
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<td>REFINING AUTOMATION AND CONTROL SEQUENCE</td>
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<td>EXPRESS ATRIUM TRANSFER POINTS VISUALLY</td>
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<td>⬤</td>
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<td></td>
<td>FINALIZE DETAILS AT EACH TRANSFER POINT</td>
<td>⬤</td>
<td>⬤</td>
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<tr>
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<td>RECONCILE AUTOMATED WINDOW AND SHADES</td>
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**Example: Preserving performance goals through value management**

**Challenge:** Balancing budget and design priorities

**Opportunity:** Create better and more efficient design
### Example: Assess impact of each potential item against performance goals

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<th>COST</th>
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<td>Design</td>
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<tr>
<td></td>
<td></td>
<td>NA</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>Eliminate classroom level space under east bar</td>
<td>NA</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Deletion of SE Utility Room</td>
<td>NA</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Lower east bar roof by 6'; windows become dormers</td>
<td>NA</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Reduce attic floor area by 70%. (Lower attic slab by 2')</td>
<td>NA</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Reduce area in north wing/east wing 2000 sf.</td>
<td>NA</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Eliminate doors and partitions at 6 enclosed offices</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Chute: move stair to west to avoid change to mechanical rooms below</td>
<td>NA</td>
<td>1</td>
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</tbody>
</table>

**Legend:**
- **Little or No Impact**
- **Moderate Impact**
- **Higher Impact**
The three goals for this system were to:

1) Maximize the building area served by natural ventilation,

2) Increase time in natural ventilation mode, and

3) Improve system visibility to promote energy awareness.

Natural Mode (Sketch by Transsolar)
Case Study: Arthur L. Irving Institute of Energy and Society at Dartmouth College

Goal: Minimize need for mechanical cooling
Case Study: Arthur L. Irving Institute of Energy and Society at Dartmouth College

Goal: Express performance through design
Case Study: Arthur L. Irving Institute of Energy and Society at Dartmouth College

Goal: Express performance through design
Case Study: Arthur L. Irving Institute of Energy and Society at Dartmouth College

Innovative Components (1st on Dartmouth Campus)

- Rooftop fanroom for natural ventilation exhaust
- Radiant sail ceiling panels in labs
- Modulated control system for automated windows
- Heat Pump Chiller
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Innovative Components (1st on Dartmouth Campus)

- Double-skin glass façade
- Parallel project window openings at double-skin
- Integrated ceiling fans in all work & collaboration spaces
- Exterior automated venetian blinds
Survey
For sustainability attributes that are quantifiable (carbon emissions, energy use, human health indicators, etc.), how effective are numerical targets.

- Counterproductive
- Not effective
- Somewhat effective
- Necessary for success
- Depends on the project
Go to www.menti.com and use the code 6657 1454

How often do quantitative goals for the following categories drive design decisions on your projects?

<table>
<thead>
<tr>
<th>Category</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>Net energy consumption</td>
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</tr>
<tr>
<td>Operational carbon emissions</td>
<td></td>
</tr>
<tr>
<td>Potable water consumption</td>
<td></td>
</tr>
<tr>
<td>Embodied carbon emissions</td>
<td></td>
</tr>
<tr>
<td>Human health indicators</td>
<td></td>
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How effective are each of these strategies in helping teams in achieving project goals?

<table>
<thead>
<tr>
<th>Very ineffective</th>
<th>Very effective</th>
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<tbody>
<tr>
<td>Targeted client engagement</td>
<td></td>
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<tr>
<td>Consistent communication around goals</td>
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<td>Establishing team-wide commitment early on</td>
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<tr>
<td>Iterative performance modeling &amp; tracking</td>
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<tr>
<td>Pursuing green building certification</td>
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<tr>
<td>Prioritizing performance during value engineering</td>
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<tr>
<td>Strong technical leadership from design team</td>
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What are the greatest barriers that prevent projects from reaching their goals?
Achieving high performance and meeting goals requires sustained effort throughout a project. In your most successful projects, who was the driving force?
What is the most important marker of achieving a project's goals?

- Meeting the numerical target
- Approaching numerical targets - predictive modeling is appropriate as a guide, not an exact target
- Project excels compared to similar buildings - benchmarking approach
- Team wide effort to optimize as much as possible - it's not about the number
What is your typical role?

- Sustainability consultant
- Owner
- Engineer
- Contractor
- Architect
Moderated Discussion
Audience Q+A
Go to www.menti.com and use the code 6657 1454

What one strategy will you implement on your next project to set aspirational performance goals that stick?