Taking a Performance-based Approach to Building Procurement

Opportunities for owners, designers, and CIPs
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Conservation Applied Research and Development (CARD) FINAL Report

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Definition of Acronyms

ASHRAE	ASHRAE (no longer an acronym); a standard-making body
B3	Sustainability guidelines for new buildings or renovations
BOD	basis of design, a type of document used in building design
CARD	Conservation Applied Research and Development, funder of this work
CBECS	Commercial Building Energy Consumption Survey
CD	construction documents
CIP	Conservation Improvement Program; utility programs in Minnesota
CSBR	Center for Sustainable Building Research
DD	design development
EDA	Energy Design Assistance, a type of new construction program in MN
EEB	Energy Efficient Buildings, a program of Xcel Energy
EUI	energy use intensity
GO	General Obligation
HVAC	Heating, ventilating, and air conditioning
kWh	kilowatt-hours, a unit of measure of electricity usage
IECC	International Energy Conservation Code
LEED	Leadership in Energy and Environmental Design
NC	new construction
OPR	owners project requirements, a communication from owners to designers
PBP	performance-based procurement
RFP	request for proposals
SB2030	Sustainable Buildings 2030, a program for sustainable public buildings
SD	schematic design

Executive Summary

The achievement of high performance buildings has become a primary goal of many in the design, construction, and operation communities. At the same time, goals for high performance are increasing along with a strict burden of proof requirement. Advancing energy codes and stringency of utility energy efficiency program baselines have made it more difficult to achieve energy savings in utility new construction energy efficiency programs with conventional methods. More aggressive, outcome-based approaches are emerging to solve these problems.

Both private and public sector projects in Minnesota have followed these trends. The public has actively sought this path, setting very aggressive future energy targets for their buildings. To achieve these standards, Minnesota established the Sustainable Buildings 2030 (SB 2030) Standard which requires project owners who receive General Obligation bonds to design, construct, and operate their buildings to achieve set energy targets, following the general energy reduction trend of the 2030 Challenge (Architecture 2030, 2006).

To help ensure that buildings in Minnesota continue to meet advancing goals and energy codes in both private and public sectors, we introduced an alternative building procurement approach called performance based procurement (PBP). The goal of the PBP approach is to specify performance requirements, including specific energy targets, at a project's conception, before the design and construction team is hired. With PBP, building owners prioritize project goals, including energy performance and budget requirements, and select the design and contractor team based on their ability to meet all the requirements. It is then entirely up to the design team determine how to best meet the performance target. After construction, actual energy performance is measured to verify that the team's approach has met contract requirements. This process puts the focus on performance targets for the entire procurement, design, construction, and operation of the building, in contrast to an approach that prescribes specific energy efficiency solutions to the design team.

The most important aspect of PBP is owner engagement during the earliest stages of their project's procurement. We found that many owners in Minnesota are unaware of the building strategies that have the biggest impact on energy efficiency. They typically leave it to the design team to determine the best combination of energy strategies for their project. Often, design firms do not have a significant focus on energy performance, so they turn over the performance strategy design to a sustainability consultant or mechanical engineer, sometimes late in the process. Passing the ownership of energy performance to the design team usually makes it a secondary goal.

For this study, we studied the viability of PBP to achieve higher energy savings, without increasing capital cost to owners, through early owner involvement, goal setting and energy modeling. The study also examined the role that conservation improvement programs (CIPs) could play in supporting this approach. We tested the PBP method in six pilot projects and observed the outcomes. We supplemented our study with assessment of existing programs, interviews and analysis through the SB 2030 program, and outreach to energy modeling professionals.

Our key observations follow:

Owners must set energy targets early and enforce them strictly. To make PBP work, owners must set a performance target before their team is chosen. This target should reflect their goals and overall values, so they are more likely to stand behind it. Challenges will be raised along the way, but the owner must continue to hold their team to the target.

Owners must allow flexibility regarding strategies. As the project progresses, design and construction teams should be given the flexibility to meet the performance goal however they see fit. This controls costs while increasing performance.

Some effort must be saved for post-occupancy. As projects transition to occupancy, the focus on performance and the knowledge about the chosen strategies must be transferred to the building operators. This is also where measurement of actual performance comes in. Adequate energy consumption metering, assessment of the results and adjustments when necessary is critical to maintain the owner's energy requirements. This M&V process must be included in contract language.

Early energy modeling is key. Early in the process, energy analysis can quickly determine the performance impact of design decisions, rather than waiting for an auditing tool at the end of design. Early modeling maximizes the energy savings potential and allows access to ultra-high performance opportunities before the design is completed.

While observing these projects we also considered how PBP interacted with existing and potential programs, including the public SB 2030 program and utility CIPs. Key program conclusions include:

Performance-based procurement offers benefits to utility CIPs. Incorporating PBP into utility energy efficiency programs provides the utility an opportunity to deepen relationships with key customers, since the process is inherently owner-focused. PBP also allows CIPs to remain ahead of advancing codes, and achieve greater net savings through more direct influence on outcomes.

There is an opportunity for a CIP offering that targets higher actual performance. Current CIPs do not include an outcome-based offering. There is potential for PBP fill this gap with either an entirely new program offering, or a new track in an existing program. If the latter, it would need to either increase savings beyond what is typical, or decrease cost. Pilot projects showed potential for one or both, though our sample was not large enough to predict specific total savings or cost potential.

SB 2030 could be aligned better with the ideal performance based procurement process. The SB 2030 Energy Standard shares many elements with the ideal performance based procurement program. In both programs, the owner expects the building to perform to a pre-determined level of energy efficiency included in their project requirements. However, some elements of SB 2030 could be improved to strengthen the program, notably early interaction and engagement with the building owners and improvement of coordination and assistance for building operations. The program would also benefit from owners taking more of a role in enforcement.

Outreach is both a challenge and an opportunity. For utility CIPs, outreach to building owners is a primary challenge of PBP. Recruiting projects via owners, and early enough in the process to implement PBP, is an immediate challenge to PBP programs. Though once engagement is achieved it does provide an opportunity for improved owner satisfaction with the process, as owners are encouraged to lead and develop project goals.

In the landscape of advancing energy codes, increasing owner expectations for performance and the desire to prove high levels of savings under utility offerings, a building delivery method that prioritizes performance is attractive. The building procurement industry is moving toward outcome-based approaches like PBP. There is a benefit to formalizing this owner-driven process.

Introduction and background

Historically, the design and construction of commercial high performance buildings has relied heavily on several accepted practices: using certain design elements for energy savings; modeling to determine energy performance; and complying with performance rating system protocols (such as LEED).

While approaching high performance design in this fashion will remain important and has captured the low-hanging fruit, it leaves behind a substantial amount of energy savings. Savings from energy use from unregulated plug loads, rigorous commissioning of controls, building operation and occupant behavior are generally not captured by this traditional approach. Furthermore, we have had to establish rigorous protocols to prevent “gaming” of the performance rating systems (such as LEED, utility new construction programs, and government design standards). These protocols are often expensive to implement, and very difficult to apply to many projects.

One solution has been to shift to a more performance-based (or “outcome-based”) approach, where protocols based on theoretical analysis of a building design are replaced by measuring actual operating performance. One strategy of this type is performance-based procurement (PBP), in which the owner sets an energy performance goal prior to even procuring a design or construction team and every step in the building life-cycle thereafter includes some focus on attaining that goal. This approach is like that used to meet the building’s capital budget. Establishing an energy performance goal creates the potential to push for better building energy performance while leaving the design and construction team with the flexibility to meet these needs cost effectively.

We have undertaken a study to test this approach in action in a number of buildings in Minnesota. This report outlines the objectives, observations, and conclusions of those test cases, for use by both building owners and efficiency programs.

New approach: performance-based procurement

Under the PBP approach, design and construction teams are contractually accountable throughout design and into occupancy to a specific energy performance goal. Attainment of this goal is substantiated throughout design and construction, and ultimately confirmed via measurement in the first year of operations. This results in actual, realized energy performance, differing from traditional procurement methods that lack either a measurable energy goal or any accountability for energy performance (and instead rely only on modeled performance). The PBP approach provides the potential for owners to push for increasingly deeper savings through more stringent targets, and for energy efficiency programs to capture more savings by addressing all areas of the building’s life cycle, including everything from pre-design to initial operations.

This approach is applicable to both utility and public programs in Minnesota. Sustainable Building 2030 (SB 2030) already uses a similar approach to help state buildings achieve rigorous energy reductions—targeting 70 percent energy reduction (below the 2003 baseline) for new buildings in 2015 and moving to carbon neutrality by 2030. One goal of the PBP study was to improve the existing SB 2030 process by integrating the proven best practices from PBP. The study also developed a framework for integrating PBP into current new construction program offerings, and developed methods for these programs to work more in concert with SB 2030. This approach also naturally prepares utility conservation improvement programs (CIPs), SB 2030, and the market for the potential of outcome-based code compliance.

Existing approaches: program landscape

There are currently several energy efficiency programs that address new commercial construction and major renovations in Minnesota. For PBP to thrive in the state, it would ideally integrate into, or build on the programs described below.

Conservation Improvement Programs

Minnesota CIPs currently promote energy efficiency in new commercial construction projects through one of two program types. These are the most common types of programs in other areas of the country as well.

Design assistance. Design assistance programs, such as those offered by Otter Tail Power, Xcel Energy and CenterPoint Energy, focus on the design development and construction document stages of design. Energy modeling and design review are used to recommend improvements to the building design that will save additional energy.

Prescriptive programs. For individual projects or utility program portfolios that are too small to justify a design assistance program, prescriptive financial incentives (sometimes called rebates) are a common program offering. New commercial construction projects can take advantage of financial incentives based on the selection of more efficient equipment. These programs generally do not provide design guidance in general, but rather promote specific types of energy efficient products to include in a new building or major retrofit by offering a set financial incentive per unit for such products.

Sustainable Building 2030

Projects in Minnesota that receive state General Obligation bond funding must participate in SB 2030. Unlike the CIPs, SB 2030 is a mandatory program for all projects that receive General Obligation bond-funding from the state. These include state agency projects, public higher education buildings, municipal buildings and some private projects that need this funding to be viable. SB 2030 is a progressive energy conservation program initiated by the Minnesota Legislature in the spring of 2008 which sets specific energy efficiency performance targets (Energy Standards) for energy use in buildings compared to representative buildings in existence in 2003. Every five years, the total carbon emissions target is reduced so that in 2030 a 100% carbon reduction (net zero carbon) is achieved.

Study objectives

We planned to leverage demonstrations of PBP within the context of these existing programs, to achieve the following objectives:

- Demonstrate that rigorous performance standards can be met cost-effectively with performance-based design procurement strategies that will in turn lead to deeper energy savings for owners and utility CIP incentive programs.
- Test an innovative new construction program strategy to help counter the effects of increasingly stringent code baselines.
- Expand the reach of SB 2030 to integrate better with utility programs, improve cost-effectiveness, and expand post-occupancy follow-through.
- Offer customized technical assistance and contract best practices to support buildings with a 50%+ reduction in energy use.

Methodology

The study team employed qualitative research methods for this CARD grant study. We assessed the current state of high performance new construction programs in Minnesota, both utility CIPs and SB 2030. This assessment involved interviewing program stakeholders, implementers, energy modelers, and some participants. We also implemented a pilot program to test PBP on several projects to compare those methods, processes and outcomes to existing programs.

Case study is an acceptable research method where the research question is well defined and the number of cases is small, complex and/or contextual. When existing real life experiences are required to determine the validity of certain approaches, the in-depth aspects of case study is especially effective. Case study allows for multiple sources of data to be triangulated to discover reinforcing conclusions or to probe deeper into conflicting data.   The main criticism of this method is the introduction of biases into the observations and findings. We have tried to mitigate this issue by basing all of our case studies on particular issues for specific cases to be the best example of trends that might be occurring in the field in general.

Pilot Projects

The pilot project leveraged two major market channels—utility CIPs and major building owners and developers:

- Owners/developers in both the private and public sectors. Best practices from the pilot can be transferred to utility programs and building portfolios to scale the program. The criteria for the selection of the design projects cases were as follows: Find at least two design projects that would be public buildings involved in the SB 2030 processes and at least two that would be private buildings
- Projects that would offer both qualitative and quantitative data
- Projects that were very early in the design process – ideally in the pre-design or early in schematic design.
- Projects that would be complete Design Development or Contract Documents with in the 18-month period of the study
- Owners and architects that would be amendable to a new approach and provide information
- Owners and architects that would be willing to conduct very early energy modeling to ensure the design will be the required energy targets
- Willingness of the projects to participate in the Xcel Energy Design Assistance Program (EDA)

Each of the case study projects were followed for 12-16 months' routine checking in on their progress towards higher energy efficiency. During the 12 months, the observer recorded observations of the opportunities and barriers of implementing the performance based procurement pilot.

The following projects were selected.

Private projects:

- Mayo Clinic Generose Bed Tower Expansion located in Rochester, MN
- Wolf Ridge ELC Dormitory located in Finland, MN
- Aeon Developments located in Minneapolis and Ramsey, MN
- Parking Ramp #6 Development located in Rochester, MN

Publicly funded projects (SB 2030):

- Metro Transit: Blue Line Light Rail Transit Operations and Maintenance Facility located in Brooklyn Park, MN
- Department of Administration: Health and Emergency Response Operations (HERO) Center located in Cottage Grove, MN
- University of Minnesota, Twin Cities Campus, Health Sciences Education and Learning Center located in Minneapolis, MN

Projects in operations phase

- Higher Ground Saint Paul located in Saint Paul, MN
- Washburn Center for Children located in Minneapolis, MN
- DHS Saint David's Center – Phase 2 Renovation & Expansion located in Minnetonka, MN

Assessment of current programs

To implement PBP pilots in Minnesota, it was important to assess the current state of program activities. We assessed current utility CIPs because PBP is envisioned to be embedded in such a program. We also assessed the energy efficiency new construction program for the public sector—SB 2030—for two reasons: it includes significant elements of the PBP approach; and any public project that we would potentially work with would be working within the SB 2030 program. In the summaries below, we share a general assessment of existing program and describe benchmarking and stakeholder feedback that we collected on these programs.

Conservation improvement programs

Minnesota new construction CIPs include two basic approaches: rebates coupled with energy modeling and design consulting services; and rebates based on custom calculations or prescriptive measures. The two largest Minnesota programs are Energy Design Assistance (EDA), offered by Xcel Energy and CenterPoint Energy; and Commercial Design Assistance, offered by Otter Tail Power Company. These programs follow generally similar processes and offer similar benefits, as summarized below.

Basic features and benefits

- Design assistance services are offered for new construction and major renovations, covering a wide range of building sizes.
- Rebates or incentives are available for a package of whole building energy measures or opportunities, based on energy savings predicted through energy modeling.
- Consulting services and predictive modeling are provided.
- Measurement and verification services are provided at the end of construction to ensure energy efficient measures were installed.
- A bonus is given to the design team for participating in the design assistance program.

Options available through Energy Design Assistance

Xcel Energy's Business New Construction program offers design assistance options for new construction, additions or major renovation projects (Xcel Energy, 2017). The program is split into two major offerings: EDA and Energy Efficient Buildings (EEB). EEB is generally intended for buildings under 20,000 ft^2 and must include a minimum of two system changes (such as lighting or cooling). EDA is the major offering that yields much of the program savings. It has two tiers of services available:

Standard EDA. Standard EDA is an iterative process that typically begins in schematic design. A kickoff meeting with the customer, design team and utility representatives is used to clarify program benefits and requirements, collect project information for further analysis, and clarify goals and intent for the project. After the meeting, utility program representatives take information gathered, create various model design scenarios and sort results into different "bundles" that represent levels of efficiency. Bundle one may include more minor or cost-effective strategies; bundles two and three may include more robust energy savings measures. The EDA program representatives present the bundles to the customer and design team and facilitate a discussion, using a real-time energy modeling tool. They consult on potential energy efficiency strategies, enhance the energy model with additional information gathered, present updated bundles and the owner, in consultation with their design team, selects the bundle most appropriate for their specific project. After construction is complete, the utility program representatives conduct measurement and verification processes to confirm the measures identified in the bundle are installed and working, a report is generated and the rebate is paid.

Enhanced EDA. This track is ideal for owners and designers interested in very early goal setting and evaluation of options beginning in the pre-design and concept stages. Enhanced EDA is intended to engage with the customer early in the design process, provides early energy modeling and includes services such as goal setting meetings, massing, daylighting analysis and HVAC rendering. Decisions made in the early stages of design have significant potential for energy efficiency and Enhanced EDA is reserved for projects that can address pre-design or concept issues.

The Enhanced EDA program and process is well-positioned to assist customers pursuing the SB2030 Standard. Both Enhanced EDA and SB 2030 aim to help customers achieve more energy savings than mainstream projects. Also, the Enhanced EDA program does provide some basic comparison to the SB 2030 target during analysis.

SB 2030

The SB 2030 program was created in 2007. Modeled on the national Architecture 2030 program, Minnesota SB 2030 implements increasingly stringent energy targets for performance[1]. The program requires the evaluation of energy consumption in design and for 10-years of operation. The program establishes a baseline of average buildings in 2003, and requires targets that yield increasingly larger savings from this baseline over time. A 60% reduction target was required until 2015; a 70% reduction from 2015 to 2019; and greater reduction every five years until 2030, when net zero performance is required.

A set of tools aid program users in tracking progress toward their SB 2030 target. The Energy Standard Tool can be modified to reflect changes in operation, occupant schedule or other drivers of energy consumption. To accommodate a wide array of building types the Energy Standard Tool models a 2003-compliant version of a given building project. It sets an energy use target based on a variety of inputs.

Early in schematic design the owner and design team determine several potential building design strategies to be compliant with the SB 2030 Energy Standard. Energy modeling and evaluation are completed on the strategies, eliminating designs that do not meet the Owner Project Requirement

[1] The SB 2030 program is integrated with the pre-existing B3 Guidelines program and tools which sets a series of sustainability guidelines for State bond-funded projects.

(OPR) and SB 2030 Energy Standard. During design development when the architectural design is finalized and the mechanical and electrical systems are selected a final energy model is conducted to ensure compliance. And as the project moves through construction subsequent energy models are conducted to finalize compliance with the SB 2030 Energy Standard. At the end of the construction documents phase, the Energy Standard Tool inputs and the building simulation are evaluated by a third-party reviewer to ensure that they reflect a reasonable estimate of expected performance and achieve the SB 2030 target.

After the building is occupied, actual energy consumption is recorded and tracked. If the actual annual consumption is greater than the SB 2030 target, the project team evaluates and remedies the source of discrepancies.

Educational training programs are also offered for building designers on both the elements of SB 2030 and the design concepts that can be used to meet it. The training explores approaches to energy efficiency in building design, including integrative design, envelope design and passive energy strategies.

Coordination with CIPs

The methods and goals of SB 2030 and EDA are similar, but not fully aligned. Recently, design teams have tried using the Standard EDA compliant energy models to satisfy the requirements of SB 2030. However, the collaboration often encountered disconnects in timing, as well as in the level of performance being analyzed or sought.

Enhanced EDA is a better match for SB 2030 projects because it requires earlier intervention, involves more detailed modeling, and includes support for completion of SB 2030 documentation requirements. Projects have been more successful at timely completion of SB 2030 if they participate in Enhanced EDA. The Center for Sustainable Building Research (CSBR) has suggested that design teams request the lowest-cost bundle within the owner and design team parameters that meets the SB 2030 Standard. It is also recommended that the design team request only alternative bundles that meet SB 2030.

Projects participating in both tracks of EDA have had issues with timely completion of the SB 2030 documentation. EDA outreach generally begins the modeling effort only after major systems have been selected. Therefore, some low-cost opportunities for energy savings may be more difficult to implement or not immediately considered.

Program benchmarking

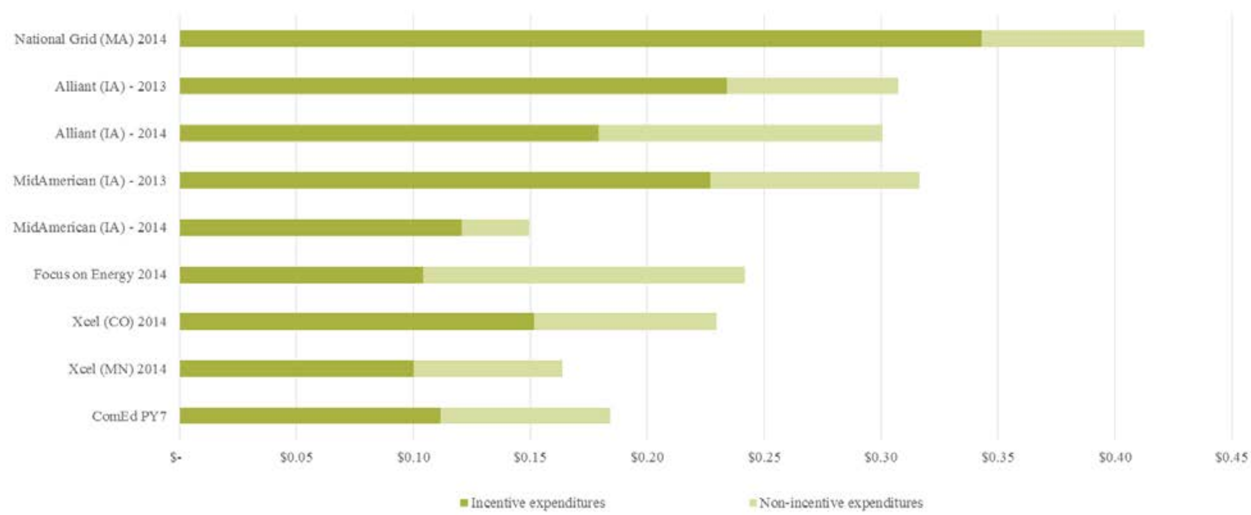
To compare new construction programs in Minnesota to others nationwide, we benchmarked key program attributes. Table 1 compares new construction programs offered by utilities and statewide efficiency programs. From this chart, we can see that all programs offer cash incentives based on energy savings versus baseline conditions. Many use a variety of tracks suggesting the opportunity to apply more than one approach within a given program. Only a couple of programs offered emerging strategies like post-construction support and net zero energy support. Energy Trust of Oregon and Fort Collins

Utilities' programs are most relevant to PBP, offering new construction programs that include a path to net zero and post construction support. However, no major utility offered incentives or technical support for setting an energy performance target. PBP is an opportunity to implement a program offering that bases incentives on savings measured after the building is operational.

Table 1. Service/incentive offerings for multiple new construction programs

	ComEd	National Grid	Xcel MN	Xcel CO	Wisconsin Focus on Energy	Iowa (MidAm & Alliant)	Energy Trust of Oregon
Single TA provider	■		■		■	■	
Closed network		■		■			
Open network							■
Multiple tracks		■	■	■		■	■
Scaled incentives based on performance		■				■	■
Scaled incentives based on technology							■
Design firm incentive	■	■	■	■	■	■	■
per kWh incentive	■	■	■	■	■	■	■
per kW incentive			■	■			
per therm incentive	■	■	■	■	■	■	■
per SF incentive		■					■
EUI incentive							
Minimum savings threshold		■	■	■		■	
Incentive cap							■
Post-construction support		■				■	■
Net Zero support							■
LEED support			■	■		■	■

Figure 1. NC program comparison: cost per kWh (Note: Code baseline varies by utility.)



Program cost is also a key metric to benchmark when designing new programs. Any new approach needs to develop an incentive, administrative, and technical assistance framework within a target budget. To estimate the total program cost per unit of energy saved, these program costs are often added together and divided by the total projected energy savings. For the utilities listed in Figure 1, the total program cost is represented by the full bar. Since all the programs include incentives for kWh and only some include incentives for therms, our comparison is based on kWh alone. While each utility must customize its program design and costs based on its service territory, energy code baseline and regulatory structure, we conclude from this exercise that a PBP program with total costs between $0.15 to $0.25/kWh will be competitive and cost-effective.

One goal of program benchmarking was to better define what we mean by deep energy savings compared to the typical program offering. To do this, we looked at a few metrics. The first evaluated detailed data from two programs (EDA and ComEd in northern Illinois). The detailed program data highlights trends over the past several years of the program offerings. The second looked at the specific kWh and therm savings associated with specific EUI goals. Because most of the pilots will likely set a site EUI goal for their projects, we need to understand how that goal impacts kWh and therm savings for several specific building types.

Table 2 summarizes the information collected for the two programs over the past four years (IL SAG, 2017). Looking through this information, we have established the following general guidelines to use for a PBP program offering. The pilots tested feasibility of these goals and helped establish a final recommendation:

- Target total program cost in the range of $0.15 to $0.25/kWh ($0.20 or less is preferred)
    - At least half should be a cash incentive
- Establish a target savings in kWh/sf and in therms/sf based on program participation data as an average for all building types. ComEd targeted 3.5 kWh/sf and 0.05 therms/sf. Targets will vary by utility.
- The program design should target average project size near 125,000 sf or greater so it can support 'typical' projects in the market.
- Savings should be benchmarked versus IECC 2012/ASHRAE 90.1-2010 at a minimum and include reference to the future baseline energy code.
- A sustained offering for a PBP new construction program should estimate total participation at 20% of all new construction projects enrolled in the typical new construction program. For instance, if a utility new construction program enrolls 100 buildings per year, the ideal participation level for performance based procurement would be 20 buildings, averaging 120,000 ft^2 in size. Using 2014 EDA historical kWh/ft^2 savings data from Table 1 (below) and assuming a 20% increase in savings due to performance base procurement, the resulting total savings potential for PBP would be about 1,200,000 kWh.

In summary, if a PBP-based program could achieve these levels of savings, at a cost in that range, and be well received by the market, then it is a viable candidate for a future CIP offering.

Table 2. Past program cost and savings for Xcel Energy EDA and benchmark program (ComEd NC).

Program Cost Information (using information from 2015):

Incentive Rate	ComEd	EDA
$/kWh	0.1	0.092
$/therm	0.5	0.65

Program Costs	ComEd	EDA
Admin Cost ($)	$1,068,364	$1,781,307
TA Cost ($)	$1,124,085	$1,781,307
Non-incentive expenditures ($)	$2,192,449	$3,562,614
Incentive Expenditures ($)	$3,399,425	$5,624,481
Total program $/sf	$0.41	$0.46
Total program $/kwh	$0.17	$0.20

Program Savings History

Information for 2015	ComEd	EDA*
Elec Savings (kWh)	32,031,731	45,793,663
NG Savings (therms)	392,503	320,972
Comingled Energy Savings (mmBtu)	N/A	N/A
Enrolled SF	13,707,857	20000000**
Number of Projects	61	133
Base Code:	IECC 2012	IECC 2009
kWh/sf	2.34	2.29
therms/sf	0.03	0.02

**25,793,758 was enrolled sf, this value interpolated to assume some sf is future year

Information for 2014	ComEd	EDA*
Elec Savings (kWh)	27,207,584	56,107,130
NG Savings (therms)	259,183	743,430
Comingled Energy Savings (mmBtu)	N/A	N/A
Enrolled SF	8,842,843	14,531,439
Number of Projects	59	122
Base Code:	IECC 2012	IECC 2009
kWh/sf	3.08	3.86
therms/sf	0.03	0.05

Information for 2013	ComEd	EDA*
Elec Savings (kWh)	34,928,896	27,774,227
NG Savings (therms)	183,088	104,800
Comingled Energy Savings (mmBtu)	N/A	N/A
Enrolled SF	13,992,672	13,013,175
Number of Projects	111	125
Base Code:	IECC 2009	IECC 2009
kWh/sf	2.50	2.13
therms/sf	0.01	0.01

Information for 2012	ComEd	EDA*
Elec Savings (kWh)	20,420,498	30,807,259
NG Savings (therms)	51,293	446,940
Comingled Energy Savings (mmBtu)	N/A	N/A
Enrolled SF	6,357,485	10,793,725
Number of Projects	51	N/A
Base Code:	IECC 2009	IECC 2009
kWh/sf	3.21	2.85
therms/sf	0.01	0.04

* For EDA: square footage is enrolled values for that program year, not final program yr square footage

Stakeholder feedback

In addition to objectively assessing the current state of programs targeting new construction, we also collected feedback from stakeholders throughout the state. This more subjective feedback included SB 2030 program participants and implementers, design firms, program implementation staff, and utility program managers.

Notable points (those expressed by at least two stakeholders) include:

- SB 2030 has similar goals as PBP though there is room for improvement for SB 2030 to shape outcomes, particularly in the area of motivation, enforcement and participation of voluntary projects. According to one stakeholder, "Compliance with SB 2030 is a little squishy." Taking a long-term view, the PBP initiative in Minnesota might need to undertake two projects – one to widely introduce PBP and a second to use PBP to provide a path to better use of SB 2030.
- The current new construction offering in Xcel Energy's service territory is doing well. Customers are satisfied and the program is achieving its goals. However, program savings will erode as codes advance and the program may need to change to remain cost-effective. Driving savings through more aggressive design approaches through PBP may be one solution.
- Initial experience indicates there is room to improve coordination and interaction between EDA and SB 2030. One stakeholder stated: "Design teams sometimes are confused – EDA helps [to a point] with EUI, but doesn't help with the meter plan (required by SB 2030). SB 2030 and EDA should work together to clarify roles." Additionally, there should be a little more emphasis on making SB 2030 more usable and relatable for owners. Many interview respondents felt the programs are rather separate, which adds confusion to the overall SB 2030 process. If new program elements are introduced in Minnesota, EDA and SB 2030 may need to integrate more closely to reduce complexity, making it easier for design teams to utilize those new program elements.
- The good news is that most owners welcome and appreciate any additional support that can be provided through SB 2030, Enhanced EDA or PBP. Owners want processes to be transparent and to align with their design practice. One owner stated that they only have so much "internal capital" to integrate new sustainability initiatives, so it is important that they understand the benefits of PBP and that PBP is as straightforward as possible.
- Existing procurement protocols, coupled with tight timelines, are the primary barriers for most owners we talked to – whether that means typically having a design-bid-build (DBB) approach, or simply not being able to change protocol. There is also concern about design team buy-in. Design teams seem hesitant to have energy targets in contracts. This could be because designers feel it takes a detailed program to determine an accurate design target. It may also be due to the design process traditionally ending early in a building's life cycle. One respondent stated: "People don't know how hard it is going to be to get to 80% [savings, a goal of SB 2030]. It's easier to connect with design community than operation community," implying that the operations community is the group that knows what it takes to really hit energy targets.

- Another large barrier is energy modeling: software tools with rapid feedback (so design teams know how each design decision impacts their EUI target) are not readily available. Also, energy models often get started too late in the process. EDA provides energy modeling for free, so an approach that requires the design/construction team to complete their own energy model may be new to some.
- There are opportunities to facilitate alignment of existing processes, provide transparency, address barriers and integrate PBP into the new construction programs active in Minnesota.

We also recognized the importance of energy modeling in performance-based projects, and solicited feedback on the state of energy modeling in Minnesota. We interviewed ten energy modelers in the state with a variety of project roles. Their average years of experience in energy modeling was between 11-12 years. We want to note that the interview sample is likely biased slightly toward those with past involvement in the SB 2030 program. We told respondents that our objective was to understand both the current and potential future role of energy modelers within a performance-based context. We summarize the responses below.

- Modelers most often first got involved in projects during Schematic Design. Some were involved in modeling of “shoebox” designs or very early in SDs.
- The primary influence of modelers in early design was to determine the mechanical system that would best provide the energy efficiency needed. They view it as an iterative process that is getting more formalized because of SB2030. Their ability to provide input early in design reflects the owner’s interest as well as having high efficiency goals to attain. They said it is really an owner’s decision on how energy efficient the building will become and the impact of their suggestions. On buildings aiming for higher performance, modelers are more often asked to comment on daylighting, wall insulation and massing.
- Energy charrettes occur on about 10-20% of the project that they work on. A charrette is a workshop that convenes project stakeholders to discuss and clarify project goals. Energy modelers will often conduct an internal energy charrette with experienced technical staff to determine the best approaches to suggest to the design team. All the energy modelers felt that charrettes helped projects save more energy.
- When asked about the typical relationships in a design process, there was a mix of experiences. Energy modelers felt the process was most integrative when the owners were more sophisticated, and/or when they had specific performance and sustainability goals.
- Most projects continue to rely heavily on The Weidt Group for energy modeling as part of one of the EDA programs that they implement.
- A key area for improvement with the use of EDA is for the program to get involved even earlier. Moving forward, earlier design integration will be critical, interpretation of the model and its effect on the design will be an important part of back and forth discussion between the owners, designer and modelers. This is not often the case in early design today. There was also interest from a few individuals in EDA doing more to make their work more transparent.
- Design of energy efficient building will also be more about precise budgeting of the absolute energy use in those early stages.

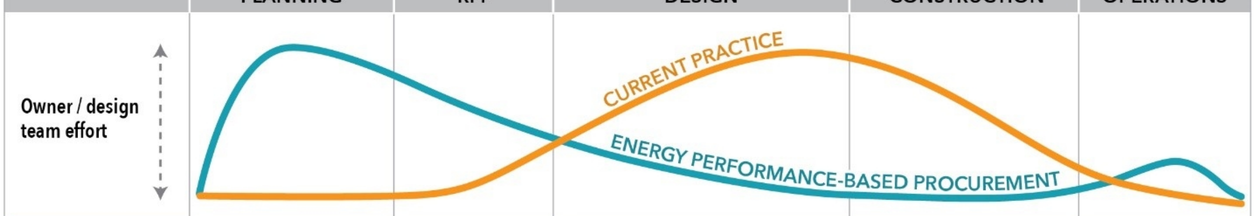
- When the energy modeling is completed through the Energy Design Assistance (EDA) process, the influence of any energy analysis completed by the design team is diminished. In addition, involvement of energy analysis from EDA can often be delayed.
- Stakeholders expressed that the energy modeling community is strong but not yet large enough, putting it behind some other regions in the country. Many architecture and engineering firms have been slower to develop their own energy modeling capacities.
- Energy modeling will become easier over time due to tools, primarily quick tools like Sefaira and Building Information Modeling (BIM), allowing energy modeling to be adopted earlier in the design process. However, the need for an experienced energy modeler to interpret the results will still be required, and as of today there remain significant limitations in those tools. To reach the level of performance sought in a program like SB 2030, owners and their design teams must collaborate more intensely, regardless of software.

Best practices for supporting performance-based procurement

Both prior to and throughout this study (both in Minnesota and in other states and territories where this work is being conducted) we have established best practices for the PBP process. Those practices are outlined in Figure 2 according to the phases of the building life-cycle, and are the practices we attempted to employ in most pilot projects as described in the next section. Any program deploying PBP should be prepared to provide support in all these steps.

The figure also describes (in the line graph) the desired impact that this approach has on the effort that is put into ensuring energy performance. In typical current practice, much of this effort is spent in the middle and latter half of design, in energy modeling and analysis, detailed design reviews and owner discussions, iteration with the owner, and compliance modeling. PBP should push most of this effort toward pre-design and the very beginning of design, as the owner spends time selecting and framing specific performance goals and the design team conducts early analysis to determine what types of systems and design approaches will allow them to achieve the goals. The remainder of the design process can then be spent refining this early energy analysis. If the refinements still meet the performance target, there is less need for back-and-forth discussion of energy measures with the owner, oversight from commissioning agents or other reviewers, or compliance modeling.

Figure 2. The steps of the PBP approach.



	PLANNING	RFP	DESIGN	CONSTRUCTION	OPERATIONS
Current practice	Little or no interaction	Respond to RFP Prepare contracts	Design building, fit energy utilization into design	On-site inspections	Program incentive paid
Energy performance-based procurement	Concept modeling Establish energy requirements Prepare RFP	Interact with A&Es to ensure RFP compliance Respond to RFP Prepare contracts Review submittal	Build RFP requirements into design Review design team submittals	On-site inspections Conduct measurement & verification on site Compare to RFP requirements	Program incentive paid Realize high performing building

The remainder of this section describes most of these practices in more detail.

Establishing an owner's energy champion

Any program engaging an owner in PBP should enlist a single individual within the owner's organization to be the champion for energy performance. This champion will be critical to success as hurdles are encountered. They should have the following characteristics or roles in the process:

- Be a key decision maker for the project; the project manager is ideal
- Believe in the concept and their ability to negotiate a better outcome for the project
- Has championed the idea to decision makers at a higher level than themselves (capital project delivery manager, facilities service manager, campus engineer, etc.)
- Will play a significant role in setting project goals shown in the tiered list
- Ultimately play a large role in selection of the energy target (or other comparable metric)
- Has a continuous role in the project from RFP through substantial completion
- Can negotiate terms with the design/construction team; ability to push back on value engineering lists, changes in scope, etc.

Energy target setting

Perhaps the most important step in PBP is selecting an energy target. This selection is inherent in the Request for Proposal (RFP) creation (next step below) but is important enough to be considered separately.

Ultimately, the owner needs to be the one to select the final performance target. If a program implementer, commissioning agent, or other consultant makes the final decision on targets then the targets will likely be compromised at the first project challenge or sign of opposition.

Energy targets are to be actual, measurable performance numbers. Targets should be selected based on relative references (i.e. benchmarks) that are meaningful to the owner, ensure the target is both 1) achievable and 2) meets a relative performance level consistent with the owner's overall values. The amount of benchmarking data that is available to be used for this task is steadily increasing. The following sources should be considered, in rough order of decreasing meaningfulness to an owner:

- Performance of other buildings in owner's own portfolio.
- Local building benchmarking. In Minnesota, performance data is available for all state-funded buildings through B3 benchmarking. In Minneapolis, data is available for most larger public and commercial buildings through the city's website.
- The SB 2030 Energy Standard Tool for setting goals is currently offered free and open to be used for all interested projects.
- National building benchmarks. The *EUI Analyzer* (Seventhwave, 2017) can be used; there are many other sources including DOE's Building Performance Database or CBECS.
- ENERGY STAR target, using *Target Finder* (ENERGY STAR, 2017).
- Performance of conceptual energy models.

These tools allow for benchmarking by primary building activity. If a building has multiple activities, it may be most effective to benchmark all the main activities, and create a combined target based on weighting by area or some other factor (like occupants). For projects required to meet SB 2030, the energy target is established by inputting project information (space types, hours of occupancy, schedules, etc.) in the SB 2030 Energy Standard Tool, which creates the SB 2030 Energy Standard for the project.

Casting the energy targets in the context of other buildings allows the owner to establish a goal on their own by considering if they want their new building to perform worse, the same, or better than other specific buildings in their portfolio, the community, or the region. This comparison has a more personal relevance than a national average from a book or reference based on someone else's perspective.

Conceptual energy models can be used in cases where the owner may have concern that their building is more unique than these reference buildings (this is a common concern). In this instance, a quick model can also provide results for addition to the benchmark plots – removing a variable in the owner's mind and improving confidence in the process. Conceptual modeling can also be useful for mixed use buildings or developments with multiple energy use profiles.

One method owners can use to formalize this target in context with other project goals is the creation of an Owner's Project Requirements document (or OPR) early in the procurement of the building. This will improve the likelihood of purchasing buildings with improved performance.

RFP and design/construction team selection

The selection of a design and construction team is a critical step in PBP.

Before a team can be selected, the owner must choose a procurement or contract structure. PBP has been proven to work well with design-build, construction manager at risk, and integrated project development. The design-bid-build approach has also had success with a legally mandated program like SB 2030, but is less tested with entirely owner-driven performance targets. Regardless of the method of procurement chosen, an RFP process can be beneficial, allowing more aggressive energy targets to be requested while controlling costs; if multiple bidders understand that their competition is also willing to take on a performance target, they are less likely to raise fees and other costs in reaction to the innovation of a performance target.

In this process, the RFP communicates performance based procurement requirements to prospective bidders, one or more of who will eventually be held to performance requirements by contract. The language chosen to communicate the energy performance criteria in the RFP is key to setting the tone with the design/construction team. Relative references, percent savings, or suggested targets soften the requirement and allows the team to revert to old practices. The word 'requirement' should be used, stating specific performance numbers. A process for calculating and substantiating these targets throughout design and construction, and requiring a post occupancy measurement, will solidify energy performance as a priority. In addition to a specific energy requirement, RFP language should also include non-energy related goals. Examples include water usage, comfort, daylight, and even programming requirements such as number of workstations or size of embedded data center. The project is most successful when sustainability performance targets are fully integrated with overall programming. The energy performance goal should be layered within other project goals that are equally or more important to the owner, such as the project budget.

Each of these elements is included in an RFP template in *Appendix A – Example performance requirements section for use in RFPs*. These elements should be customized for the owner and project in question before inclusion in the final RFP.

Once the RFP period is over and proposals are submitted, prospective team members are generally interviewed. In addition to the usual factors of qualifications, fee, and proposed approach and scope, the owner will need to choose their team based on the performance targets established in the RFP. Since these criteria is new to most owners, we have provided a set of questions that can be posed in respondent interviews. The questions can help an owner determine which respondents understand and are most likely to meet (or exceed) performance requirements. The questions can be found in *Appendix B – Interview questions for selecting a design/construction team under performance-based procurement*.

We have worked with projects that skip the RFP stage. Though these are an exception, those owners who are comfortable working with a certain team – especially one that is used to designing for performance – may sole-source their project. It is important that all the other best practices discussed here be included in the scope of that team's contract, and not stated as simply 'desirable goals,' or added after the contract is in place.

Contracting and enforcement

The contract should also include language to help enforce the project's energy requirements (or other important project goals). Owners may choose to offer an incentive for achieving the goal, hold a retainage against the contract until the energy requirement is met, or hold neutral enforcement as a base requirement without incentive or retainage (much like LEED level requirements are included in the contract).

Incentive basis – some owners may choose to provide the design/construction team with an incentive for achieving the energy requirement. Owners can align incentives for energy performance in the same way they incentivize hitting an accelerated construction schedule, for example. The design build process readily provides a framework for this approach. It can also be integrated into design-bid-build. One owner suggested that the incentive align with a percentage of the guaranteed savings versus a code compliant building. If actual performance is achieved, then they are saving real money each year and happy to share the savings with the team. That owner even suggested a potential annuity for annual incentives, some number of years after occupancy. Another innovative approach was carried out by RMI for their new office building. This approach established a pool of money that all parties shared (Jones, 2014). It could grow or shrink based on decisions they made. Energy goals were tied to receiving the pool. A final option is for the owner to use the utility provided incentive as the incentive for the team hitting the energy target. This could be leveraged using any one of the incentive options described above. In any case, the incentive needs to be on a similar level as other incentives used to motivate the team. Perhaps greater than $100-$150k depending on project size.

Retainage basis – some owners may choose to hold a retainage until the energy performance is substantiated. This can be contractually arranged in a similar manner as the incentive approach outlined above. The GSA Federal Center South project held a value of 0.5% of the total construction price (this is a large sum for this project). To date, we have not encouraged this approach; we just let owners know that others have chosen this approach. There are several examples of state, federal, and university projects in the Pacific Northwest that have used this approach.

Neutral enforcement – this was the chosen approach for a couple of the private pilot projects that we worked with. With this approach, the owner relies on the team meeting the requirement in the same way they meet other requirements such as number of beds, project schedule, or LEED certification to name a few. The requirement is stated up front, agreed to by both sides, and then continuously managed throughout design, construction, and operation. This approach may work best for owners with large portfolios and a somewhat steady future stream of new projects (new construction (NC) and major renovation). Design and contractor teams have additional motivation to hit the energy requirements to maintain a solid reputation for future work with the owner. For owners that have very few projects or perceived as less desirable work in a busy construction market, this may be more difficult. Design teams and contractors may be less motivated since it does not appear to impact their future revenue stream after this project is complete. In these cases, it can be extremely difficult to keep everyone on the team motivated toward achieving the goal once other project challenges arise.

Others (outside of this project) have documented approaches that are a combination of these methods. For example, a combination of the retainage and incentive approaches would provide the possibility for either a carrot or a stick, providing some of the benefits of both approaches (at the expense of a bit of additional complexity).

Design: facilitation

At the very beginning of design, an energy kickoff or charrette should be held. From the PBP perspective, the primary purpose of the kickoff meeting is to remind the team of the commitments they made when competing to win the work. At a minimum, this should cover a review of the tiered goals that they selected during the interview/submittal process. All goals should be reaffirmed with the entire team (remind everyone of obligations, including the owner, of their commitment) and documented for reference in future phases. The members of both the design and construction team likely include many people that were not included in the RFP and interview process, and who will be getting these details for the first time.

The kickoff should also include discussion of M&V and the schedule of deliverables throughout the project. Specific design approaches or other sustainability goals like LEED could also be discussed, but it is likely that there will be limited time for sustainability discussion; those focus areas are led by others, and hearing many competing sustainability requirements may cloud the core performance message. The performance portion of this discussion can be brief, focused, and firm.

It is likely that budget issues will be brought up early in design as well; this is common. And these issues are often raised not due to the economic impacts of energy requirements, but likely come from other areas of the building process (for example, “the project is over-budget; where can we cut – I bet some of these energy items cost more money”). It is important for the project manager to hold ground on what is causing the budget issues and cut there first. The facilitator should be ready to press the team for 2-3 examples of other areas where design could cut cost without impacting the performance targets.

Design: substantiation

Substantiation is the act of showing that the project is still on course to hit its targets. It is likely substantiation submittals will occur at the end of schematic design (SD), end of design development (DD), end of construction documents (CD), and end of construction. These should include updates to how the modeled EUI has evolved to match the evolving design. If the team consistently says the EUI is the same, then it is likely that it either is not being updated to match the design and/or they have not been asking the right questions to understand how the building will actually operate. For example, the operational schedule will likely be one of the most influential factors on actual EUI – and many modeling approaches simply use standardized schedules. PBP, on the other hand, requires customized schedules to match expected operation.

These submittals can be in the format of the team’s choice, to keep effort and complexity to a minimum. At a minimum, the submittal should probably include the following:

- Current modeled EUI
- Factors that caused a change in EUI from previous iteration
- Energy by end use
- 4-5 key variables that will influence the final EUI (sensitivity study)
- List of unknowns (what info is still needed to finalize the energy analysis)
- Measurement and verification status

Sensitivity energy analysis will be key to achieving performance targets. Traditional modeling tries to anticipate performance by nailing down a single likely outcome. The reality is that models have hundreds of inputs and picking a single combination nearly guarantees that it will be incorrect. Teams committing to energy requirements will need to do a sensitivity analysis around the key variables that will impact the actual EUI. Occupancy schedules and weather are two that would be included on almost any project list. Others may vary based on building type and other factors. We feel it is feasible to evaluate 5-7 key variables to understand how much they alone can cause the EUI to move. This is important for performance evaluation, design/contractor team education, owner education, and means for the design/construction team to mitigate their risk in committing to a target. It is also a defining metric to design for building resilience.

Measurement and verification

By design development, the team should already be developing a measurement and verification (M&V) plan. Such a plan is primarily implemented after occupancy, but many of the pieces (e.g. meters) are put in place during construction, and the entire plan must be integrated with the design of the building itself. At a minimum, the M&V plan should include:

- Whole building energy meters for electric and gas service(s). Install current transformers and gas flow meters (separate from utility meters) that report to the client's database on hourly or sub-hourly intervals. The database may be provided by a third party (hosted on the web) and must be accessible to designers, contractors, and operators. The database must store data for three years or more.
- Sub meter plug loads separately from all other loads.
- Sub meter lighting loads separately from all other loads.
- Building manager records notes about building occupancy and significant control changes or commissioning activities.

Other elements that can make measurement and verification even more effective include:

- Sub meters added to above system for each tenant space (keep light and plug loads separated).
- Sub meters for all major equipment and special areas (air handlers, chillers, boilers, exterior lights, data rooms, etc.)
- Perform a blower-door infiltration test and share the results with the design team.
- Weather normalization of the energy target. (Though our analysis suggests that this often has an impact of only a few percent, though it is often considered useful by owners and their teams, it is dwarfed by more impactful factors like occupancy.) Teams could even install a weather station for the building. Record horizontal solar radiation, ambient air temperature, and ambient relative humidity (at a minimum).
- Send data to ENERGY STAR Portfolio Manager; use to benchmark building.
- Survey the occupants to assess comfort, determine actual operational hours and identify opportunities for training and behavior-based conservation.

Each of the key members of the design and construction team should have some role in M&V after occupancy. This is important to ensure that each member remains engaged with the project after occupancy. This also reinforces with all parties the fact that energy targets are based on real operations, especially to those whose involvement would otherwise often end at the end of design. It can be helpful to create a responsibility matrix for M&V like the example shown in *Appendix C – M&V responsibility matrix*.

The energy requirement should be checked after a pre-defined period of time (perhaps 12 or 18 months after substantial completion). This will be used for contractual obligation, owner incentive, or retainage purposes. It will also be used to substantiate the utility energy efficiency program incentive.

If everyone waits until the 12-month time to look at the data for the first time, it is highly unlikely to be complete or accurate. Similarly, the 12-month check-in cannot be the last time it is looked at. It is important for the owner representative (likely facility services staff member) to have ownership in the approach/data. Make sure that their ideas for how to monitor and track are in the overall plan. Make sure it is simple enough for anyone to understand.

Training

If PBP has gone well, the post-construction period may be a good time to integrate the PBP approach into an owner's ongoing procurement approach. The results and benefits of the approach from this first project can be presented to leadership, capital planning, and facility services personnel for discussion. Discussion could focus on how PBP could fit into ongoing processes, facility standards, OPRs or other documents. Integrating PBP more deeply later can be difficult; it is easier when the project is fresh in people's minds and everyone involved has a success story they are both familiar with and want to share.

Results of pilot projects

We piloted PBP on a number of projects to understand how it could work in Minnesota construction projects. These projects ranged from ideal examples of implementing PBP starting in the RFP stage, to improved implementation of SB 2030 processes in the design stage, and even one project that used PBP solely in the operational phase of the building (to explore the measurement and verification component of a performance-based approach).

In this section, we summarize the use of PBP with each of these projects, and then compile a set of results and outcomes across all of the projects. At the end of the section, we summarize the best practices that we've assembled in using PBP with these projects.

Projects

Performance-based procurement can be used for a broad spectrum of project types. Throughout our study, PBP methods were used at some point in the ten projects listed in Table 3.

Table 3. The ten projects observed during the study.

Project name	Type	Size	Programs	Earliest phase
Mayo Clinic Generose Expansion	Inpatient healthcare	140,000 ft^2	None	Pre-RFP
Dept. of Admin. HERO Facility	Public safety	42,000 ft^2	SB 2030	Pre Design
Metro Transit BLRT Maint. Facility	Maintenance facility	168,000 ft^2	SB 2030	Design
Aeon Developments	Multifamily	Varied	Xcel EDA	Planning
Parking Ramp #6 Development	Mixed-use	TBD	None	Pre-RFP
Wolf Ridge ELC Dormitory	Dormitory	Uncfmd.	MN Power	Pre-RFP
Higher Ground St. Paul	Assisted Housing	112,750 ft^2	SB 2030	Operations
Washburn Center for Children	Outpatient healthcare	76,721 ft^2	SB 2030	Operations
DHS Saint David's Center	Child Care Center	26,600 ft^2	SB 2030	Operations
UMTC Health Sciences Education and Learning Center	Higher education	150,851 ft^2	SB 2030	Pre-RFP

Six of the ten were studied in-depth; the other four were observed at certain key points in their process. Descriptions of nine of the projects are given below[2].

[2] We did not have time for adequate follow-up with the project at Wolf Ridge ELC.

Mayo Clinic Generose Expansion

Outreach

As part of our general outreach to announce this pilot program in Minnesota we contacted many of the larger building owners in the state, including Mayo Clinic. Mayo had adopted aggressive energy goals as part of a commitment to the Clinton Climate Initiative, and as a result had already been interested in strategies they could take to reduce energy usage. Most of the strategies they had employed (like retrocommissioning) were geared toward existing buildings, and they had been looking for a strategy that could also address new space including gut retrofits, new construction, and fit-outs. They were interested in PBP because it allowed them to tie the eventual energy consumption of these spaces directly to their organizational goals for energy improvement.

We discussed upcoming projects with their project managers, and decided to implement PBP on the very next project, which was an expansion of their Generose Building, a bed tower on Mayo's St. Mary's campus. The project was made up of three entirely new floors of the bed tower and included inpatient, outpatient, therapy, office, and mechanical space. Total floor area was to be roughly 140,000 ft^2. It would be served by an entirely new HVAC system.

Planning

The first step in PBP for the project was choosing an energy target. We initially provided Mayo with a number of benchmarked data points for both inpatient (see Figure 3 as an example) and outpatient facilities. We also included some medical office benchmarks.

Figure 3. Energy benchmarking exercise for the Generose project. This was the first of an iterative process.

In addition to these benchmarks, we helped Mayo analyze their own existing building performance data to understand the EUI target for this building in that context. Because this project is an addition (adding similar space) to an existing building, that building, Generose itself, was a very appropriate benchmark. The existing building had an EUI of approximately 155 kBtu/ft2/year. Applying Mayo's goals for energy improvement yielded a target of 122 kBtu/ft2/year for the new space, which our benchmarking exercise showed was similar to ENERGY STAR and toward the lower end of other benchmarked buildings.

The next step was discussing procurement of a building with this level of performance. Mayo had used both design-bid-build and CM-at-risk (CM@R) methods of procurement in the past. As PBP has been well tested with the CM@R approach, Mayo decided to use this approach. We helped them craft an RFP that would clearly define the energy target in addition to other sustainability goals (see *RFP and design/construction team selection*). It also included measurement and verification and other elements that would ensure the entire team remained committed and engaged to energy performance throughout the process.

Once proposers responded to the RFP, we further aided Mayo with questions to ask those respondents in their proposal interviews, to determine which teams may be best suited to hit the energy target.

Design and construction

Throughout the early stages of design, we worked with the design and construction team that was selected. We aided in an early design charrette focused on energy and sustainability, where the entire team obtained a common understanding of energy requirements of the project, brainstormed energy solutions, and heard the owner's lead architect state the EUI target as a project requirement, akin to budget. This project manager was fulfilling the role of the "energy champion" in this case. It is important for every project to have such a champion, so when obstacles arise and the design and construction team challenges the energy target, the importance of that requirement are simply re-iterated. The lead design firm was providing energy modeling to substantiate their progress toward the target; this was included in their overall fee proposed for the project.

This project was still in design (developing construction documents) at the publication of this report.

Program interaction

The Generose project is being constructed in Rochester, MN, in the territory of Rochester Public Utility (RPU). RPU does not have a formal new construction program, so there was no direct interaction between our PBP effort and the utility. However, the utility is now very interested in the process that Mayo is using, and is considering how it may be incorporated into other projects in the future.

Aeon Affordable Housing Developments

Outreach

As part of our general outreach to announce this pilot program in Minnesota we contacted developers in Minnesota. One progressive affordable housing developer, Aeon, was particularly interested in the concept of PBP. Aeon had recently completed a showpiece affordable housing development called The Rose, which had achieved an operating EUI of 35 k Btu/ft^2/year. They were now looking to systematize that momentum to future projects, and PBP would allow them to do so. We soon began working with them on two projects, at the time called Towerside and Greenway Terrace. Both were affordable housing apartment buildings of about 60 housing units in size (80-90,000 ft^2), and both required a significant public funding component to become viable developments. Towerside is to be in Minneapolis, and Greenway Terrace is to be located in Ramsey. Greenway Terrace apartments is further differentiated because it includes many townhome housing units that are separated from the main apartment building.

We decided to move ahead in supporting both projects despite some uncertainty, as both had already secured enough public funding that the projects were likely eventualities even if design was not completed during the scope of our pilot.

Planning

Aeon had developed trusting relationships with a few design firms and contractors in the area, and generally felt its projects were uniform enough that it was most efficient to develop the buildings with the designer and contractor on board from the beginning. Aeon would hold separate contracts with each though, so it would not strictly speaking be design-build. This would remove the competitive aspects of PBP (such as the RFP process), but all other elements would remain applicable.

We first supported each project in choosing an energy target. Working closely with Aeon, we were able to identify three sources of building benchmarks that would be helpful for narrowing down a target for this project type:

- Recently constructed multifamily buildings in Minnesota, available from national data sets
- Energy performance of Aeon's other affordable housing projects, tracked by their operations group
- A CARD-funded project called EnergyScoreCards Minnesota (Woodson, 2015) that benchmarked hundreds of multifamily buildings in the state, according to building age

Having three different lenses for viewing potential EUI targets was helpful for Aeon in selecting the target. They had contextual reasons, and funding, to aim for an energy target for Towerside of 40 kBtu/ft^2/year. The budget for Greenway Terrace was more constrained and did not allow as stringent a target; based especially on past, similarly-funded Aeon developments the target for Greenway Terrace was set at 48 kBtu/ft^2/year.

RFPs were not required for these projects with their preference for sole-source procurement of both design and construction. (It should be noted that they did not select the same designer or the same contractor for the two projects.) So, our role immediately preceding design was relegated to getting the team members up to speed on the performance-based approach.

Design and construction

Unfortunately, as of this publication this was the farthest that either project got in the process. The Towerside project was put on hold awaiting gap funding (a small amount of additional public funding beyond what was initially granted) to make it financially viable. When the project receives that funding, which could come as soon as Fall 2017, they hope to continue in the process.

Greenway Terrace chose not to use a performance-based approach because of the difficulty in measuring energy usage and accounting for anomalies across its diverse set of apartments and townhomes. Measurement and verification does become substantially more complex when dispersed across many single-family housing units. However, we found that it could have been completed, and done so reasonably cost-effectively; we argued for a modified version of the process to be used. The developer ultimately chose to stick with a more traditional path.

Program interaction

The Towerside project was in Xcel Energy territory and was set to enroll in the EDA program before it was put on hold. The Greenway Terrace project was in Connexus Energy territory, where there is no new construction program.

Parking Ramp #6 Development

Outreach

Because of our involvement with Mayo Clinic, we made an ally in the local economic development agency, Destination Medical Center (DMC). DMC was also in the process of setting performance goals for projects they support, so we had a shared goal. In the short timeframe between embarking on this partnership and the publication of this report, we began working with the DMC on a couple of projects. The plan is for our team to aid these projects in utilizing PBP, thereby ensuring they would also meet the energy goals required by the DMC.

One of those projects is a mixed-use development planned to be added above a downtown parking ramp (Ramp #6).

Planning

Rochester Parking Ramp #6 is currently under construction. It was designed and the lot zoned to accommodate up to ten additional stories of residential or office use. In July 2017, the City issued an RFP for a team to develop such a building in the air rights above the ramp.

Working with the City, we developed energy targets specific to the potential building functions—residential, office, hotel and retail. These targets were formally incorporated into the RFP as sustainability evaluation criteria, and PBP language included as an exhibit to the RFP. Proposals will be judged by their commitment to energy performance and ability to design to and ensure facility performance. In the RFP evaluation scorecard sustainability elements, of which energy performance is the largest focus, will comprise 150 points out of a total 1000 points. Energy targets were presented in tiers of *mission critical*, *highly desirable* and *if possible* and based on benchmarking data from a number of sources—Minnesota multi-family benchmarking research, U.S. CBECS cold climate building data and benchmarking data from Minneapolis and other regional cities.

The complete RFP is available online at Rochester RFP and responses were due September 22, 2017. Following selection of the development team, we intend to pursue continued support of the project as it progresses through contracting and design, with the goal of ensuring the City and developer's goals are realized.

Metro Transit Blue Line Light Rail Transit Operations and Maintenance Facility

Outreach

As part of the outreach effort for public-sector SB 2030 projects, CSBR looked at projects whose schedule matched the timeline of this research grant. Several state agencies were contacted and the PBP pilot program was introduced. The Metro Transit Blue Light Rail Transit (LRT) Operations and Maintenance Facility (OMF) was solicited because this large 168,000 ft^2 facility was in early schematic design in the winter of 2016. The facility is a portion of a much larger light rail infrastructure project. Metro Transit had built several similar facilities and was interested in improving the timeliness of their completion of their SB 2030 requirements. An engaged project manager was also integral to pushing this project towards using the PBP process integrated with their SB 2030 requirements.

While interested in implementing PBP, they were hesitant about issues related to Federal (and specifically FTA) funded projects that include other procurement requirements. As was the case with other projects, they were also concerned that participation in PBP would preclude them from receiving the EDA-based rebates.

Planning

Early in the outreach effort it was noted that the project had not yet determined their respective SB 2030 Energy Standard. This task should have been completed during predesign. In investigating the reasons for this delay, it was discovered that the large amounts of process loads made it more difficult to establish and verify an energy standard for the building. Also, there were staffing issues with the consulting engineering team responsible for the energy modeling that was being performed to meet the SB 2030 Standard

Design and construction

Since this project followed a non-standard set of design submittals (30%, 60% and 90%) corresponding to the typical design process of schematic design, design development and construction documents phases, they were difficult to use as benchmarks in the progress of the project. Initial outreach focused on the establishment of the Energy Standard at the equivalent of schematic design to allow for opportunities for energy savings to be evaluated in large part prior to the equivalent of the completion of the design development phase of the project.

The energy target goal establishment proved problematic as delays ensued in motivating the design team to complete the tasks necessary to use the SB 2030 Energy Standard tool in a timely manner. After some delay, engagement was made with the energy modeling consultants and the discussion began on how best to exclude process loads from the total building loads. Following this effort, some quality control review of the fidelity of the models and a staff change of the primary modeler further pushed back the timeline on the model establishment. Discussion was necessary to establish appropriate baselines for specific equipment loads for the project; as variations in the process-derived loads had made significant differences to the resulting EUIs.

Program interaction

The Operations and Maintenance Facility is enrolled in the basic (not enhanced) Xcel EDA program. Similar light rail facilities have also participated in the EDA process over the previous few years and are being referenced by the design team and The Weidt Group as baselines for expectations of savings opportunities for this project.

Figure 4. Schematic of the Blue Line Light Rail Transit Operations and Maintenance Facility.

Department of Administration Health and Emergency Response Operations (HERO) Center

Outreach

Because this project was required to comply with SB 2030 and was in the early predesign process in 2016 the project team was contacted and presented with the PBP approach proposal. The project manager was very euthanasic about PBP and claimed that her firm was a proponent of early energy modeling and employing energy modeling as a method to reach high energy efficiency in buildings, particularly in federal projects that required meeting LEED requirements. The city of Cottage Grove and Woodbury were initially reluctant to participate because they thought that they would lose the Xcel Energy program incentive but the project manager was able to clarify the purpose of PBP with the owners, as she believed it would likely increase the amount of the utility rebates.

Planning

As part of the state bond process, a predesign document was created in March 29th of 2017 which noted the design for a 41,056 ft^2 joint police training facility for the cities of Cottage Grove and Woodbury. In the pre-design document, the State of Minnesota Sustainable Building Guidelines or B3 are noted under Applicable Design Criteria and Codes on page 34. Additionally, the following requirement to meet SB 2030 was included in this document and the project indicated that they were underway on meeting the standard. The preliminary SB 2030 Standard was identified at this stage to be 35 Btu/ft^2-yr.

Design and construction

Schematic Design for this project began on June 2017 and is expected to continue to November 2017. We met with the design team for a check-in on July 8, 2017 just as they were in the beginning of Schematic Design.

The team noted that they are pursuing passive strategies early on this project and are performing iterative modeling using "Insight" through their Revit model to evaluate comparative strategies. They have looked at five different massings (though it was noted that it is not expected to be sufficient to establish a final predicted EUI for the design). More specific modeling in Trane Trace was slated to begin at 50% of schematic design. The project team has begun the early phase energy modeling and the process of establishing an early benchmark EUI with the B3 software. As of August 28, 2017, they were about 40% through Schematic Design.

Construction will not begin until September 2018 with anticipated completion in October 2019.

Program interaction

The HERO center is expecting to sign up for Xcel Energy's Enhanced EDA program.

Figure 5. Site view of the HERO center.

University of Minnesota, Twin Cities Campus, Health Sciences Education and Learning Center

Outreach

We contacted the University of Minnesota, Capital Planning and Project Management, project manager for the Health Science and Learning Center Project regarding applying PBP to this project. It is a 188,500 ft^2, four-story building. The Schematic Design began in June of 2016 and construction is anticipated to begin in March of 2018. This project was selected because it was already following many PBP processes because of the Universities' approach to establishing energy goals.

Planning

A pre-design report established an EUI of 85 kBtu/ft2/year for this project. It was based on a secondary school building type that represented the functions of the proposed facility. The EUI was included in the RFP for selecting a design/construction team for the project. The RFP also required an energy modeler to work with the design team to meet the energy performance goal.

Design and construction

In May 2017 the energy modeler for the project recalculated the SB 2030 Energy Standard to be 76 KBtu/ft^2/year and the design energy use per square foot to be 78.73 KBtu per year. This approximately 3.5% overage is permitted under SB 2030. The revised numbers were based on more precise data about the building space types as well as light and power density and hours of operations.

Program interaction

Although this project qualified for Xcel Energy's Enhanced EDA, the University did not participate for the following reasons: 1) They would not then own the energy model and could not make changes when they wanted to and 2) the EDA process did not keep up with their schedule when energy modeling data is needed in the design process. They will use EDA at the end of the Design Development phase to determine the energy rebates that they will receive.

Figure 6. Conceptual design rendering of the Health Sciences Education and Learning Center.

Higher Ground Saint Paul

Higher Ground is an organization providing assisted housing for homeless individuals. The project was entering the operations phase of its life cycle after going through the SB2030 process, and we interviewed its facility manager.

Operations and performance

The facility manager was interviewed primarily to determine the level of engagement of the operations project team in meeting the SB 2030 Energy Standard. This individual had been the facility manager at that organization since the building had been occupied in late 2016.

There was a limited amount of information transferred from the design process to operations. It did not appear that the Basis of Design or the SB 2030 Standard EUI were yet part of the operations assessment of this project. Some of this information gap may be because the project has yet to report its first-year energy consumption to the SB 2030 program. The facility manager is aware of the future requirement of tracking energy usage for the facility. However, the facility manager thought that the building was designed to meet the SB 2030 Energy Standard. Working with The Weidt Group on options, she felt confident that the building would attain the standard.

The project team was not aware that there was a requirement to record energy and water consumption and is planning to require additional metering on subsequent phases of this project. While facilities staff acknowledged that actual energy and water data would be helpful in determining the efficiency of the building, they were concerned about the impact on their workload and would prefer an automated reporting system. The facility manager said that they do internal benchmarking for all their facilities but didn't describe how that is done without recording energy consumption.

Figure 7. Conceptual design rendering of Higher Ground St. Paul.

Washburn Center for Children

The Washburn Center for Children is an outpatient medical building. The project went through the SB 2030 program, and had recently entered the operations phase when our study began.

Operations and performance

The upper management of Washburn was interviewed to evaluate the level of engagement with the SB 2030 Standard. Management staff interviewed knew that the project was required to meet SB 2030 Energy Standard. The organization’s board of directors, its manager and the architect were all on board and were committed to meet this standard cost-effectively. The SB 2030 Energy Standard focused the energy efficiency discussion and they could compare different alternatives that would meet the Energy Standard.

The manager we interviewed was not aware of the Basis of Design document but thought that during the weekly meeting most of the responses to the Owners requirements were presented. He noted that a more formal process would be helpful for first time owners. A clearer process for creating the Owner Project Requirement documents and the designer's response in the Basis of Design document would have been useful. When asked about the obligation to record energy consumption, the manager said that he was aware of it but they haven't completed it in the first several years due to other pressing matters during the building start up. He was positive that they would document energy consumption at some point.

Figure 8. Conceptual design rendering of the Washburn Center.

DHS Saint David's Center

The Center is a child care center at Department of Human Services. The project came into operation during the study.

Operations and performance

This project's facility manager was interviewed about his interaction with the SB 2030 program. He had been recently assigned this position due to staff changes and the building had been in operation since 2016. The manager noted that the SB 2030 Standard Requirements were not well communicated and as a result there has been difficulty in meeting the requirements of the program. He was unaware how the building design intended the building to meet the energy requirement but knew there had been considerable time and effort devoted to meeting the energy standard. However, he is unsure how the facility is intended to meet SB 2030, despite the documentation he has reviewed.

Though energy and water consumption tracking is a requirement of the B3 Guidelines in SB 2030, there is currently no consumption data for this project. Information on this funding-derived obligation was not clearly communicated to new staff. However, the manager is enthusiastic about using consumption data to drive savings and using the savings to improve St. David's building performance.

Figure 9. The DHS St. David's Center.

Summary of project results

We tracked both savings and cost metrics as we observed pilot projects. Our ability to obtain comprehensive cost data was limited (though some is shared in *Incentives and cost effectiveness* below). The savings data we obtained is summarized in Table 4.

This data shows that pilot projects with at least design phase data have selected EUI targets approximately a third lower than their applicable EUI benchmark. Actual design EUIs at the time of this publication are even lower than those targets, such that the designs are beating the baseline by roughly 40%. This generally surpasses typical new construction program benchmarks by a significant margin (see *Program benchmarking*).

Cost impacts in these projects were more related to program activities, so those are discussed in *Incentives and cost effectiveness*.

Table 4. Summary of quantitative results from pilot projects.

	Baseline (Benchmarking)	Baseline EUI	Target EUI	Design EUI[1]
Mayo Clinic Generose Expansion	Regional Clinic Median (PBP)	160	122	110
Metro Transit BLRT Maint. Facility	90.1-2004 (SB2030)	215	120	83
Aeon Towerside	Portfolio Median (PBP)	64	40	TBD
Higher Ground St. Paul	90.1-2004 (SB2030)	120	81	77
Washburn Center for Children	90.1-2004 (SB2030)	80	55	55
UMTC Health Sciences Education and Learning Center	90.1-2004 (SB2030)	-	90	66

[1] Design EUI estimated based on in-progress design at time of this publication.

Program Opportunities

Our experience with assessing current programs, and then executing pilot projects using performance-based procurement, has led to a number of conclusions. We first discuss those that could improve utility CIPs in Minnesota. Next, we discuss potential improvements to SB 2030. And finally, we address an ideal new CIP that could be created from scratch using the PBP framework.

Improving CIPs

A key goal of this study was to explore the opportunities for integrating PBP with conservation improvement programs in Minnesota. Throughout our efforts, but especially in the pilot projects, we found several ways to include PBP in existing new construction programs. Each of these opportunities and the challenges associated with it are described separately, but there is significant interaction amongst them. A utility would probably be best served incorporating several of these in their existing programs since each opportunity may be difficult to pursue on its own.

More direct engagement with owners

Utility new construction programs could significantly increase direct engagement with owners. The PBP approach recognizes the owner as a central figure for driving energy performance, alongside both design and construction teams. The building owner is the ultimate decision-maker, and the only one who can make value judgements on performance versus cost. The customer- or owner-centric nature of a performance-based program could potentially give utility new construction program administrators more influence on new construction or major renovation projects and all programs could realize improved customer satisfaction.

Engagement with the owner allows for discussion of project goals, and often even owner values. This is an opportunity for the customer to experience exceptional customer service. The owners in our pilot projects were happy to have this assistance.

This direct engagement also drives the owner to more strongly consider the energy and sustainability goals for their projects. It generally allows for better integration into the program and ultimately provides greater savings as an owner is primed to be open to any idea that improves performance. The CEO of the Washburn Center for Children was an example of such an owner. They leveraged the target to rigorously enforce sustainability goals through the RFP, contract, and design. They said that the energy target focused much of the discussion, and led to many new ideas.

Increasing owner engagement begins with program outreach strategies. Typical new construction incentive programs, such as Xcel Energy's EDA program, connect primarily with design teams to recruit projects into the program. This is an efficient outreach strategy because each design firm works on several major projects per year. Also, though new construction programs prefer to work with projects at the very beginning of design, they will typically accept projects that are at any stage of design (other than the very end) to maximize participation. Performance based procurement requires that the outreach targets shift, both toward owners and toward engagement starting before the owner has contracted for design or construction. This change in timing provides some significant benefits, but also presents an obvious outreach challenge.

This approach and its timing forces the owner to discuss and seriously consider energy impacts prior to design starting and before a detailed energy model has been developed. This process opens the door for discussion and provides a level of influence that most new construction energy efficiency programs rarely achieve. In the Mayo Clinic project, for example, the owner had never considered how these design processes impact the operational EUI goals for their campus. The result of considering the EUI target up front was that they looked at energy performance differently – it became more of a core requirement like the project budget that they demanded from day one. On past projects, options for improved energy performance would have been presented to them midway through design. In addition, they had operations staff included in energy charrettes and review of early energy modeling results, which allowed those who would be impacted by the energy usage and most involved in M&V to also be involved in design decisions affecting energy.

A shift to more focus on the owner does comes with a significant challenge: there are many more large building *owners* than there are *designers* (the typical channel for new construction outreach). This makes the same approach to outreach more time consuming by an order of magnitude. In our pilot work, we found that this was substantially mitigated by working with certain types of owners who build more buildings, such as developers, governments and public institutions, healthcare owners, and affordable housing organizations. We also leveraged broader outreach channels such as non-profit organizations and economic development institutions. And we were still able to obtain leads through designers – namely architecture and planning firms – because they often provide pre-design assistance for projects to help obtain funding, understand feasibility, or inform the RFP. Finally, we recognized the critical nature of timing in this process, and that if an owner does not have a new project or major renovation at the right stage of development now, they likely will have another project at some point in the next few years. A program with a longer-term commitment would make outreach substantially easier for this reason.

With all of that, we still did not fully eliminate this challenge. It's likely that there will always be some outreach challenge for the PBP approach. And the suggestions above do represent a significant shift in the way outreach is conducted for new construction. The good news is that many other program types (e.g. Industrial programs) have historically used owner-focused outreach, so this is not entirely new to efficiency programs.

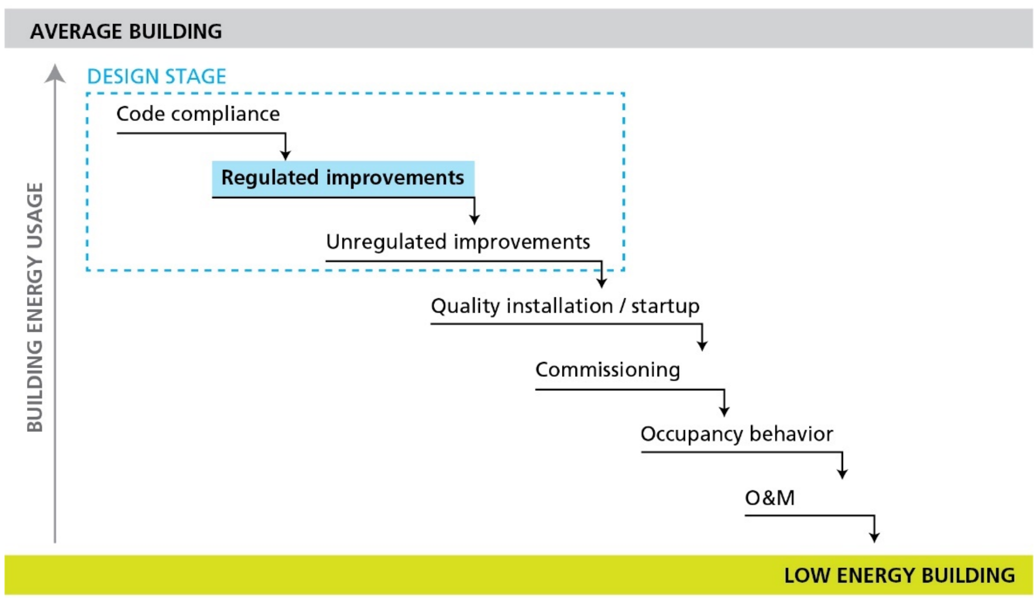
Incorporate energy targets for real performance

With performance based procurement, projects can focus on the real energy outcome of the building, as opposed to theoretical savings based on percentage better than code. This shift in focus should occur as early as possible in the project's inception, to influence as much pre-design activity as possible (e.g. bidding) and continue through the entire design process.

Focusing on measurable performance targets could yield significant benefits for most types of projects.

On ultra-high performance projects for example, the traditional baseline analysis method doesn't account for impacts beyond mainstream levels of efficiency. These impacts come from integrated project delivery, life-cycle cost analysis, HVAC system synergies or even elimination, cascading energy use, occupant engagement, daylighting, alternative approaches to thermal comfort standards, operations management, unregulated loads, and more. Instead, the traditional approach focuses on design alone, and then only on a portion of design. In Figure 10, the impact of traditional programs is limited to that shown in dashed-line box. All other items, including those in the list above, cannot be easily influenced in this typical approach.

Figure 10. Energy-saving impacts in a high performance building.



Conversely, a PBP approach that focuses all actors on a measurable performance target can impact all of these areas. This results in several new energy conversations. For our transit facility pilot project, the owner and design team could discuss the facility's energy system operating characteristics in much more detail than they would normally do at the beginning of design (e.g. how often will those garage doors really be open? How much hot water does one of these facilities really need to use?).

For more mainstream building projects, such as a spec office building for example, a developer may be hesitant to make major changes that differ from the design approaches, systems, and equipment typically used in such a building. For such a project, the traditional program approach is constraining as well, because the developer is only willing to do things differently from their last project if those improvements have very short paybacks. In this case the use of a performance target can have more impact because it forces other areas, such as quality installation and startup, to include a focus on energy performance. Quality installation and startup are services that the developer is technically paying for anyway; the performance target simply forces these services to be delivered.

The Greenway Terrace project, which did not have enough extra funding for high performance systems, used performance targets to achieve savings in other stages of the process. The owner recognized the benefits that the performance target would have on other aspects of the building. As a result, Greenway Terrace performs in the lowest quartile of their portfolio as opposed to highest quartile. If an owner has some interest in stretching performance beyond their usual experience, they can use tiered goals to define priorities (see the *RFP and design*/construction team selection section for more information).

Building owners need a different approach to focus their project team on the performance targets. From our overall best practices (see *Energy target setting*), the following are the key steps to identifying a successful performance target:

1. ***Benchmarking together with goal setting.*** This process ensures that energy targets (and subsequent discussions, design decisions, etc.) are based on achieved performance of other buildings. Determining aggressive but financially feasible energy targets for any specific building project is crucial to the approach.

2. ***Establishing the energy target prior to issuing the RFP.*** Getting the target set prior to issuing the project RFP and including that target in the RFP sends the strongest signal to all who are interested in participating in the project that energy performance is a requirement of the project, on par with budget and program.

3. ***Contractual requirements.*** The contract must require team members to participate in measurement and verification efforts after occupancy, ensuring that they are there to help the owner with any energy issues that arise, as well as ensuring that they are focused on real operational performance during design and construction. This is especially important in discussing HVAC measures – some measures suggest high performance but are difficult to commission properly; these may not be considered. (see *Contracting and enforcement*)

Note that a measurement and verification plan is a prerequisite of having a performance target. Some amount of M&V should be included in most projects with any interest in energy. But this does present an additional cost or complexity for some projects. Greenway Terrace, for example, cited M&V complexity as part of the reason that the full PBP approach was not followed through on – it was simply too complex for their building type (which included a group of single family residences).

Incorporating an energy target into program requirements would be a bare minimum change that a new construction program could make to capture the benefits of PBP. An existing program like the EDA programs offered throughout much of Minnesota could adopt these performance targets as a procedural requirement, or tie them to incentive rates. Either way, the best practices above should be followed. The tie to program incentives is explored more in the *Incentives and cost effectiveness* section.

Greater influence on design

The energy target extends the impact of the owner's energy goals to all steps of procuring the building, not just design. But design remains a key step in achieving a high performance building. In the PBP approach, the influence on design can seem more indirect than some new construction program approaches, like that in EDA. But it can be just as effective.

The program implementer in a PBP-based program may still provide specific energy recommendations for the project, but that would no longer be their primary method of influencing the design team's approach. The energy targets in the design team's contract provide the primary design influence from such a program and can potentially lead to greater influence. For example, in our project with Mayo Clinic, the initial design had a large amount of curtainwall glazing. The design team recommended some strategies, such as better glass and incrementally better curtainwall frame, to save energy in the façade selection. Even so, the design team's energy analysis showed the building would never hit its target with that much glass. The owner then simply asked for a different façade design that met their energy target; the design team promptly returned with a façade with optimized glazing (35% glass; still plenty for a comfortable, well daylit building). A traditional program would have offered incentives for improving the glass, and possibly even provided some additional incentive for reducing the window to wall ratio. However, the incentives would be fractional compared to the cost of the façade.

Moreover, if the design team is proactive about it, the process results in greater flexibility in design. It is completely up to the design team whether greater effort should be put into equipment selection, envelope design, control sequences, or startup and commissioning. The performance based procurement program does not dictate solutions for any of these areas, in contrast to some institutional owners who have dictated prescriptive energy requirements, from ground-source heat pumps, to daylighting controls, to renewable energy. As an example, in our work with Aeon, the energy targets immediately led the designer to conclude that one or two envelope choices could achieve the target, and prompted a broader discussion about which HVAC system type could meet the energy targets while staying within the financial budget.

All of this results in transferring significant additional responsibility for performance to the design and construction team. The task of energy analysis will naturally transfer to the design and construction team too, as opposed to staying with the owner or the program. Because the team is held to a certain target, they need to understand how every design decision impacts the energy analysis. In general, this means greater effort in the designer's scope for energy modeling than on most projects. The performance based energy target allows design teams to change their design process to accommodate the best methods for attaining the owner's requirement. This is likely to impact the market for energy modeling where performance based procurement is employed. Many design firms in Minnesota are now beginning to complete their own energy models (see the *Stakeholder feedback* section), but there is still room for improvement. Modelers need to be able to make more accurate predictions and there is a general need for increased capacity in the occupation. While lack of capacity and expertise is a barrier, it also creates an opportunity both for individuals and for the community to grow in its ability to address high performance design. (Incidentally, the advent of this approach creates similar opportunity for measurement and verification professionals.)

One example of the current state of energy modeling is the HERO project. For the architect on the project, early phase energy modeling simply moved efforts and associated labor hours from a later project phase to an earlier one and did not result in an appreciable net gain in project hours. From the owners and designers we have spoken with, this will at times result in an additional design fee for the owner. But on many projects in Minnesota that are interested in energy performance, the design team is already doing an energy model for loads, system selection, LEED, or design decisions. The additional cost for relating the design to the target would be minimal in these cases. In any case, energy modeling under the performance based procurement approach is much simpler than compliance modeling for LEED or code. This is because modeling under PBP does not require a baseline model and has no rigorous third party review to pass, because designers are conducting the modeling in their own best interest (to hit the target). LEED and code compliance are often the most expensive components of a modeling scope.

Incentives and cost effectiveness

Potential cost impacts

A PBP utility energy efficiency program is designed to support higher performance buildings than a traditional new construction program. Program cost effectiveness (in terms of $/kWh-saved) is fundamentally contingent upon either increased savings (discussed in *Summary of project results*), or on a decrease in program delivery costs (especially for more mainstream projects). Theoretically, there are opportunities to reduce overall program cost with the PBP approach.

A PBP program both drives uptake of high-performance buildings and can simultaneously benefit from the new high-performance design paradigm, as some responsibilities are shifted from the utility to the project team. High performance building projects typically involve a team with substantial energy expertise and scope for modeling, costing and optimization, executed real-time and continuously integral to the team's design process. Savings in ultra-low energy projects are often due to fundamentally different approaches than the code is meant to handle: integrated project delivery, HVAC system switch/elimination, occupant engagement, daylighting, alternative thermal comfort standards, operations management or unregulated loads. In the long term, shifting toward a measure-and-verify evaluation paradigm could also bring unregulated building loads into the purview of the utility program, increasing the denominator in the cost effectiveness calculation (see *Incorporate energy targets for real performance* above).

Furthermore, detailed utility modeling may become redundant or superfluous to the design process under PBP. Program administration calculations can be streamlined by adapting or directly utilizing high-quality deliverables from the design team. And/or the PBP program can shift toward an outcome-based program (see the *Opportunities for new CIPs* section below).

Incentive rates also have an impact on program cost. While they are crucial to the success of a program, incentives should be considered largely independent of the PBP program design, calibrated to the specifics of the market and goals of the utility energy efficiency program.

Within this PBP program framework, cost effectiveness is still sensitive to several nuanced customer variables— number of customer touches and lead times for project recruitment, number of repeat customers, average building size, project attrition or cancellation and complexity and depth of the PBP services required by the particular customers. These variables can be managed by careful program design— focused outreach, project screening and streamlined internal tools and templates. (Outreach strategy is discussed further in the *Outreach, Target Market and Messaging* section, below.) Cost effectiveness is also sensitive to how long the program runs; it may take multiple years for a program to spread startup costs over many projects and generally achieve market momentum and economies of scale.

Finally, from the design team's perspective, performance-based programs may ultimately enable a leaner project delivery for high performance projects by allowing design teams, now contractually enabled and entrusted to achieve measurable targets, to prioritize their efforts or even commoditize the delivery of high performance buildings.

All drivers of cost-effectiveness in a PBP program versus traditional new construction are laid out and compared in Table 5, for both this pilot-phase program approach as well as a standalone program.

In an initial market-transformation pilot program, PBP may be layered on top of a traditional new construction program to leverage existing marketing, outreach and administrative infrastructure, as well as to appropriately pace transformation of local market technical competencies. During this phase, it may be desirable to set minimum performance requirements (in terms of EUI, by building type) to justify the additional program expenditure and to guarantee market transformation. Special higher incentive rates may then be required to encourage uptake.

Table 5. Comparison of PBP to other new construction program options.

	Traditional NC program		**Performance-based procurement program offering**	
	Typical	**Higher performing buildings**	**Layered on traditional NC (MT pilot phase)**	**Standalone**
Savings - Regulated	Standard	High	High	High
Savings - Unregulated	None	None	Yes	Yes
Project Team Modeling	No	Yes	Yes	Yes
Utility Modeling	Yes	Yes	Yes	No
Utility PBP	No	No	Yes	Yes
Utility Incentive	Yes	Yes	Yes	Yes
Utility Total Program Costs	Medium	Medium	High	Low

Cost outcomes

We also attempted to collect cost outcomes on the nine projects that we observed, but it proved substantially more difficult than collecting energy analysis outcomes. Such costs were not isolated at the appropriate levels on most of the projects that we observed, and in other places were confidential. However, we can comment on two primary observations of cost:

- Performance based procurement approach can move the cost of energy modeling from the program to the owner, and thereby reduce program costs.
- The performance based procurement approach requires technical assistance for prioritizing goals, setting an energy target and periodic high level energy modeling review, all which are new tasks in relation to traditional new construction.

We'll use an example to explain. Consider a new 200,000 ft^2 building enrolled in a basic new construction program; using program benchmarks we can estimate savings of 600,000 kWh, 100 kW and 3,000 Dekatherms annually from this example. The total comprehensive new construction energy efficiency program delivery cost that covers the cost of energy modeling for this project is typically about $40,000 for this size project, including $10,000 for program administration and $30,000 for modeling and technical assistance. The program also incurs the cost of incentives; if we use Xcel Energy's EDA incentive rates, the estimated rebate for this example is $39,500.

Applying performance based procurement to the example above, energy modeling and technical assistance costs could be reduced by 50% as the design team assumes responsibility for much of the energy modeling as outlined in their PBP contract with the owner. The program does assume some additional up-front costs (goal-setting, etc.). The limited data that we could collect from two observed projects suggests a program implementation cost of $28,000 per project (including administration and TA) which is a $12,000 savings compared to $40,000 per project benchmarked cost (which is admittedly not a direct comparison). This should improve utility program cost effectiveness, as is. In addition to that cost savings, the approach also has the potential to increase savings, which also improves cost effectiveness.

For the *owner* of the example building, the energy modeling by the design team and building performance verification do create additional cost. If the market is sufficiently transformed to the point where most higher performing buildings have some amount of energy modeling conducted anyway, the increase for the additional modeling rigor needed to comply with the program could be limited to $10-15,000 on a project – the substantiation submittals are relatively simple because the team is ultimately modeling for their own substantiation as much as for the program. In addition, the PBP approach should reduce the amount of time the owner must spend overseeing different design iterations for energy decisions, resulting in a slight cost reduction for the owner. In the two projects for which we could collect data, owners reported about $5,000 in time saved on oversight of energy design details. If we assume a 20% increase in energy savings for better performance results in a somewhat higher incentive (by about $8,000), the oversight savings and higher incentive ($5,000+$8,000) end up being similar in magnitude to the increased cost in energy modeling, making this cost-neutral for the owner.

Improving SB 2030

Taking ownership of SB 2030

Sustainable Building 2030 (SB 2030) and B3 programs are meant to be owner driven processes. These programs require owners to attain very high-energy efficiency targets for their building projects. Unfortunately, they often must do so without sufficient knowledge and support. As a result, owners have been dependent on design teams and utility programs to achieve the energy targets. If this support team does not already have both the knowledge of, and commitment to, SB2030 then the program is often considered a secondary consideration in project discussions. Energy is discussed later and less often then needed. Energy modeling results come too late in design to make inexpensive design changes. Often this results in adopting energy efficiency strategies incrementally, starting with a code-based building and adding energy efficient strategies until the energy goal is obtained. As strategies are added, cost is often added as well.

In addition, other priorities arise that compete with the SB 2030 target, especially within the design and construction team. If the owner is not committed to SB 2030 at this point, the project will generally not meet its target.

First-time owners who go through the SB2030 process have especially had trouble in their roles as drivers of energy efficiency. They have expressed the need for a more formalized process for them to ensure that they can meet the B3 program requirements. In most cases, they are willing to follow a process that will result in meeting the energy requirements if it is simple and straightforward. Other more experienced owners, frustrated with the additional costs of the incremental approach, have used a more holistic approach. They have required early energy modeling as a part of an integrative design process with all team member engaged to ensure that they obtain energy requirements at the lowest cost.

From observing our pilot projects, we found that an owner's understanding of the path through the SB 2030 process is not necessarily as important as their commitment to achieving the goal. This commitment is often driven by their perception of the degree to which SB 2030 is mandatory. The program would benefit from a simpler, clearer communication of the mandatory nature of SB2030, with specific guidance to owners about the negative outcomes to them and their projects if they do *not* meet the standard. This may result in more committed owners, alleviating the issues above.

More use of Owners Project Requirement and Basis of Design

The inclusion of a clear Owners Project Requirement (OPR) document both in the pre-design phase and the project RFP will help formalize the process for inexperienced owners. The SB 2030 Energy Standard would be an integral part of the OPR, and make its mandatory nature clear. The OPR is an established feature of the B3 Guidelines (of which SB 2030 is the Energy Standard), but the program could do better at ensuring that it is created, and created early enough.

Another feature of the SB 2030 program is the requirement of the Basis of Design (BOD) document at the end of each of the design phases. The BOD document is a formal response to the OPR depicting the systems, methods and design that will be employed to meet the SB 2030 Energy Standard in the early design phases. This also needs to be created more consistently on program projects.

Both documents will guide the owner in setting the energy standard and evaluating their team's adherence, making it easier for them to take ownership of the process.

Educating on the benefits

If owners are to develop a commitment and thorough awareness of the cost effectiveness of a performance-based approach, they will have to fully understand the economic advantage of the process. There is potential for both increased energy savings on projects, as well as decreased costs in design, if the process is employed appropriately. Additional education sessions for owners early in the project development stage may help communicate this benefit. This could be partially accomplished in the development of the state required Pre-Design document.

Energy champion

Whenever possible and especially in the case of a first-time owner, SB 2030 will encourage appointing, or at least identifying, an Energy Champion for each design team. The energy champion is a person that is knowledgeable about most aspects of energy efficiency, and is employed directly by the owner to ensure that energy targets are met in the most cost effective manner. They will be expected to manage the energy efficiency process from assisting with the target setting, managing the design team, energy modeler and engineers, interacting with the commissioning agent, determining the amount of measurement and verification, ensuring adequate training of the operations staff, initiating the recording of energy consumption data, and troubleshooting building energy performance deficiencies. This champion could be an employee of the owner, or an owner's representative. The latter is often the ideal approach, and can be very inexpensive if an owner-directed commissioning agent is already employed.

The energy champion will be responsible for ensuring that the energy requirements are incorporated into the building design very early in the design process. By the end of the project's Schematic Design, the steward should confirm that the final building design has a high probability of meeting the owner's energy target. Final energy modeling should be completed half way through the project's Design Development phase confirming the building design will meet the Owners Project Requirements.

Improving energy modeling

During the design phase, the steward would assist the owner in evaluating the first costs and life cycle costs for energy efficiency options, generally derived from energy modeling. The steward would push design teams to model more innovative and less costly solutions, or to ask their CIP-assigned energy modeler to analyze such solutions. Energy modelers are willing to incorporate more synergistic design solutions if they are encouraged to do so.

Better project transfer to operations

Because of the overwhelming duties of a facility manager in relation to their time, energy system knowledge created in the design phases is seldom transferred to the operational phase. Building operators are required to operate buildings that they know very little about beforehand. Additional understanding of the energy systems design intent could alleviate initial start-up problems, and yield better building operation.

The recording of energy consumption data is also essential in this operational phase, not only for validation, but also to maintaining energy efficient operation. The energy champion plays a fundamental role in assisting the transfer of this critical knowledge from the design and construction phase to building operator. The energy champion ensures they are properly trained, and that they understand the requirements to monitor the energy consumption of the building. Once operational data is collected, the energy champion can work with operators in troubleshooting energy solutions for buildings that are not meeting the OPR. The automation of energy consumption data would be helpful in the early years.

Prototyping

Prototyping common building types could demonstrate strategies for reaching the energy goals of SB 2030 and build confidence that those targets are achievable. Compliant examples of actual past SB 2030 buildings would demonstrate how these requirements were met and that they are cost effectively attainable. If one building of a given type can reach high-energy efficiency, then all projects of that building type have a road map to success.

The incremental approach to energy efficiency has its limits on how much additional cost an owner is willing to accept. However, with the holistic approach, energy efficiency is not an add-on at the end of design but a central element along with other owner’s requirements in the design of the building. Within this framework, energy efficiency is already incorporated into the many building components and requirements from the beginning. This fundamental change in focus on how energy efficiency is incorporated into the design process changes the underlying calculation of the cost of the building. However, change is difficult in the development, design and construction industry. Owner and designers are risk averse and resist changing a tried and true formula. However, if examples of success can show them a clear path to meeting a new or different requirement, then they are more likely to change their practice.

Opportunities for new CIPs

Every year new buildings come on line that use more energy than expected. A performance based procurement approach can break that trend by influencing fundamental project goals and contractual requirements. A performance based procurement energy efficiency program offers the utility an opportunity to drive the deepest levels of energy efficiency that result from an integrative design process. From the owner perspective, the performance based procurement approach delivers a high performance building within a stipulated budget. It instructs the design team to prioritize energy efficiency amidst myriad and sometimes conflicting project goals and to identify cost tradeoffs as necessary. With a performance based approach to building procurement the process of contractual measurement and verification makes savings more dependable and sustained.

Outlined below is a general framework for designing and implementing a PBP utility new construction program, offered either as an enhancement to an existing new construction program or as a new utility program. A new type of continuous customer relationship is required in this framework, with customer engagement shifting to earlier in the project development process and continuing past project completion, always laser focused on the measured energy outcome.

Outreach, Target Market and Messaging

The key to a successful utility energy efficiency program starts with outreach and marketing. Traditional utility energy efficiency new construction programs typically engage architects and design teams for project recruiting. For PBP, outreach must focus on the utility customer or building owner. This focus is crucial because the owner must incorporate energy targets into the RFP or contractually incorporate the project energy target, project budget and the measurement and verification plan into the OPR. Success at recruiting owners early sets the stage for an effective PBP program. However, reaching customers early is challenging and the following tactics are recommended to make the recruitment process easier:

- ***Develop clear messaging for the program's features and benefits.*** It is important to distill the PBP program features and benefits for the customer and to ensure it fits within the utility's overall energy efficiency messaging. As part of our pilot project recruiting process we have experimented with different owner recruitment messages. The following are some examples used by partner utility new construction programs, including Xcel Energy's EDA program:
    - "Performance based procurement helps ensure projects attain the highest level of efficiency"
    - "Build a high-performing and energy efficient building within your construction budget"
    - "You benefit when design teams compete on building performance"

- ***Train and support utility account managers or outreach professionals.*** If account managers or outreach professionals have regular meetings with key customers, provide training that equips them to prospect for future new construction projects and to transfer leads to support staff that can call the customer, describe the offer in detail and close by obtaining a completed application.

- ***Communicate the incentive for performance based procurement.*** For a utility with an existing new construction program incentive structure, offering a higher incentive for following a performance based procurement path will likely generate increased customer interest. However, if a utility prefers to offer performance based procurement within its existing incentive structure, projects pursuing performance based procurement should be targeting higher savings which will result in a higher total incentive payment. It is important to make the proposed incentive structure easy to understand and communicate; any utility that decides to implement a performance based procurement option should dedicate time to outlining incentive scenarios and consider seeking stakeholder feedback. Most utilities offer financial support for design teams active in utility new construction programs; we recommend design teams participating in performance based procurement be eligible for similar incentives.

- ***Be flexible but still selective.*** At the outset of a PBP program it may be difficult to engage projects before the RFP or contract. This is particularly true for developer-led projects and first-time program participants. For projects entering the program after the RFP but with commensurate energy goals, elements of the performance based procurement process can still be integrated after the RFP or contract, by amending a design contract or incorporating measured performance into the Owner's Project Requirements.

The following narrative outlines the performance based procurement process from a utility perspective, after participant enrollment. Specific details for each phase are outlined in the ***Best practices for performance-based procurement*** section; please refer to that section if more background is needed.

Planning phase for performance based procurement

It is recommended that a Performance Based Procurement utility energy efficiency program:

- ***Require the owner to appoint an energy champion.***

- ***Require the owner to set an energy target (EUI).*** The utility program administrator or representative would assist the owner and energy champion with this task. EUI and project budget should be set before the design team is hired or before any design has started. From the utility program standpoint, the program needs to aim for a EUI target that will result in deeper savings than the average from their traditional NC program. The relationship between EUI, kWh, and therms varies for each building type. The average savings for these values in the traditional program also varies by building type. Therefore, this approach needs a way to distill EUI selection into average savings for both kWh and therms. It also then needs to make sure that the selected EUI enables the customer to realize deeper energy savings. EUI setting national programs such as Architecture 2030 as well as Minnesota's regional Sustainable Building 2030 (SB 2030) program are reliable tools to set achievable and cost-effective targets. Once an energy target is set, the utility should be able to estimate energy savings and incentives. It is important to share potential incentives with the customer as early as possible.

- ***Offer support in writing the OPR document.*** The OPR document defines the project owner's building performance requirements. The OPR illustrates the level of satisfactory performance the building should achieve when completed. Therefore, it is critical for an efficient design and construction process that the owner's requirements are written clearly and concisely. The utility can assist the owner with the value of the OPR as well as with setting and inserting the energy requirements within the OPR.

- ***Provide Performance Based Procurement language for RFP documents.*** During the planning phase, the utility (or utility program implementer) provides guidance on RFP language that will convey the importance of meeting the energy target, communicating the owner's measurement and verification scope and highlighting non-energy project goals. The utility program administrator is not directly involved in writing the RFP, but would provide examples of performance based procurement language a customer could use for the RFP and for the contract between the customer and the design/construction team.

- ***Assist owner with design and construction team proposal and selection.*** The owner may ask the utility or the utility program representative to help them select the team best suited to meet the project requirements. While this is an optional feature of a utility performance based procurement program, facilitating or supporting selection assistance may deepen the customer-utility relationship, boost customer confidence in their ability to manage the process, help them ask the right questions and reduce the chance that energy and other key project requirements will be de-emphasized.

RFP Phase

During the RFP phase, the customer or their energy champion writes the RFP and incorporates the information developed during planning. This includes:

- Owner's Project Requirements document with project goals and the energy target
- Performance based procurement language
- Desired project budget
- Desired timeline, bidding and completion date
- If applicable, owner's incentive structure for meeting energy requirements or energy standards

The energy champion takes the lead on writing and engages with the customer's project team members to finalize the document. The utility program representative should have provided example performance based language during the Planning Phase and can remain available to help the customer if needed.

Schematic Design Phase

The utility program should require an energy charrette once the design and construction team is selected. The charrette is crucial because it explicitly prioritizes energy efficiency amidst all the myriad complex and competing demands a project team faces. The charrette starts to prioritize the most critical energy-impacting design decisions, which become fundamental tenets of the design. At this point, the project team may be exploring several design options, which are reviewed relative to the energy performance target. The charrette should also identify high-level integrative design opportunities or coordination issues and provide an opportunity for integrative costing. It is strongly recommended that the utility program administrator require the owner, the general contractor (or cost estimator), mechanical and electrical engineers, building designer, utility representative, owner’s facility manager and energy champion attend the charrette. The utility could offer a small bonus, as part of the overall incentive structure, to owners, designers and construction teams that fully participate in the charrette. During the charrette, the energy target should be presented, explored and verified, a preliminary BOD should be established and the owner’s measurement and verification requirements should be discussed.

A fundamental feature of a PBP energy efficiency program is to focus on the energy target or EUI and utilize benchmarking data to help the owner select the energy target appropriate for the project. Concept energy modeling will be required by the design team to test conceptual design options against the EUI target and confirm it is being achieved by the final selected schematic design package. Building Information Modeling programs now have energy modeling capability to determine the building design’s probable EUI early in the design process as well as throughout SD design process.

A PBP energy efficiency program should leave this early concept modeling responsibility to the design team, giving them latitude to model at a level of rigor appropriate to their individual design process and focused on the design decisions under consideration. It is essential that the modelers, designer and engineers work in an interactive process to be able to create innovative design solutions that are both cost effective and energy efficient enough to meet energy targets. Performance-based modeling is laser-focused on measured EUI, meaning a team could prioritize their modeling efforts to what matters for EUI, potentially reducing net modeling costs relative to other detailed compliance-type modeling procedures. Accountability for driving energy performance shifts fully to the design team; the utility program's scope is limited to procurement assistance (and depending on the incentive structure perhaps some technical incentive-focused review later at project completion). As a result, utility program implementation costs for a well-designed PBP program may be lower than a traditional design assistance program.

At the end of schematic design, the utility representative and owner's energy champion should review design team submittals to ensure the project is on track to achieve the intended target. The building design should be at a stage where there is a 90% assurance that it will achieve the owner’s energy target.

Design Development Phase

During this phase, the primary role of the energy champion and utility representative is to review substantiation submittals to verify the energy target is being met. At the 50% Design Development stage, the building design is verified by the energy modeler that the design will meet the owner's energy target. At the end of the Design Development phase, the Basis of Design document should include the final design that meets the owner's energy target. The energy champion should create a preliminary metering/measurement and verification plan.

Construction Document Phase

The energy champion should review final substantiation submittals, finalize the metering/measurement and verification plan and review any value engineering and related energy impacts.

Construction

If utility energy efficiency incentives are calculated by comparing modeled energy use to a code baseline, this is a good time for the utility representative or energy champion to confirm energy savings.

Substantial Completion

At this stage in the project, a utility supported performance based procurement new construction program can follow one of two paths:

Performance-based procurement can layer on top of a traditional utility new construction program. During substantial completion, the process looks like the typical utility new construction program. The project is verified by the utility representative and utility energy efficiency incentives can be paid. A utility new construction program that is aiming for a performance based procurement program design can pay incentives based on modeled results while also requiring the customer to establish an energy target and follow the steps outlined above.

Or a Performance-Based Procurement program could stand alone. The utility new construction program could base incentive payments on meeting or exceeding the energy target, which means the incentive would be paid after the building is in operations over a specified period. There are pros and cons to this approach.

One main advantage is that the utility can determine real savings and is able to pay based on real savings. Very high performing projects also often employ strategies that are not regulated by energy codes or compliance modeling and are not captured or driven by traditional design assistance—integrated project delivery and cost analysis, HVAC system switch/elimination, occupant engagement, daylighting, alternative thermal comfort standards, operations management, unregulated loads. However, these high-performance design strategies do impact energy use. A true performance based program can capture those savings. Moreover, because of more advanced measurement and verification instrumentation, a focus on energy transparency in operations and continued utility customer engagement, these projects should also generate long-term sustained savings and may naturally bridge into utility programs that focus on existing buildings.

On the downside, from the owner perspective, paying utility energy efficiency program incentives at some point after operations could make it difficult to keep the owner motivated and engaged. There may also be complexity in how the incentive is calculated for a true performance-based program, particularly if the incentive is relative to a theoretical baseline; this is a nuanced issue but could be resolved by reviewing utility program goals, regulatory evaluation requirements and enlisting the help of contingencies (e.g. an as-built model alternative path), standards or advanced measurement and verification. A true performance based incentive option would pay the owner a partial incentive at the end of design and annually based on meeting or exceeding an annual performance target.

Additionally, we recommend there be a project hand-over process, where the design/construction team and energy champion work with the building operations staff to manage the building's transition from construction project to operations. Also, the mechanical system designer would participate in educating the building operators about the intended building design to meet the energy standard. In a performance based procurement program, the final steps take place during operations.

Operations

During operations, the energy champion, owner and design/construction team collect energy consumption data as outlined in the contract and in the measurement and verification plan. There should be regular check-in meetings to review measurement and verification data at the end of the second year of operations to evaluate the actual energy performance compared to the owner's requirements. If a utility new construction program administrator opts to pay incentives based on meeting or exceeding measured performance, incentives would be paid at this time. Lastly, owner incentives are paid to the design/construction team if the energy target is achieved per their contractual arrangements.

Recommended Program Design Elements

Performance based procurement offered in the form of a utility new construction energy efficiency program will be most successful with institutional owners and with projects that are Design Build, Integrated Project Delivery, or Construction Manager at Risk. A utility that adopts a performance based procurement approach should be comfortable with a longer "sales" cycle; since the idea is to engage a customer or owner before the design team is hired, it typically takes three to five customer contacts before an application is submitted to the utility. Since these projects are so early in planning, we have seen a higher attrition rate even after an application is submitted. This is often due to changes in financing or shifting customer priorities. It is recommended that the utility fill the pipeline with projects as a cushion for attrition. The following tactics have been helpful in our efforts to recruit owners into the pilot:

- Leverage account manager relationships
- Identify projects through metropolitan planning commission approvals
- Connect with local city or county officials
- Lead with an offer of integrated design support or energy charrettes for early engagement
- Provide bonus incentives for applications received in planning or pre-design

Performance based procurement can fit into an existing utility new construction energy efficiency program as a performance based procurement "track." This approach would also be a good option for a utility that wants to launch a new construction program that focuses on performance. For utilities to assess the feasibility of adopting a performance based procurement approach into their utility energy efficiency portfolio, we have estimated savings and program costs below.

Estimated Savings

For program planning purposes, we consider the expected energy savings per ft2 of building entering the program.

- 1.2 to 3.3 kWh/ft^2
- 0.008 Dth/ ft^2
- 0.0002 to 0.0007 kW/ft^2

The wide range of estimated savings per square foot is the result of a number of variables. Some of these uncertainties are fundamental uncertainties around the uptake of energy efficiency by the local building industry, influenced by market fluctuations in industry capital costs, local familiarity with energy efficiency, available energy efficiency incentives and general customer demand and appetite for investing in energy efficiency. An additional variable might be the deemed baseline against which savings are calculated, for example the current version of energy code or other stipulated performance benchmark.

Estimated Program Costs

Program costs will need to be customized for a utility that is considering introducing a performance based procurement program into its market. The program costs provided here are estimates only and are intended to provide preliminary information that will allow assessment of high level cost-effectiveness. The research team analyzed data from existing new construction programs and assumed a simple budget consisting of rebates or incentives, performance based procurement assistance services and program administration.

- Technical assistance................ $0.03 to $0.09/ft^2
- Customer rebates .... $0.16 to $0.43/ft^2
- Program administration.......... $0.02 to $0.07/ ft^2
- Total program cost................. $0.21 to $0.56/ ft^2

The wide range of program costs presented here are due to many factors. When normalizing to square feet of buildings program costs are highly sensitive to the following factors— average building project size, complexity and depth of the PBP services required by the customers, project attrition or cancellation, number of repeat customers, how long the program runs and how many projects ultimately participate in the program. Another variable in the cost of a PBP program is whether the process is layered on top of a pre-existing SB 2030 program.

Conclusions and context

The design and building industry, building codes, and green building programs are moving toward higher and higher performance buildings. As building designs aim for increasing levels of performance, fundamental changes in the project delivery process are taking place in the market. In Minnesota, we tested a new performance based project delivery approach both independently, and within the context of the SB 2030 program.

We discovered that, while SB2030 has similar goals to performance-based procurement, there is room for improvement to shape outcomes, especially in owner motivation, enforcement and participation of voluntary projects.

Taking a long-term view, the PBP initiative in Minnesota may need to offer two paths – one to widely introduce PBP and a second path to better use SB2030 as a PBP goal.

The impact of the energy target on the design process was another key lesson from the pilot. Setting and keeping the energy target as a main focus greatly expands the impact of the owner's energy goals to all steps of procuring the building, not just design. But design remains a key step in achieving a high-performance building. In the PBP approach, the influence on design can seem more indirect than some new construction program approaches, but it can be just as effective.

In addition to these developments in Minnesota, the performance-based approaches to procurement also integrates with other national trends, namely benchmarking and outcome-based codes.

Benchmarking

Building energy disclosure ordinances (often called "Benchmarking") have made building energy data readily available in many locations throughout the United States (IMT, 2017). This trend fits well with PBP for a few reasons. First, the energy data available in each region make an excellent benchmark for setting performance targets, as discussed in *Energy target setting*. So, facilitating PBP is easier when building energy ordinances are in effect.

Second, the M&V portion of the PBP process leads to complying with building energy disclosure requirements. The staff who are operating the building will have not only measurements and recordings of performance, but will have a better understanding for why that performance is what it is. This makes the act of disclosure – and questions and conversations that arise from it – much easier. And in the unfortunate case of poor performance and negative publicity, it makes operational improvement more actionable.

Lastly, benchmarking ordinances should increase market demand for PBP. Peer-to-peer energy comparisons become standard and transparent in real estate transactions, rather than limited to specialized, detailed due-diligence investigations. Developers and tenants are widely empowered and motivated to stipulate actual energy performance to control operational costs, differentiate their product from their peers, align with corporate mission and identity and insulate against energy cost fluctuations.

Outcome-based codes

Performance based procurement can be a much-needed stepping stone to outcome based codes. Developing a comprehensive performance based procurement program can educate the market and prepare owners to meet outcome based codes.

While there are no currently plans to implement outcome-based codes in Minnesota, the idea has picked up traction quickly in a number of regions that are generally leading indicators of energy efficiency developments. So, this could be an additional long-term consideration.

Future work

- Further benchmarking efforts would help to make many building energy usage data sets in Minnesota publicly available to all owners. This type of data is important in setting appropriate performance targets.
- Work is needed to understand the possible enforcement mechanisms of SB 2030, and how those can potentially be deployed – even up to the level of state policy. This understanding, coupled with education of prospective building owners, may lead to more internal enforcement of SB 2030 on projects, and therefore an increase in overall compliance.
- This project tested PBP in a handful of pilot projects. A broader, utility-scale pilot would be an excellent next-step for PBP in Minnesota. Though we worked closely with utility CIPs such as Xcel Energy’s, and to a lesser extent those in Rochester, some additional development work is needed for this approach to be incorporated directly into a Minnesota CIP.

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Appendix A: Example performance requirements section for use in RFPs

This example was used directly in one of the pilot projects we worked with.

This document provides specific guidelines for the project's architectural and mechanical, electrical, plumbing (MEP) performance requirements stated in Project X Project Specific Agreement. It provides information on the required annual energy target and substantiation of that target. The units of energy discussed herein are thousand British thermal units per gross square feet (kBtu/ ft^2) of total building addition area as measured at the site.

1. **Building performance requirements**:

Mission critical goals are project requirements, and must be met by all responders for a successful proposal. *Highly desirable* and *If possible* goals should be attempted, in that order, where the responders are able to achieve them to improve the chances of success in the proposal.

Mission critical

A. Meet building programmatic and functional requirements stated in Project X Project Specific Agreement.

B. Achieve a maximum operating energy target of 122 kBtu/ ft^2 annually; lower is preferred. The following program breakdown is provided for reference only.

C. Execute a measurement and verification (M&V) plan including:

    i. (Submeter Option) Meters for all utilities shall be included and shall monitor the energy usage of the entire addition. Meters shall be networked to appropriate facilities energy monitoring system.

    ii. Incorporate control system points, meter and sub meter data, and weather data into the M&V plan to help identify and repair building system performance issues.

    iii. Building energy consumption data will be logged and monitored continuously by Project X facilities energy management systems and staff to verify performance over time.

    iv. More detail provided in section 3.

Highly desirable

D. Achieve a maximum operating energy target of 110 kBtu/ ft^2 annually; lower is preferred. The following program breakdown is provided for reference only.

E. Execute a measurement and verification (M&V) plan including:

   i. Submeter each HVAC system.

   ii. Submeter all major medical plug load devices.

   iii. Engineer of record will log and monitor all building energy consumption data continuously. Data should be normalized for weather prior to comparison to the energy target.

<u>If possible</u>

F. Insert even more aggressive targets here, such as net zero energy.

2. **Substantiation of Energy Performance Target:** This project shall meet at least the site EUI stated in the project goals list. This requirement shall be delivered by the design and construction teams through the use of any variety of permanent energy efficiency measures utilizing on-site equipment.

   The design and construction team shall be responsible, in collaboration with Project X staff, for demonstrating that the goal has been achieved using documented, operating building energy usage. The real building energy use will be measured at the building (addition) footprint for a 12-month period. The building site energy use intensity (kBtu/ ft^2) is calculated by the site energy use divided by the gross building floor area, as defined by Deru and Torcellini[3]. The 12-month data collection period will begin after initial commissioning, but shall not start more than 4 months after project completion. Project X will be responsible for tracking occupancy and other changes to building use that may affect energy use. The design and construction team shall deliver a report indicating whether the performance target has been achieved; if the target is not achieved, the report shall provide a comprehensive correction plan for improving performance.

3. **Measurement and Verification Plan Overview and Intent:** A measurement and verification plan will be crucial in later phases to demonstrate that the building meets the performance goal and to maintain high levels of performance over the life of the building. An M&V narrative is required for the Final Plans. This narrative will outline:

[3] Deru, M.; Torcellini, P. (2005). Standard Definitions of Building Geometry for Energy Evaluation Purposes. Technical Report NREL/TP-550-38600. Golden, CO: National Renewable Energy Laboratory http://www.nrel.gov/docs/fy06osti/38600.pdf

A. Key assumptions and methodologies for tracking performance during the design and operation, including a list of data points to be collected during the M&V phase (several of which are outlined in Sections 1A and B).

B. In the instance that the building is not meeting the required EUI, the M&V outputs should clearly highlight which end uses are not meeting expectations. In this scenario the M&V plan will also call for a correction plan to be created.

C. Responsible parties during the design, construction, and operation of building.

D. Approval of the final energy performance measurement system will take place at substantial completion.

4. **Schedule and Deliverables:** The following schedule and associated deliverables have been developed for this project. The deliverables for each review period are included below.

    A. The Project Manager will meet with the design team during regularly scheduled project meetings, substantial completion, and 12 months' post-monitoring. These meetings are anticipated to review the following: energy analysis update, updated design EUI, project budget, project schedule, measurement and verification update.

    B. Per the Project Manager's direction, the design team shall provide or update the following documents at each applicable milestone:

        i. One-page narrative of the intended approach to meet the energy performance target; provide potential EUI range with this approach (at the end of SD).

        ii. Proposed energy efficiency measures (during SD and at the end of DD).

        iii. Predicted energy consumption by end use and by fuel type (at the end of SD, DD, and CDs).

        iv. Measurement and Verification plan narrative and scope of responsibility (at the end of DD see section 3).

        v. Actual energy consumption (after substantial completion).

Representatives from the design team shall also attend construction progress meetings and provide prompt feedback on the potential impact of design adjustments and material substitutions on the performance goals.

Appendix B: Interview questions for selecting a design/construction team under performance-based procurement

1. Do you foresee any code variances required to meet the energy target with your design?
2. Are there any ECMs that are included in your design that either the design team or the construction team has not had experience in implementing in past projects?
3. Could you describe a specific example of where passive architectural features have had a major influence on building systems design?
4. Can you describe how your proposed systems will provide a premium indoor environment for occupants with relation to the end uses of the building?
5. Has the University's goal of maintainability impacted any aspects of your design?
6. A full building pressure test will be required for this project. What is your plan to comply with this and also to make sure you meet the required infiltration rate?
7. How does the architectural design manifest sustainability beyond just energy savings? Please discuss in the context of the LBC, biophilia and our strong desire to create a "retreat like feel."
8. What design concepts or features will engage occupants in a sustainable learning experience? Beyond the token dashboard
9. How has the proposed occupancy pattern influenced your design approach?
10. What are your concerns about the ability to reach the energy target?
11. What do you anticipate to be the largest factors in hitting the site EUI?
12. Have you designed a building with similar systems in this climate that has achieved your stated EUI?
13. What has been your experience with setting energy targets and evaluating post-occupancy?
14. What is a typical EUI that you have achieved for your projects?
15. Have you researched EUIs for other conference center buildings? How did they compare?
16. If your design is chosen, what is your plan to provide compliance with the energy target throughout the design process and after post occupancy?
17. What would be your course of action if energy use exceeds the target post-occupancy?
18. In the final summary document, we would like to better understand what proportion of EUI reduction is associated with some of the innovative features on your projects.
19. Please outline how you are going to manage the building delivery process to ensure your design intent is met. How does hand-off/collaboration with the winning contractor actually work?
20. Do you feel that you can provide all of these options within the project budget? What doesn't fit in the budget?
21. What has been your past experience with maintain the project budget through the bidding phase? How will you manage architectural requirements with energy requirements as it relates to hitting the energy target?

If this project does come over budget - what items will you first look at to reduce cost?

Appendix C: M&V responsibility matrix

Use the following matrix to define which parties are responsible for executing the M&V plan.

Matrix Legend

■	Responsible party
X	Supporting party
	No responsibility

	Owner's Building Manager	IT Consultant	Mechanical Engineer	Electrical Engineer	Controls Engineer	Commissioning Engineer	Energy Consultant	General Contractor	Mechanical Contractor	Electrical Contractor	Controls Contractor	Dashboard Service Provider	Not applicable
Design the M&V system													
Perform a blower-door test													
Install HVAC sensors													
Install current transformers													
Low voltage wiring for sensors													
Configure meters and sensors													
Calibrate meters and sensors													
Program correct names and units													
Set up internet connectivity													
Maintain internet connection													
Administer data/information sharing													
Store data for a specified time period													
Host a public-facing web dashboard													
Install a public-facing kiosk													
Set up automatic fault detection													
Survey occupants													
Record notes about building operations													

Matrix Legend

■	Responsible party
X	Supporting party
	No responsibility

	Owner's Building Manager	IT Consultant	Mechanical Engineer	Electrical Engineer	Controls Engineer	Commissioning Engineer	Energy Consultant	General Contractor	Mechanical Contractor	Electrical Contractor	Controls Contractor	Dashboard Service Provider	Not applicable
Upload energy data to Portfolio Manager													
Upload energy data to City of Chicago													
Upload energy data to LEED													
Build a calibrated energy model													
Verify energy performance against target													

And here is an example of the matrix completed for a project:

Matrix Legend

■	Responsible party
X	Supporting party
	No responsibility

	Owner's Building Operator	IT Consultant	Mechanical Engineer	Electrical Engineer	Controls Engineer	Commissioning Engineer	Energy Consultant	General Contractor	Mechanical Contractor	Electrical Contractor	Controls Contractor	Dashboard Service Provider	Not applicable
Design the M&V system			X	X	■	X	X				X	X	
Perform a blower-door test						■							
Install HVAC sensors									■		X		
Install current transformers										■	X		
Low voltage wiring for sensors											■		
Configure meters and sensors							X				■		
Calibrate meters and sensors							■				X		

Matrix Legend

- ■ Responsible party
- X Supporting party
- (blank) No responsibility

	Owner's Building Operator	IT Consultant	Mechanical Engineer	Electrical Engineer	Controls Engineer	Commissioning Engineer	Energy Consultant	General Contractor	Mechanical Contractor	Electrical Contractor	Controls Contractor	Dashboard Service Provider	Not applicable
Program correct names and units							X				■		
Set up internet connectivity	X	■									X		
Maintain internet connection	■												
Administer data/information sharing	■											X	
Store data for a specified time period											■	X	
Host a public-facing web dashboard												■	
Install a public-facing kiosk												■	
Set up automatic fault detection											■		
Survey occupants	■					X							
Record notes about building operations	■												
Upload energy data to Portfolio Manager	■												
Upload energy data to City of Chicago	X						■						
Upload energy data to LEED	X						■						
Build a calibrated energy model							■						
Verify energy performance against target							■						