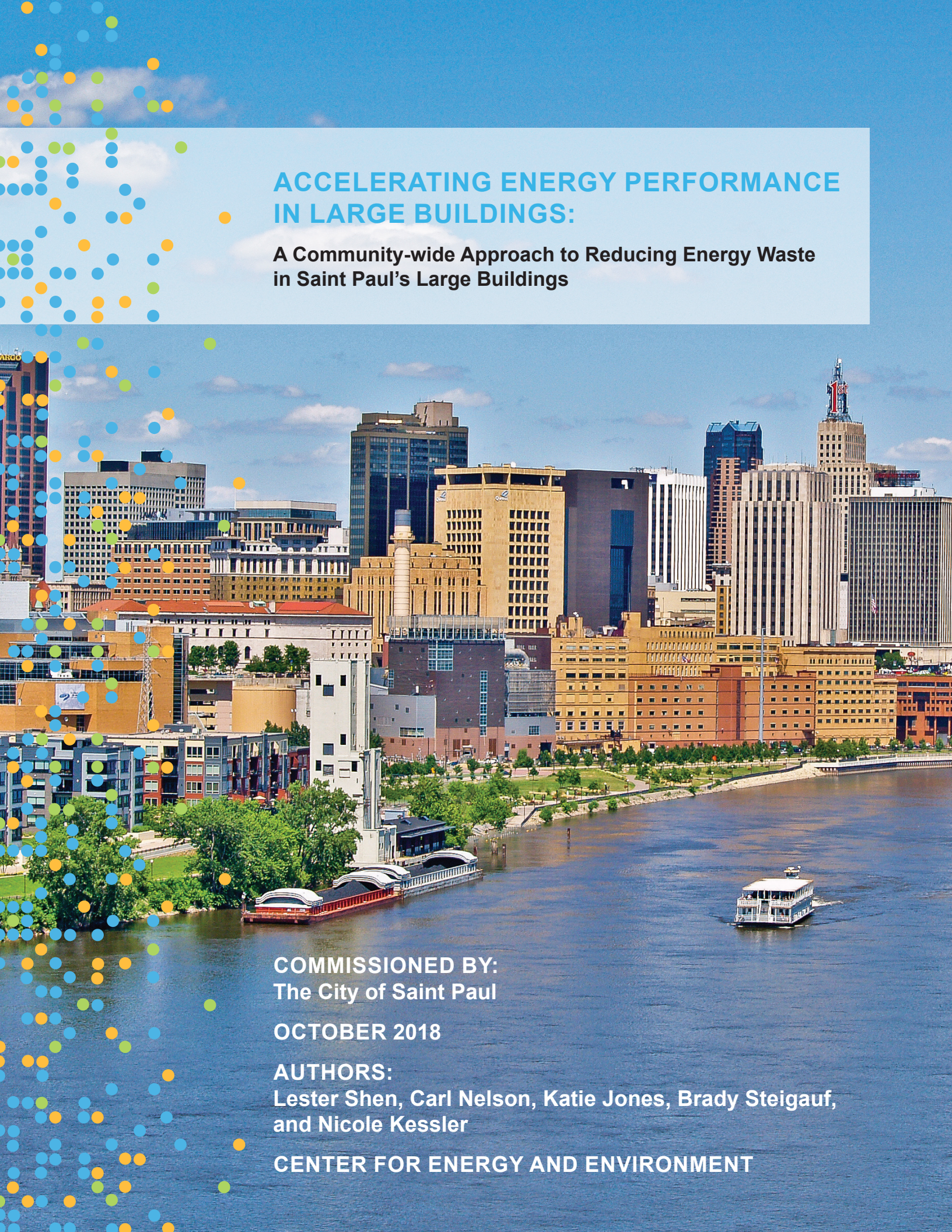


An aerial photograph of the Saint Paul skyline, featuring a mix of modern glass skyscrapers and older brick buildings. The city is situated along a wide river, with a large white ferry boat and a smaller red and white tugboat visible on the water. The sky is blue with scattered white clouds. On the left side of the image, there is a decorative pattern of colorful dots in blue, yellow, and green.

ACCELERATING ENERGY PERFORMANCE IN LARGE BUILDINGS:

**A Community-wide Approach to Reducing Energy Waste
in Saint Paul's Large Buildings**

COMMISSIONED BY:
The City of Saint Paul

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Summary

For many mid-to-large sized cities, large buildings (50,000 square feet and more) are a primary source of greenhouse gas emissions and a major opportunity for emissions reduction through energy efficiency efforts. This study was conducted to support city strategies that save energy in large buildings. Nearly a dozen Saint Paul building operators and other building professionals were interviewed for this report, and the authors conducted a review of other efforts nationally, to inform the report recommendations.

Since the primary goal is finding solutions that achieve large energy reductions at the lowest cost to building owners, this report focuses on operational efficiency — operating existing building equipment at its optimal level of energy usage. Studies have shown operational savings of 10% to 30% is achievable in most buildings that are not already aggressively pursuing operational efficiency.

In this report we detail our findings on the organizational and technical barriers to pursuing operational energy efficiency projects. We provide an outline of an ambitious program concept (as part of a larger community-driven building energy challenge) that would comprehensively address barriers to operational efficiency and provide services to help building owners and operators achieve energy savings at low or no cost. These efforts are complimentary to, and can increase uptake for efforts to achieve comprehensive retrofits in existing buildings.

Background

This report investigates the opportunities for community-driven efficiency programs in large buildings, with the City of Saint Paul as a test case. In 2017, the City of Saint Paul embarked on a planning process to develop a climate action plan. The buildings section of that plan, sponsored by Xcel Energy through their Partners in Energy service, identified energy use in buildings as the largest source of CO₂ emissions,¹ and a focus for future efforts to meet Saint Paul's climate goal of carbon neutrality by 2050. This report was commissioned by the City of Saint Paul and supported by the City Energy Project to help develop strategies for reducing energy usage, and therefore greenhouse gas emissions, from large buildings. In addition, the city and its partners wanted to identify opportunities that could be delivered as part of a community-wide call to action, such as through a building energy challenge. We further refined the focus on operational savings in large buildings because operational savings of 10% to 30% are achievable in most

¹ Greenhouse Gas Emissions from Saint Paul Building Energy Use, presentation by Xcel Energy's Partners in Energy for Saint Paul Climate Action Planning meeting, February 27, 2017.
https://www.stpaul.gov/sites/default/files/Media%20Root/Greenhouse%20Gas%20Inventory%20Presentation_2-27.pdf

buildings at minimal cost, making this an untapped source of significant greenhouse gas reductions within the city.

Operational Savings – The Untapped Source of Energy Savings

Numerous studies have shown enormous savings potential in large buildings (generally buildings with 50,000 square feet or more of floor space) just by adjusting equipment operations to a more optimal level. According to a 2012 New Buildings Institute/Ecotopie paper, best practices in building operations and maintenance can lead to 10–20% energy savings, while bad practices can lead to 30–60% greater energy use.² A more recent study (2017) by Pacific Northwest National Lab estimated that U.S. buildings, on average, could save 29% of their energy use by re-tuning existing building equipment.³ CEE’s experience with large buildings suggests that savings are almost always possible. In addition, savings as large as 15% or 20% are not uncommon, even in newer buildings.

Typically, these opportunities are not discovered or implemented, because they fall outside the scope of typical building operations activities, which focus on meeting occupant needs. In a complaint-driven culture, no one is complaining or demanding facility managers improve building operational efficiency.

Recommissioning is a well-known method of achieving operational savings in buildings. This is a process that relies on a detailed building energy survey and analysis that details both operations and maintenance opportunities and capital-intensive opportunities to better fit the building equipment for existing occupancy. The downside to this thoroughness is that recommissioning can be time-consuming and capital-intensive. Furthermore, the implemented measures may not always persist (which is why recommissioning is recommended to be done about once every five years). As a result, while recommissioning efforts often bring savings, only a small percentage of commercial buildings take advantage of these services.

Another approach that has gained traction in recent years is called “building re-tuning.” This is also sometimes referred to as continuous commissioning, ongoing commissioning, or persistent commissioning. This is an operational approach that can bring savings often at a lower cost than the more extensive recommissioning efforts, although the savings may not be as deep, depending

² Frankel, M., Heater, M. and Heller, J. “Sensitivity Analysis: Relative Impact of Design, Commissioning Maintenance and Operational Variables on the Energy Performance of Office Buildings,” New Buildings Institute. August 2012. <http://aceee.org/files/proceedings/2012/data/papers/0193-000073.pdf>

³ Pacific Northwest National Lab (PNNL), “Impacts of Commercial Building Controls on Energy Savings and Peak Load Reduction,” May, 2017: <https://energy.gov/eere/buildings/downloads/impacts-commercial-building-controls-energy-savings-and-peak-load-reduction>

on the approach taken. The goal is to continuously identify and correct operational problems that waste energy. Often the solutions require little or no cost beyond the labor required to perform the corrective action. The focus is to perform diagnostic tests to detect poor operational scheduling/settings or significant energy-wasting malfunctions. The aim is to operate “each significant energy-consuming device or system [so that it] uses only as much energy as needed to perform its intended function.”⁴

In Minnesota, efforts have already been underway in developing these practices amongst building operators. The University of Minnesota Center for Sustainable Building Research (CSBR) is developing the B3/SB 2030 Energy Efficient Operations Manual (B3 EEOM) to provide a tool for facility managers and building operators to achieve and continuously sustain energy efficient operation in existing buildings.⁵ During tool set up, energy consuming devices that are prone to excess energy consumption are identified for that specific building and simple tasks for detecting each possible energy wasting malfunction are identified. The tool is designed to manage the energy efficient operation process by organizing information about what tasks should be performed, how to do them, when to do them, who is assigned to do them, when they were actually done, what was found, and the status of any remedial actions required. To date the tool contains tasks for the most common energy wasting malfunctions in buildings, and more are being developed. Also under development is identifying and training skilled professionals to set up the tool for use in specific buildings.

In this report we focus on re-tuning as the basis for a transformation of building operations and maintenance practices. This is the most appropriate building energy efficiency program for city-led efforts in large buildings, because:

- Building re-tuning is broadly applicable to nearly every large building in a city, and it is likely that nearly every building could save some energy from applying these methods;
- It is a very low-cost way to save energy, thus helping achieve the greatest greenhouse gas reduction benefits at a low cost without cities needing to ask for actions with high up-front costs; and
- Because this approach involves a cultural shift for many in how energy is managed, it will benefit from a community-wide effort involving city leadership.

Barriers to Achieving Operational Efficiency

We carried out interviews with Saint Paul building operators and other stakeholders, and conducted a literature review. From this research, we found that four barriers are preventing

⁴ <http://csbr.umn.edu/work/b3operationmanual.html>

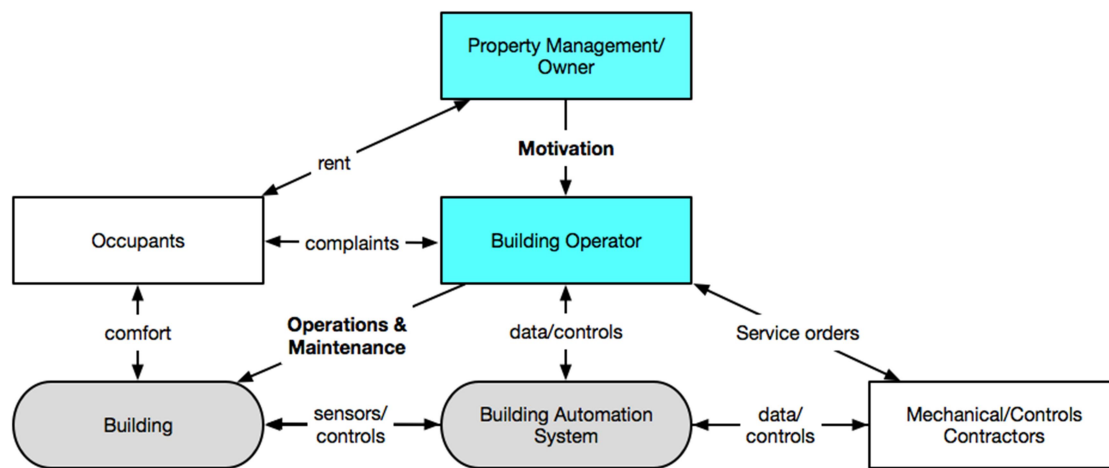
⁵ <http://www.csbr.umn.edu/work/b3operationmanual.html>

buildings from operating at their full efficiency potential. We summarize each of these below and provide a more in-depth discussion of the market dynamics that cause these barriers.

1. ***Lack of knowledge about the opportunity for operational efficiency.*** Opportunities for energy savings through operational efficiency can go undetected. Most building owners and operators think of efficiency as a capital improvement activity, such as replacing lights or upgrading HVAC systems. Building stakeholders are often unaware of how much energy and money they can save by detecting how their equipment is wasting energy, correcting the issue (often at no or low cost), and then maintaining the savings by preventing the issue from recurring. In some cases, there may be a lack of technical knowledge about what the opportunities are, or who to turn to for help in discovering those opportunities.
2. ***Building operators respond to the needs of the building occupants first.*** Building operators respond to the needs of their occupants, and the top priorities are generally building problems or occupants being too hot or too cold. Occupants do not have communication channels designed to influence energy efficiency in the building, and no one protests when building equipment is using more energy than needed to meet their needs. When the major priority of building staff is to keep complaints to a minimum, building comfort and smooth equipment operation (reliability) become the primary metrics to evaluate job performance.
3. ***Building controls contractors have the ability to help improve building efficiency, but it is not their primary focus.*** Recent years have seen a strong trend towards installing more Building Automation Systems (BAS), with the capability to control the buildings temperature settings for different building zones through digital controls, for example. The BAS has the potential to help detect and diagnose opportunities to improve operational efficiency. However, we found that this is rarely utilized, in large part because of the complexity of the BAS. The capability to program the BAS usually resides with a controls contractor, a specialist who is paid for service calls just like an electrician or plumber. Whenever a setting needs to be changed, it is most frequently done by the controls contractor, rather than the building operator. This also adds one more layer between the building equipment and the building operator – and without the facility manager asking to optimize the energy use of a building, or a strong incentive by the controls contractor to seek out efficiency opportunities, situations of energy waste are even more likely to remain hidden.
4. ***Building occupants are the primary users of the building, but they can feel disconnected to energy savings.*** While occupants may pay some of the energy bills themselves, occupants generally do not directly pay for or see any measure of energy use. Instead, occupants seek comfort and make sure that the building is properly heated and cooled while they are in the building. However, they have little influence over building energy decisions or usage.

Key to understanding these barriers is recognizing the web of stakeholders who are involved in influencing the ultimate efficiency of the building. Figure 1 shows the typical relationships between the main commercial building stakeholders. The Building Operator is employed by the property management/building owner to operate and maintain the facility for use by the occupants. To assist the Building Operator, a Building Automation System is often employed where sensors can measure temperature, humidity, and fresh air levels, which affect the comfort of occupants in the building and monitor and control the operation of the building equipment. A mechanical or controls contractor will assist in the operation and servicing of the Building Automation System, which despite the benefits of more sophisticated and consistent control also results in an increased level of complexity to building operation. Consequently, the contractor becomes an important resource and partner to the building operator. The occupant pays rent to the owner expecting that the building provides them with the necessary functions and services to perform their work. When these expectations are not met, the Building Operator often receives immediate feedback from the occupants.

Figure 1. Primary Stakeholders for Commercial Building Operations



Two important findings from the interviews define the main motivations that drive building operator actions:

1. Building operators are responsible not only for the operation of building equipment, but also for providing the necessary services to building occupants with regard to maintenance and upkeep. Along the lines of “the squeaky wheel gets the grease,” keeping occupant complaints to a minimum was clearly the prime objective of most building operators that we interviewed. The other major metric for job success was found to be

keeping costs (maintenance, repair, servicing, and energy) within budget. In most cases energy efficiency was not a primary concern and can probably be attributed to the false notion that energy savings is only obtained through capital investment. For most of the operators we talked to, the two measures for good building operation are: a building operating within the defined system settings and a minimum level of complaints.

2. For those sites that were achieving significant operational energy savings, the building operators described a strong reliance on management to provide leadership, direction, and encouragement in fostering their energy efficiency efforts.

It is clear that broad market adoption of building re-tuning efforts depends on the commitment of building owners and managers to direct building operators to prioritize re-tuning in their efforts. Therefore, a critical success factor in developing a successful strategy is an effective means to enlist building owners and managers to embrace this approach.

With the strong growth in controls systems, there has been a bifurcation in the skills needed for building operations. Traditionally, building operators came from a maintenance or trade background, utilizing physical contact with the equipment to inspect equipment and implement adjustments or treatment measures. With the growth in automated control systems for buildings, traditionally trained building operators are presented with computer-based reporting and notifications when equipment isn't working properly. Consequently, there can be a wide range of building operator sophistication with control systems. The impact of this is discussed in more detail in Appendix A.

With the introduction of these advanced building control technologies, the relationship between building operators and their controls/mechanical contractors has shifted. With the ability to monitor and control equipment remotely, some onsite building staff rely more and more on contractors — not just as a trusted source of control hardware and software, but also as a partner in operating the building. The Envision Charlotte program (discussed further below) experienced a similar situation where they found that building operators belonged in one of two types: (1) very sophisticated with a trend toward use of analytics and (2) minimal sophistication with a poor understanding of the relationships between occupant complaints and operational actions. They found that technical support by a third-party consultant was necessary for each building operator, and these services were provided by the program.

Related Efforts

Our literature review identified several existing efforts that can help to inform a community-based outreach strategy for re-tuning large buildings.

Energy challenge programs

In an effort to spur voluntary adoption of energy efficiency practices among buildings a number of jurisdictions, most of which are cities, have issued challenges to reduce energy consumption. The challenges vary in their design, with some aiming to induce inter-building competition. Others seek to inspire all buildings to meet a specified target collectively. Some of these are done as part of city benchmarking efforts, and some are not. In most cases, the city creates a building energy challenge and recruits property managers and owners to enlist their buildings. City-sponsored events for the building operators that foster peer sharing and recognition are expected to lead to the adoption of energy efficiency practices. These events include gatherings such as happy hours, lunch and learns, workshops, and award ceremonies.

A major limitation of this approach is that with encouragement and no technical assistance, building operators are often on their own to figure out how to improve their building's efficiency level (particularly operational savings). Technical or programmatic support remain a barrier to implementation of effective and lasting savings.⁶

Ideally, an energy challenge would foster a community of practitioners that worked together in pursuit of a common goal. Rather than a building energy challenge, a civic energy challenge where the collection of buildings pursued an aggregated energy savings or greenhouse gas reduction would foster a more open community of practitioners. The primary catalyst for this challenge would be a public-private partnership that includes not only the municipality, but also business leaders and the energy utilities.

An objection to the competition model is that pitting building against building can create a competitive tension that works against the objective of raising the state of practice for the entire community. During our interviews with building operators, most interviewees said that they would not be motivated by a competitive challenge. They felt that competing with other buildings would be a disincentive for participating in the program. In addition, such a challenge may hurt the relationships that they had with other building staff they interacted with from neighboring buildings. We found that the building operators were much more open to the idea of building a community of practitioners.

An important aspect of a community of practitioners is installing an ethic of continuous improvement and the sharing of information. A challenge can be designed to foster this by focusing on the improvement of each individual building. No two buildings are the same – unique by design, equipment, occupants, and site location. By comparing buildings to themselves the focus can be placed on equipment operation, and important improvements in equipment

⁶ At least, for finding operational savings. Xcel Energy has a robust portfolio of equipment rebates and technical assistance for capital improvements.

operation and maintenance become the metrics for success. The goal is for each building to be the best that it can be. This minimizes the effect of forces that are often beyond the control of the building operator that can mask his/her best efforts. One building can use very little energy and be inefficient, while another building can use a lot of energy and be efficient. Creating a common goal of energy efficient practice can allow practitioners to compare and share experiences and raise the level of practice for the entire community.

Comprehensive City-Wide Programs

Envision Charlotte is an example of a civic energy challenge that included several design features to support and encourage actions. It can be considered one of the most successful energy challenges in the nation, with a documented program savings of 19% in a five-year period.⁷ The Envision Charlotte Challenge arose out of a partnership between the city, utility (Duke Energy), and business leaders (Cisco and the Charlotte Center City Partners) to work with the commercial building sector to make Charlotte a leader in sustainability.⁸

Important aspects of the Envision Charlotte program are:

- A web-based software tool developed by Accelerated Innovations⁹ for building operators provides a framework for organizing and supporting the challenge. The web-based tool uses an energy dashboard for each building with a calendar that recommends timely tasks that building operators can elect to perform as a core part of the challenge. The dashboard can keep track of building operator achievements that are used for individual recognition of success. The software also presents whole-building energy usage data in 15-minute increments, which is a useful tool for tracking improvements in energy performance for individual buildings, as well as for calculating program-wide savings.¹⁰
- Program staffing to support both the engagement and the technical components of the program. Engineering support staff provide technical assistance to building operators that is focused on their individual building. Periodic meetings are scheduled by the

⁷ "Uptown Charlotte buildings cut 19% from their energy use, new data shows" by Bruce Henderson, Charlotte Observer, April 20, 2017, see: <http://www.charlotteobserver.com/news/local/article145575924.html>

⁸ The "Envision Charlotte" is now called the "Smart Energy in Offices" program by Duke Energy, who has expanded program delivery to other cities in its territory, see: <https://www.duke-energy.com/business/products/smart-energy-in-offices>

⁹ Accelerated Innovations is a Saint Paul-based software company: <https://acceleratedinnovations.com/>,

¹⁰ The tracking of energy information, establishment of a pre-program baseline, and calculation of weather and occupancy normalized energy savings is critical for Duke Energy to be able to obtain regulatory approval for recovering expenditures for the program, and receiving incentives on the energy saving achievements of the program. This was successfully done for the Envision Charlotte/Smart Energy in Offices program. See: Proposed Smart Energy in Offices Program, Docket No. E-7, Sub 961, Duke Energy Carolinas, May 13, 2014.

engagement manager with each building's stakeholders to support continuous improvement.

The City of Atlanta was among the first cities in the U.S. to commit to the Department of Energy's Better Building Challenge in 2011. By January 2018, the Challenge recruited 680 properties representing 116 million square feet of commercial building space to commit to reduce their building energy use by 20% by 2020. This ranks the Atlanta Better Building Challenge program first in the nation for building energy challenge participation, and far exceeds the city's initial goal of recruiting two million square feet to the challenge. Beyond program participation, as of 2017, Atlanta's buildings successfully reduced portfolio-wide energy and water use by 17%.

With strong leadership from the Mayor of Atlanta, the program's success is largely due to its strategic local partnerships and existing relationships, as well as positive recognition for building owners, operators, engineers, tenants, and vendors that helped advance the program's goals. For example, the city leveraged its local funding network to partner with Southface Energy Institute, a local energy nonprofit, to offer free commercial audits for the first round of participants. This helped incentivize early enrollment for nearly one hundred buildings and provided them with a framework of recommendations to achieve the challenge goal. Southface also hired two FTEs to help with data analysis, verification, and technical support for buildings to achieve energy and water savings.

The city also partnered with Central Atlanta Progress, the downtown business improvement district, to assist with program recruitment through its membership base and offer marketing expertise for buildings to communicate their energy savings to the real estate market and prospective tenants. Lastly, the city and Southface Energy Institute also partnered with local vendors to fill an audit template that could be submitted to the program for baseline energy analysis, in return for the city listing the vendor's company name on the website as a program sponsor. Completing the audit template was advantageous for vendors, as their status as a program sponsor made them a first-choice to receive vendor bids amongst buildings participating in the challenge program. In summary, the ABBC's success was largely due to existing relationships through the city's business improvement districts, technical and programmatic assistance from Southface, and the initial free audit offering that transitioned into partnerships with local vendors to support the program.

In 2016, the City of Bellevue, Washington, and Puget Sound Energy (PSE) partnered to launch Urban Smart Bellevue, a two-year building energy challenge program that encouraged participating large commercial buildings to reduce their energy use by 5% through behavioral and operational changes, with an additional challenge of 1% savings through capital projects. The goal of the program was to enroll 200 buildings, represented by any singular or combination

of building tenants, operators, and/or owners. The utility provided two administrative FTEs to staff the program, in addition to hiring external vendors, while the City of Bellevue provided 10% of an FTE. Based partially off Envision Charlotte's model, Urban Smart Bellevue also incorporated themes of Community-Based Social Marketing, using targeted value propositions to building owners, facility managers and operators, and tenants, and an Energy Management Information System (EMIS) to allow participating businesses to review nearly-live energy data analytics and track behavioral engagement.

Programmatic offerings included behavioral toolkits and campaign materials for tenant engagement, building operator training workshops, and recognition awards for buildings that achieved the challenge goal. By the end of the program's two-year duration, Urban Smart Bellevue fell short of its participation goal, reaching only 101 participants, but exceeded its savings goal by capturing 6% savings within its larger building sector and 9% savings from smaller properties.

One of the main lessons learned from program implementation was that implementation is time and staff intensive: In-person recruitment and interactions were the most successful at motivating energy savings, and off-site data analytics were not as inspirational as peer-to-peer facilitated workshops. Additionally, the two-year timeframe was not substantial enough to allow for exponential growth in program participation resulting from word-of-mouth peer recruitment, as seen in other cities like Atlanta and Los Angeles' Better Building Challenge programs.

For more information on the City of Atlanta's and Bellevue's challenge programs, see Appendix C.

Buildings, Benchmarks, and Beyond (B3)

Buildings, Benchmarks and Beyond (B3) is a state-funded initiative to provide design assistance and related tools such as benchmarking to publicly-funded buildings. Benchmarking is a proven tool to help measure and improve energy performance. The B3 program is also developing the Energy Efficient Operations Manual (B3 EEOM) to provide a tool for facility managers and building operators to achieve and continuously sustain energy efficient operation in existing buildings.¹¹ The B3 EEOM setup guides the user through a process that identifies energy consuming devices that are prone to excess energy consumption and simple tasks for detecting each possible energy wasting malfunction are identified. The tool is designed to manage the energy efficient operation process by organizing information about what tasks should be performed, how to do them, when to do them, who is assigned to do them, when they were actually done, what was found and the status of any remedial actions required. To date, the tool contains tasks for the most common energy-wasting malfunctions in buildings and more are

¹¹ The B3 Energy Efficient Operations Manual portal is here: <https://www.b3mn.org/operations/>

being developed. B3 is also developing a program to identify and train skilled professionals to set up the tool for specific buildings.

Utility programs

Xcel Energy has extensive programs to promote and encourage energy efficiency for its business customers. While most of these efforts focus on capital improvements, there are several notable efforts that focus on operational savings:

- ***Building Operator Certification program.*** Xcel Energy will provide tuition reimbursement for building operators to take an approximately two-week training course in building operations. Studies have shown that this can help to reduce energy usage in buildings. However, the training is a significant time commitment, and because it is a general training, it does not focus on the specific systems and conditions found in any particular building.
- ***Commercial Efficiency Program.*** This is for very large buildings and will provide comprehensive services for identifying and implementing a wide range of efficiency opportunities, including operational efficiency. To qualify, a building must generally use a minimum of 10 GWh of electricity and have the opportunity to save 1 GWh, which applies to only the very largest buildings in Saint Paul (generally well over 500,000 square feet for average energy-use intensity (EUI), as well as smaller buildings with significant energy-using equipment, such as hospitals).
- ***Energy Management and Information System (EMIS) Program.*** This is currently a pilot program that Xcel Energy is assessing, with 35 participants projected statewide in 2018. The program is generally available only to large commercial and industrial customers. The program helps to fund the implementation of energy management and information software that is used to detect energy efficiency opportunities and is designed for improving operational efficiency. Technical assistance is also provided to help building operators implement efficiency recommendations.¹²
- ***Recommissioning Program.*** Xcel Energy offers co-funding for the cost of a recommissioning study, as well as rebates for implementing the tune-up recommendations of the study. Guidance is provided for recommissioning providers, to ensure they include common recommissioning measures in their studies.
- ***Building Benchmarking Support.*** This service is for customers interested in entering their energy data into Energy Star Portfolio Manager (a free online benchmarking tool maintained by the U.S. Department of Energy). Xcel Energy's service automatically loads weather-normalized bill data into Energy Star Portfolio Manager, saving building staff from having to manually enter data into the tool. This tool has been very popular

¹² Xcel Energy, "2017-2019 Minnesota Electric and Natural Gas Conservation Improvement Program," Docket E,G002/CIP-16-115, June, 2016.

with building staff in Minneapolis for complying with Minneapolis' energy benchmarking ordinance.

- **Energy Design Assistance.** This program provides extensive support, including energy modeling, for new construction projects. Typically building commissioning is conducted as part of the new construction process.

District Energy St. Paul provides support to help customers achieve optimal performance and energy efficiency.

- **Onboarding and Design Assistance.** District Energy engineers provide assistance during the building concept development phase, whether for new construction or remodels. The District Energy staff work with developers and building owners/managers to refine load models, assess potential HVAC solutions and mechanical system design, recommend the controls sequence of operation, and advise on related construction best practices as well as navigation of potential certification programs.
- **Commissioning and Recommissioning.** District Energy provides one-on-one assistance through initial building commissioning or recommissioning to make sure settings optimize the chilled water and hot water interface and can maintain the appropriate Delta T. Information is made available to customers about energy usage trends and opportunities for operational improvements within mechanical and automation systems.
- **Engineer Training.** District Energy hosts an annual training focused on building operations. Utilizing industry experts and in-house staff, the workshop serves as an opportunity to learn about emerging technologies, market-ready solutions for HVAC systems, and best practices for improved building performance.
- **Energy Efficiency.** District Energy provides customized support to building operators to identify energy efficiency opportunities and to execute optimization projects.

Strategic Energy Management

Strategic Energy Management (SEM) is an energy efficiency program approach that targets both capital and operational energy efficiency opportunities and has achieved great success across the country. While it was developed for, and has been used predominantly in the industrial sector, where it has achieved great success, in recent years it has been expanded to the commercial sector.¹³ The primary insight of SEM is that *organizational commitment to energy efficiency*, combined with *a well-designed process of continual energy performance improvement* is critical to achieving high-energy performance. As articulated by a leading trade organization of energy efficiency program administrators, the main elements of the SEM approach are:

¹³ J. Burgess, et al., "The Second Generation of Strategic Energy Management Programs," Proceedings of 2015 American Council for an Energy Efficiency Economy Summer Study on Energy Efficiency in Industry. August 2015. <http://aceee.org/files/proceedings/2015/data/papers/1-31.pdf>

- 1) Commitment to the SEM approach from organizational leaders;
- 2) A well-articulated planning and implementation process; and
- 3) A system for measuring and reporting energy performance.¹⁴

While the full scale implementation of SEM is most applicable to very large energy users, the insights from this model are applicable to the goal of achieving increased operational efficiencies in all buildings, especially those larger than 50,000 sq. ft. In particular, our research has shown that a commitment by building owners to focus on operational efficiency and some method for measuring energy improvements are essential ingredients for good energy management and persistent savings.

Designing a Community Approach in Saint Paul

This report provides specific recommendations for the City of Saint Paul to reduce energy usage in large buildings through collaboration between the city, building owners, building operators, and energy utilities. This approach would be broadly applicable to any mid- to large-sized city where the leadership is engaged in energy efficiency.

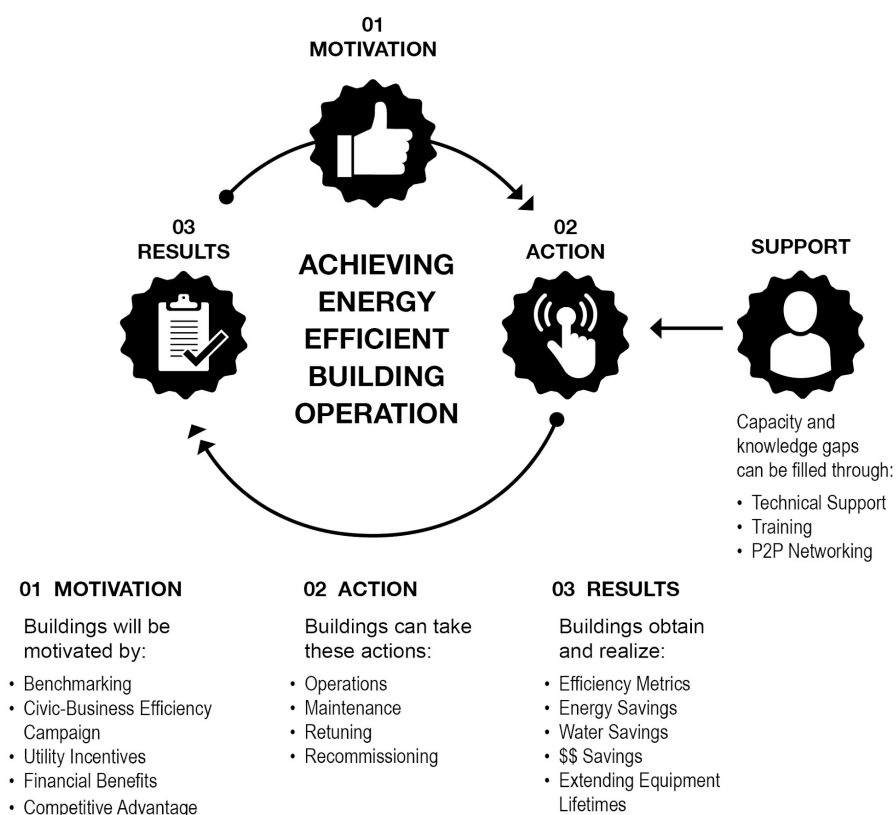
As our research has shown, to have maximum effectiveness the initiative needs to accomplish the following:

- Provide ***motivation*** for starting a re-tuning initiative — involve a visible commitment to action from city leaders and building owners, in order to provide motivation for completing the work.
- Provide educational and technical ***support*** to building operators to help them discover and take ***actions*** to implement building re-tuning measures.
- Provide an easy mechanism to track ***results*** and improvements in energy performance.
- Cultivate a culture of continuous energy improvement.

These essential elements are shown below in Figure 2.

¹⁴ Consortium for Energy Efficiency, “CEE Minimum Requirements for Strategic Energy Management Programs,” 2014: <http://library.cee1.org/content/cee-strategic-energy-management-minimum-elements/>

Figure 2. Key elements of achieving energy efficient building operations



Based on our interviews and review of other initiatives around the country, these goals can be achieved by developing and implementing a civic energy challenge that would involve the components that are discussed. This is an ambitious programmatic concept, but not one that can be accomplished by leveraging existing partners and capabilities. We estimate that within the first year of this program, assuming 45 buildings could be recruited to participate (about 10% of the buildings over 50,000 square feet), Saint Paul buildings could reduce their electric bills by 1.9 GWh and heating bills by 6,300 MMBtu through improving operations.¹⁵ Fully

¹⁵ This is assuming an average reduction of 2% in total energy usage due to the program (Envision Charlotte, with a similar design, achieved over 4% savings), and an energy usage of about 12 kWh/sq ft for electric usage, and 38 kBtu for heating, based on the author's analysis of the 2016 usage of buildings covered under the Minneapolis benchmarking ordinance (who are required to disclose their energy usage), and applying it to the average square footage of Saint Paul building types, from a city assessor database of 464 Saint Paul buildings. Usage was segregated into bins by building size: 50K-100K sq ft, 100K-250K sq ft, 250K-500K sq ft, and >500K sq ft. This was felt to be the best publicly available dataset relevant to Saint Paul large buildings. Heating in Minneapolis is from a combination of natural gas and district energy, as in Saint Paul. Note that we excluded the impact of district cooling.

implementing this program would cost several hundred thousand dollars or more, but save more than that in energy bills over the lifetime of the efficiency measures that would be implemented.

1. Establish challenge goals and peer sharing/recognition structure

A Saint Paul Building Energy Challenge would be the visible commitment by city leaders and building owners to improve operational efficiency and reduce greenhouse gas emissions. The city should set an appropriate community goal to reduce greenhouse gas emissions and energy usage city-wide. The city would then ask building owners to participate in this community challenge and actively recruit buildings to participate. Participation would be clearly defined, and participants would commit to taking specific actions when they signed up, such as signing up their building operators for a program orientation and reporting back on the energy-saving actions they have taken. Participants would be visibly recognized by the city on its webpage and as part of quarterly meetings for building operators. The quarterly meetings would also allow building staff to share best practices/case studies and get to know each other. Each building that signed up would have access to the tools, information resources, and technical assistance that would be part of the challenge.

2. Develop re-tuning program framework and provide technical assistance

a. Develop informational resources and tools on building re-tuning practices

Much information on building re-tuning already exists. As such, the necessary work would be in pulling together the relevant information that is appropriate to the city's climate-zone and Saint Paul building-stock, and developing an easily comprehensible resource for building operators. For example, we found that not all building operators are able to benefit from Internet resources; so, if a website is produced, it should be supplemented with written materials that are more readily accessible to them.

The information resources should also support the creation of a community of practitioners or learning network for building operators, so they can learn from each other. Thus, in-person trainings on specific topics, tours of buildings to show off operational measures that have been implemented, and other opportunities for interaction would be organized.

b. Conduct seasonal building re-tuning campaigns

To highlight building re-tuning opportunities and to create a sense of the whole community jointly contributing to the overall program goal, informational campaigns would be developed and pushed out to participants. These would highlight seasonal opportunities to consider specific building re-tuning measures. For example, in the spring a "check your economizer" campaign could be run, highlighting that as the summer season approaches, a check on your economizer operation is prudent (economizers allow outside air to cool buildings during the night and can

reduce air condition costs; they are also frequently incorrectly set up and are a simple re-tuning measure).

c. Provide an online tool for tracking energy savings

An essential component of developing and maintaining a culture of continuous energy improvement is measuring and tracking energy usage over time, so participants can see the impact of energy-saving actions and bolster the business case for continuing to participate. Energy benchmarking provides high-level annual data, but operators need more granular feedback. Some buildings already have systems or software for tracking weather-normalized energy usage; however, the majority do not. Providing a cloud-based system that would automatically input the energy data into the platform and be accessible to building operators could be a valuable resource. This platform could also provide other functions, like supporting the seasonal building campaigns.

A way to capture this data is to use smart meters, and incidentally, one of the objectives in the buildings section of the city's climate action plan is to implement smart meters in Saint Paul. These meters will have the capability to communicate interval data (i.e., electric usage data in short intervals, typically every 15 minutes, this provides much more information about energy use patterns than the monthly usage data on current bills).¹⁶ This interval data could then be used in the online tool, and available in real-time or near real-time, for building operators. Although this is not a necessary condition for the program, it would greatly enhance the usefulness of the tool for participants and allow them to track and compare usage from day-to-day, or even hour-to-hour, to look for anomalies. It could also provide a great usage case for implementing a smart-grid pilot, which Minnesota state regulators have indicated they are interested in seeing from utilities.¹⁷

d. Provide technical support to building operators

In order to be effective at improving building operational efficiency, it is important to identify:

- Which devices have the highest potential for significant undetected energy waste
- Which efforts are the most effective and beneficial to detect energy waste
- How to best correct any excess energy consumption found
- When to regularly verify that the devices are operating efficiently

¹⁶ At District Energy St. Paul 99% of hot water and chilled water meters provide data at one-minute intervals.

Energy usage reports can be generated for customers, and they have the option to receive real-time meter data by integrating data points into their building's energy management system.

¹⁷ See MN Public Utilities Commission docket number E999/CI-15-556.

Many building re-tuning measures can be implemented directly by building operators, although in some cases the operators will need to be empowered by the building owner to implement them. However, for the program to be most effective, implementation must go beyond the simplest measures, to ones which are likely to require technical assistance. This would involve on-site technical assistance by professionals such as engineers and controls contractors specifically trained in building re-tuning.

Next Steps

We have outlined the broad strokes of an ambitious plan that could start to realize some of the untapped opportunities for reducing greenhouse gas emissions in Saint Paul and save building owners money. This energy challenge focuses on the motivations of building owners and operators, and we recommend that future research, and phases to a challenge, include the needs and inclinations of building occupants as well. By instilling and fostering the motivation to achieve energy efficiency, actions can be adopted and results obtained and measured.

The current, focused concept is nonetheless bold for Saint Paul and promises to start building a foundational culture of energy efficiency. The plan is also very scalable and applicable to nearly all large buildings in the city.

Earlier this summer, the city took the first step toward realizing this plan by launching “Race to Reduce,” a three-month campaign that challenges large building owners and managers to reduce their energy usage over the summer months. This campaign will also provide insight and lessons learned for creating a sustainable ongoing effort that incorporates all of the features recommended here. At the end of the summer, we recommend conducting an evaluation of this campaign, to assess the effectiveness of the energy challenge, and to identify what additional programmatic components building owners and managers would find most useful.

We also recommend continuing to engage key stakeholders – primarily building owners and managers, and utilities. This could be done through the creation of an advisory committee for this project. Building owners and managers can provide valuable insight to refine the program concept. Their buy-in and support of any ongoing initiative will be crucial to its success. As we’ve discussed in this report, utilities already provide funding for a host of energy efficiency activities, and are a source of potential funding for a broader initiative.

Appendix A: Stakeholder Interviews

Stakeholder interviews were undertaken at the direction of the City of Saint Paul to gather more information on the challenges and opportunities to save energy in buildings, particularly from the perspective of owners and managers, as well as those who manage the building's day-to-day operations. Research was conducted in collaboration between District Energy St. Paul, Xcel Energy, and the nonprofit Center for Energy and Environment. By talking with building professionals and those who influence building professionals (such as contractors, vendors, and manufacturers), the research team hoped to learn about ways to promote low or no-cost opportunities to save energy in the stock of large buildings in Saint Paul — or inform future technical assistance or other initiatives to help organizations embrace efficiency, and building operators reduce energy costs. This effort is part of a larger effort by the city to reduce energy and greenhouse gas emissions in the building sector.

It is well documented that buildings use more energy than is necessary in ways that are avoidable, despite the fact that almost all building owners, managers and operators have at least some concern for energy efficiency. A design thinking approach was adopted as a method to understand why this waste persists and to discover what could be done to make minimizing it a common operation practice.

Design thinking is a user-centered, problem-solving process that businesses are adopting to develop innovative approaches. Tim Brown, the CEO and president of the product design firm IDEO, defines design thinking as:

“A methodology that imbues the full spectrum of innovation activities with a human-centered ethos. ... by this I mean that innovation is powered by a thorough understanding, through direct observation, of what people want and need in their lives and what they like or dislike about the way particular products are made, packaged, marketed, sold, and supported.”¹⁸

The most important step of design thinking is to empathize:

“Work to fully understand the experience of the user for whom you are designing. Do this through observation, interaction, and immersing yourself in their experiences.”¹⁹

The objective is to gain an understanding of the obstacles and barriers that people encounter and determine the factors that influence their perceptions and behaviors. This also requires an understanding of the contexts which define their roles and govern their actions. These insights

¹⁸ Tim Brown, “Thinking”, Harvard Business Review, June 2008, pp 85-90.

http://www.ideo.com/images/uploads/thoughts/IDEO_HBR_Design_Thinking.pdf

¹⁹ <http://dschool.stanford.edu/redesigningtheater/the-design-thinking-process/>

can uncover root causes and identify systemic solutions. For this project we used interviews with building staff and other stakeholders to gain these insights.

A total of 10 interviews were performed — six with a combination of building operators, facilities personnel, and property managers; three with controls and mechanical contractors and their distributors; and one with a utility customer service engineer. District Energy St. Paul and Xcel Energy are the two utilities that provide energy services to all six buildings. The buildings were recruited from a list of possible candidates suggested by the City of Saint Paul and were invited to participate in the interviews by the city. These participants were those on the list who consented to the interviews when contacted by CEE staff. The building types included four commercial buildings (a municipal office building, a hospital complex, two owner-occupied buildings), and two residential sites (an owner-occupied condominium building and a high-rise public housing complex). The commercial buildings had Building Automation Systems (BASs), while the residential buildings did not. Each interview was done on site and lasted for approximately one hour. Appendix B shows the trigger questions that were used to help guide the interviews.

Interview Results

Building operator backgrounds: All of the building operators had over ten years of experience with the majority coming from a building maintenance background. Some had electrical, pipefitting and HVAC experience, and most were trained to operate their specific buildings either from their predecessors or by on-the-job training. Two participants had formal technical and engineering training.

Duties and Responsibilities: For all the building personnel, building operation was only a portion of their primary responsibilities, which also included building maintenance and upkeep. Their principal objectives are to provide the necessary services to the building occupants while keeping costs within the budgets set aside for operations and maintenance. The major measures of job success are defined by saving money and keeping occupant complaints to a minimum. Comfort issues are typically the major reason for complaints, specifically dealing with the temperature and humidity within the space.

An important trend that has helped building operators is the increased use of BASs with their sensors and controls that monitor and regulate interior conditions. Occupancy sensors and automated scheduling aid in delivering more energy efficient lighting and space conditioning. The building operators who were interviewed all noted that the data from BASs were a valuable tool for them to explain to building occupants that the building was performing within the specified building operating parameters. With this concrete quantitative information, building staff could more effectively respond to comfort questions and deal with complaints. Interestingly, when asked if they thought that their building was operating efficiently, more than half of the building operators felt that since the data showed that the building was operating

within the defined operating specifications, their buildings were operating efficiently.

For the two residential multi-family buildings, one building was owner-occupied condominiums and the other had low-income tenants. Building operators controlled common areas and maintained the building physical plants. Neither building had a BAS and tenants had control of their space heating and cooling.

Analog to Digital: Many of the building operators stated that the introduction of computers and BASs has been the major change in their jobs over the past five to ten years. For more experienced workers, going digital required acquiring computer skills and the ability to read dashboards and interpret the meaning of the information displayed. This adds a new layer of complexity to operating and maintaining their buildings.

With the introduction of these advanced technologies, the relationship between building operators and their controls/mechanical contractors has shifted. With the ability to monitor and control equipment remotely, some onsite building staff rely more and more on contractors; not just as a trusted source of control hardware and software, but also as a partner in operating the building. In some cases, building operators relied on their controls contractors to change the operating parameters of their systems. This relationship can be to the mutual benefit of both parties. Our interviews with controls contractors revealed that an important part of their business model is to cultivate service contracts with their customers. For building operators, relinquishing the burden of data analysis and building controls to BASs and contractors eases on-site building staff of some operational responsibilities and allows them to concentrate on their maintenance duties. This improves their relationship with the building occupants and helps them manage complaints. Another outcome of this trend toward the digital is that building staff have become the eyes and ears of the BASs and contractors, checking that equipment is operating properly and performing preemptive maintenance. When issues are encountered, the contractors send out service staff to remedy the problems. In some cases, contractors were consulted to help them scope projects and receive bids. Contractors often helped to fill out forms for utility rebates as part of their services.

The trend toward the digital reinforces the strong reliance of building operators on their mechanical and controls contractors and the desire to maintain a long, stable relationship with their contractors. Effectively, this creates a tendency toward sole sourcing, which in turn falls in line with the business model of the contractors. This runs counter to the goal of the property management to minimize costs by using a competitive bid process for equipment and services. This can put building operators at odds with property management even though they are working toward the same goal of managing building costs. One solution to this issue is the adoption (by manufacturers and suppliers) of open standards that allow different brands of equipment to communicate with each other and work in hybrid combinations and open competition. This should increase options and allow for more competitive bidding and lower costs. However,

greater system complexity might also arise, and with it the need for additional support services — calling for greater expertise of the building operator or greater reliance on their contractors.

Building Energy Use: Building operations staff identified lighting and HVAC operations as the primary ways that their building consumed energy. Awareness of energy use was provided from energy bills and data from their BAS. Very little was known about how their building energy use compared to other buildings — with the exception of the hospital, which was part of a larger network, as well as a healthcare sustainability association.

When asked about performing energy efficiency improvements, nearly all identified capital improvements as the main course of action, and those improvements were dependent on budget availability. These improvements ranged from LED lighting, improved HVAC equipment, controls, sensors, and windows. A couple of sites also identified staffing needs and training would improve the operations and maintenance efforts.

An important question that we asked building staff was whether they thought they were providing building services as energy efficiently as possible. This was an attempt to lead the discussion toward operational efficiency, as opposed to capital improvements. The building operators who relied closely on the data from their BASs, and the contractors who provided BAS systems and services, were the most aware of the need for and benefits of adopting operational efficiency practices.

District Energy provided an important role in improving building energy performance through their monitoring of return water temperatures from the building. Buildings were contractually required to have exit temperatures below or above a certain temperature, and if these were exceeded, a District Energy building engineer went on site to assist in helping the building operator achieve the necessary results.

Support: As mentioned previously, building personnel received much of their expertise about their buildings from their predecessors along with on-the-job training. Documentation in the form of manuals and Standard Operating Procedures (SOPs) were generally lacking, and a need to develop these was identified at many of the sites. Vendors, contractors, and manufacturers were listed as important sources of information. Online courses, webinars, vo-tech seminars, trade magazines, and professional licenses were also named as ways to keep up with the field and latest practices. Many of the building operators participated in BOMA courses and activities. Xcel and District Energy were also named as important sources of information. Several of the building operators also said that informal interactions with building personnel of neighboring buildings was an important way to share experiences and gain insights. The building operators noted that there was either a lack of familiarity or little interest in the Building Operator Certification, they also mentioned that they had little time for training and that their needs were fairly specialized for their specific situations. Many expressed an interest in participating in peer networks where short sessions could allow them to share best practices and discuss issues. The

District Energy engineer used a problem-solving approach to help building operators diagnose proper actions. He felt that putting them in a learning mode was the most effective training approach. Xcel Energy account managers also provided advice and support through programs and incentives.

Management: With regard to energy efficiency efforts, building operators described a strong reliance on management to provide the funds for needed capital improvements (such as LED lighting, VFD motors, BASs) and additional staffing. It was also clear that for those sites that were achieving significant operational energy savings, management provided leadership, direction, and encouragement in supporting building operator efforts. These building operators responded that they enjoyed good communication with management who regarded them highly and provided them with support and praise. The management at one site had an unsatisfactory experience with a performance contracting firm and decided to perform those services in-house. This site currently achieves excellent energy savings through a system of ongoing building optimization and tuning.

Motivation: While many of the building operators didn't say they needed recognition for their work, praise and support from building occupants and management was valued. They did not feel that competition with other buildings would provide motivation, and that it would probably hurt the relationships they had with the other building staff they interacted with from neighboring buildings. Some did think that third-party recognition might be useful when it came to negotiating with management for funds or gaining respect within the peer community.

With regard to utility rebates and incentives, one building operator did not think that custom rebates were particularly helpful. The paperwork was considered too onerous and would require more time to complete than is worth the rebate received. He suggested that a midstream approach; paying down the price of products, would be more useful.

Most of the sites knew their energy costs but had little knowledge of their energy use — with no awareness of their EUI or baseline energy consumption. Consequently, any norming with other building types was non-existent and provided no motivation for energy efficiency actions.

Appendix B: Stakeholder Interview Questions

Building Operator Breaking the Ice Questions

1. How long have you been working at this building?
2. How long have you been a building operator?
3. What is your professional experience and background?
4. When you started working in this building, did you communicate with any of your predecessors to get you up to speed on the building and systems?
 - a. How do you pass your learning and knowledge on?
 - b. What do you think about licenses?
 - c. What do you think about training and certifications?

Building Operator Jobs Trigger Questions

1. What are the primary tasks you perform to save energy? What problems are these tasks addressing?
2. Do you think your building uses more energy than it needs to perform its work/functions?
3. What is the most important action you take to save energy in your building?
4. Do you know how much energy your building uses? How do you think your building compares to other similar buildings in consuming energy?
5. Do you have defined building operating parameters that tell you that your building is operating properly?
6. How is your role perceived?
 - a. By the building occupants?
 - b. By the building owner/property manager?
 - c. How do your activities or goals change, depending upon which of these is your primary customer?
7. How has your job changed over the past five to ten years?
8. How do you get information?

- a. How do you keep up with new technologies?
 - b. Who are your trusted sources of information?
 - c. What networks are you a part of?
9. If you were training a new hire to help you with keeping the building operating efficiently, what would you instruct them to do?
- a. If we were to create educational tools and training, what would work best for you and your staff?

Building Operator Gains/Pains Trigger Questions

1. How do you define that you've done a good job or are satisfied with your work?
2. How do you think the equipment in your building might not be operating as efficiently as possible?
3. Are there ways that the people in your building aren't using energy efficiently?
4. What are the main barriers or obstacles to reducing energy waste in your building? Time? Cost? Effort? Know-how?
5. How do you calculate the payback on energy projects?
 - a. How do you prioritize which ones you will do first?
6. Are there any tools or resources that you would find helpful in deciding what energy projects to do?
7. What could be done to make it easier for you to make your building use less energy?
8. What risks might you encounter by performing energy efficiency work?
9. When you learn about a new technology or procedure, what motivates you to implement it? Cost? Ease? Innovation?
10. Are there building energy use issues that annoy you? Are there malfunctions that you often have to deal with? What is the most frustrating aspect of your job?
11. We all know that what is designed for a building, isn't always how it gets built. Has your operations team documented the equipment you have and how it operates?
12. If there was something that you could change about your job, what would it be?

13. How is success or failure measured for you?
- a. What types of acknowledgement or recognition do you receive for a job well done?
 - b. What types of acknowledgement or recognition would you like to receive from peers, building owner/property manager, building tenants?
14. How does your employer deal with your achievements in saving energy?
- a. Is your budget impacted?
 - b. Is your bonus impacted?
 - c. Is energy efficiency achievement one of the criteria used to evaluate your job performance?
 - d. What would motivate you to reduce building energy waste?
15. In general, what are your big issues, concerns, and worries? What keeps you up at night?
16. Can you describe one or two pieces of advice that you would like to share with others?

Appendix C: Case Studies of Other Challenge Programs

Atlanta Better Building Challenge

Interviewed:

- Shelby Buso, Central Atlanta Progress
- Kailor Gordy, Central Atlanta Progress
- Mary Howard, Southface Energy Institute
- Joe Winslow, Southface Energy Institute
- Megan O'Neil, City of Atlanta

The City of Atlanta was among the first round of cities committed to the U.S. Department of Energy's Better Building Challenge with a goal of committing two million square feet of downtown commercial space to reduce building energy use by 20% by 2020. Seven years after the program launched, over 680 properties representing 116 million square feet committed to the challenge. The program's success is largely due to its strong marketing strategy and pre-existing relationships with downtown building owners and local nonprofit Southface Energy Institute. According to the former Director of Sustainability at Central Atlanta Progress, Shelby Buso, who helped implement the program, recruitment was never an issue in Atlanta. Instead, the program leveraged existing public-private relationships to invite building owners to participate in the challenge in return for public recognition from the mayor, and marketing expertise for building owners to communicate their energy savings and sustainability efforts.

Capitalizing on downtown buildings' interest in improving public image, Atlanta's program sought to provide buildings with a roadmap to sustainability through energy efficiency. Partnering with Central Atlanta Progress (the city's downtown business improvement district), the city was able to leverage an existing network of buildings for recruitment. In addition to assisting with recruitment, Central Atlanta Progress offered marketing expertise to help participating buildings advertise their energy savings to tenants, customers, and the real estate market to add value to their energy efficiency projects (in addition to utility bill savings), which reinforced positive, sustainable practices. The city also used funds from a local foundation to partner with the Southface Energy Institute to provide roughly 100 of the first businesses to enroll in the challenge with free energy audits. The free audits not only incentivized early program participation, but also provided buildings with recommendations to achieve the challenge program goal, making the commitment seem less daunting. Throughout the program, Southface's role has been to provide technical support with setting up building accounts in ENERGY STAR Portfolio Manager, providing energy counseling to buildings and managing benchmarking data analysis and verification for the Department of Energy.

Atlanta's competitive challenge program had evolving metrics for success. Initially, the challenge winner was the first building to achieve a 20% energy reduction, however several buildings reached this threshold earlier than anticipated. Given that the challenge program's goal was to catalyze long-term

savings, the metric for success changed to 20% energy savings portfolio-wide. Interestingly, after word spread of the energy bill savings within Central Atlanta Progress' geographic area, two other business improvement districts signed on to the challenge, spurring a friendly competition between the districts to capture the most savings. To weave equity into the program, the City of Atlanta began a "Grants to Green" program, which offered initial funding to help small-to-medium sized businesses finance capital improvement projects with the caveat that they voluntarily benchmark and disclose their energy data to the city.

Building operator engagement took several forms. If the building owner signed up for the challenge and required their building operator to attend a workshop(s), the most successful engagement occurred when the facilitator emphasized the city's role in helping the operator save money and, in turn, please the building owner. In this case, the city helped building operators review the audit results and recommend changes to the building owner. Oftentimes the building operator had wanted to make the changes for a long time, but the program offered the justification and support to implement. Though Atlanta's challenge program was competitive, building operators shared their strategies for saving energy with one another at workshops. As the program evolved and participation grew, workshops became more specialized to discuss sector-specific opportunities for energy savings.

Atlanta's challenge program grew exponentially after its initial outreach to buildings in the downtown core. Original engagement involved in-person interactions with downtown buildings to invite them to participate in the challenge. Afterwards, the program began to appeal to building owners across the city as awareness of the program spread word-of-mouth. Atlanta's program also hosted several events to recognize buildings with impressive energy savings, elevating awareness of the program. These events came at a minimal expense to the city because they were often hosted at a building participating in the challenge that was eager to showcase their building's efficiency. The Mayor of Atlanta attended recognition "parties" and signed handwritten thank you letters to building owners whose portfolios achieved the 20% challenge goal. Recognition events were intended to be fun — with local bands and artists invited — to celebrate the collective and individual achievements of building owners and engineers within five categories.

Marketing was also leveraged through vendor engagement, and as energy audit requests increased through the challenge program, Southface began to have concerns about capacity. Their solution was to develop a template audit form for vendors that, if completed and the results were disclosed to the program, gained the vendor recognition as a program sponsor. Completing the audit template was advantageous for vendors, as their status as a program sponsor made them a first-choice to receive vendor bids amongst buildings participating in the challenge program. In 2019, vendors will also receive recognition at the city's annual recognition event.

According to staff at Southface, the greatest savings were likely obtained from operational and maintenance changes recommended by Southface. There is some uncertainty here, as there is no utility data verification for the program. Perhaps here, it is worth mentioning that Georgia Power, Atlanta's investor-owned utility, had minimal involvement in the challenge program. Through Georgia's Public

Utilities Commission, it did file some of the limited funding that it provided to the program, but not the energy savings (as it did not measure or verify them). Additionally, program participation in Georgia Power's conservation programs was minimal prior to the ABBC. In terms of capital improvements made through the challenge, most projects included LED lighting upgrades leveraging Georgia Power's aggressive rebates, as well as controls upgrades that provided quick returns on investment. Property Assessed Clean Energy (PACE) financing was not available until 2017.

In terms of staff required for the program, Southface provided roughly 2.2 FTEs, soon to be 3 FTEs in 2018. The City of Atlanta provided about a 0.4 FTE through the Mayor's sustainability office, and Central Atlanta Progress provided 1 to 0.5 FTE, and other business improvement districts spent even less time.

Urban Smart Bellevue

Interviewed:

- Emma Johnson, City of Bellevue

The City of Bellevue partnered with their investor-owned utility Puget Sound Energy to run a challenge program asking participating commercial buildings to reduce their energy use by 5% over two years through operational and behavioral changes, with an additional challenge of achieving 1% energy savings from capital improvements. Bellevue's approach was based partially off Envision Charlotte's model, but also incorporated Community-Based Social Marketing, targeted value propositions to building owners, facility managers and operators, and tenants, and an Energy Management Information System (EMIS) that allowed participating businesses to review energy data analytics and manage behavioral engagement. The program's goal was to enroll 200 buildings in the challenge, beginning downtown. Though Bellevue has a population of roughly 140,000 residents, it has a significant business community due to the west coast's tech corridor.

Buildings that agreed to participate in the free program received invitations to workshops, access to an online dashboard to review building energy data, and toolkits for occupant engagement campaigns. The city hosted a total of four, cross-sector workshops for building operators to share energy saving strategies amongst one another. At the workshops, awards, case studies, and mayoral thank you letters were distributed. According to Emma Johnson, the city's former program lead, peer recognition at these events was more valuable than public recognition. An example of this was a hotel building operator hosting a guided tour for other operators, giving him a chance to showcase the building's energy performance and receive peer-validation. This reinforced the hotel operator's positive behavior, and motivated attendees to do similar work within their own buildings. Peer-learning was more inspirational than a top-down educational approach.

As part of Bellevue's integrated approach, Bellevue's challenge program offered participant's access to EMIS: a set of state-of-the-art customer segmentation tools that allowed users to profile data analytics. The tools included recruitment capabilities, such as personalized invite letters, a Puget Sound

registration page, personalized energy reports, and a Utility Program Manager portal to monitor and manage customer engagement. In terms of energy use, the program tracked participating buildings' energy use at daily and even more granular intervals before weather-normalized data with statistical regression models that also accounted for occupancy and operating hours. Progress was measured using the previous calendar year's energy use as a baseline. Program savings were then calculated by Puget Sound Energy by subtracting actual energy consumption with anticipated consumption, in addition to subtracting any capital projects so that savings were not double-counted. The program also measured the attitudes of participants through a series of surveys aimed to evaluate causality between the program and energy savings.

Bellevue's program combined several methods to engage occupants in behavioral change. Initially, the program aimed to identify "energy champions" within buildings. Energy champions were designated to provide internal program implementation: identifying opportunities to save energy, engaging other occupants, and navigate their buildings' organizational culture. Energy champions were then equipped with engagement toolkits like energy saving guides, an energy "treasure hunt" activity, and a mobile phone application to report energy actions taken by building occupants. For the energy treasure hunt activity, the energy champion would convene a group of environmentally oriented co-workers to walk through their building and identify behavioral changes to save energy. If the building commissioned a controls contractor, the contractor could be included to guide the hunt. At the end of the activity, the team would identify at least three actions that they pledged to take. By using the mobile application to track energy actions taken, teams were eligible prizes, such as free coffee catered to participants that successfully changed behavior.

Through interviewing Emma Johnson, several lessons and considerations emerged. Most importantly, Challenge programs take longer than anticipated. By the end of Bellevue's two-year program, peer-to-peer recruitment was only beginning to take off. This is similar to the case of Atlanta and Los Angeles, where the greatest participation growth occurred in the middle of the programs' duration, both of which lasted over six years. Program awareness is an issue during the first two years of the programs' launch. According to Emma, mail-out invitations were not a cost-effective recruitment method. Both Atlanta's and Bellevue's programs emphasized that in-person meetings, followed by phone calls with building owners, occupants, and tenants stimulated the greatest interests and actions, but were time and staff intensive. Consistently throughout the programs, personal interactions generated the greatest positive results. For Bellevue, peer-to-peer learning at workshops inspired the greatest interest in changing behavior and kept people engaged. There appears to be a "snowballing" effect in participation — as more participating building names were posted on the city's website and positive stories of energy savings spread word-of-mouth, enrollment grew exponentially. When asked what an ideal program length would look like, Emma suggested at least five years before the program could optimally engage small-to-medium sized buildings. These smaller buildings have significant energy savings potential, as they collectively use a considerable amount of energy but do not have building operators or energy managers as staff capacity to identify technical or financial resources to save energy. Buildings of this size are often the most interested in O & M, low-to-no cost solutions to save energy, as they have fewer

resources for capital investments. These buildings also have less brand recognition and are often unaware of the program if its duration is too short. If a building owner manages their building's energy through a contractor, the contractor might also not be aware of the Challenge program as well.

Another suggestion of Emma's was to not design a mobile application. While the app was helpful for the first six months after it was installed, the lack of personal interaction led to participants quickly losing interest or forgetting it existed. Poster tallies or other low-tech recording methods could be just as effective, and would free resources for a more thorough energy coaching and facilitating peer-learning. Likewise, the online data dashboard included in the EMIS was underutilized for its cost. Though building engineers occasionally used it to prepare for a call to learn about the program's resources, remote analytics did not replace in-person learning opportunities.

Puget Sound Energy also funded a direct install program for small businesses fewer than 10,000 square feet that the city promoted through the Challenge program. The direct install program included an initial energy audit, as well as on-the-spot installations of LED lights and low-flow faucet aerators, pre-rinse spray heads and showerheads. Additionally, the program includes a proposal of efficiency upgrade opportunities for the buildings, such as more expensive LED light fixture replacements, occupancy sensors, HVAC equipment, and refrigeration upgrades.