MINNESOTA DEPARTMENT OF COMMERCE
DIVISION OF ENERGY RESOURCES

EnergyScoreCards Minnesota

Results from Energy and Water Benchmarking in 500+ Minnesota Multifamily Buildings

Conservation Applied Research & Development (CARD)
FINAL REPORT

Prepared for: Minnesota Department of Commerce, Division of Energy Resources

Prepared by: Bright Power, Inc. Minnesota Green Communities, Center for Sustainable Building Research, Minnesota Housing Finance Agency, MN Center for Energy and Environment

EnergyScoreCards Minnesota is an initiative of EnergyScoreCards, Minnesota Green Communities, University of Minnesota Center for Sustainable Building Research, Minnesota Housing, and Center for Energy and Environment. This two-year effort aims to reduce utility costs, energy and water use, and carbon emissions in multifamily housing through energy benchmarking.

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EnergyScoreCards Minnesota is an initiative of EnergyScoreCards, Inc. (a subsidiary of Bright Power, Inc.), Minnesota Green Communities (MNGC), University of Minnesota Center for Sustainable Building Research (CSBR), Minnesota Housing, and Center for Energy and Environment (CEE).

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Abstract

EnergyScoreCards Minnesota was a program to study the feasibility and impacts of energy and water benchmarking in over 500 multifamily buildings in Minnesota, conducted from 2012 to 2015. The study design provided two years of a benchmarking service, EnergyScoreCards, to half of participating buildings (the treatment group), and used the other half as a control group. The service included automatic collection and analysis of owner-paid electric, gas and water data from utilities, access to an online benchmarking software (EnergyScoreCards), and support from a dedicated Account Manager. The program demonstrated that benchmarking is feasible as a large scale strategy in Minnesota multifamily buildings for owner-paid utilities. Results of a statistical comparison found significant savings of 5% energy savings and 30% water savings in master-metered buildings receiving the service for two years in comparison to the control group. This final report includes a detailed account of the study design, methodology, impacts, demonstrated uses of benchmarking, and barriers to and successful strategies for engaging building owners. Benchmarks for energy and water consumption in common Minnesota multifamily building types are presented based on the study data set. The potential to use multifamily energy and water benchmarking as a standalone strategy, as a component of holistic energy and water management strategies, or as a policy tool is discussed based on these results.

The effort was funded by a Minnesota Department of Commerce, Division of Energy Resources (DER) Conservation Applied Research Program (CARD) grant, the Xcel Energy Emerging Technologies Grant Program, and a Multifamily Rental Energy Efficiency grant from Minnesota Housing. The program was led by Bright Power, Inc. with four Minnesota based partners: Center for Sustainable Building Research at the University of Minnesota, Center for Energy and Environment, Minnesota Green Communities and Minnesota Housing.

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Executive Summary

EnergyScoreCards Minnesota was a pilot initiative to study energy and water benchmarking in 500+ Minnesota multifamily buildings which took place from 2012 to 2015. The effort was funded by a Minnesota Department of Commerce, Division of Energy Resources (DER) Conservation Applied Research Program (CARD) grant, the Xcel Energy Emerging Technologies Grant Program, and a Multifamily Rental Energy Efficiency grant from Minnesota Housing. The program was led by Bright Power, Inc. with four Minnesota based partners: Center for Sustainable Building Research at the University of Minnesota, Center for Energy and Environment, Minnesota Green Communities, and Minnesota Housing.

EnergyScoreCards Minnesota provides one of the largest demonstrations of the feasibility and impact of multifamily benchmarking to date, with detailed documentation on methods, results and lessons learned. The findings, documented in this final report and separate Impact Evaluation and Process Evaluation reports, can be used by building owners, program designers and implementers, and policy makers using benchmarking as a tool to drive energy and water savings in multifamily buildings.

The primary findings of EnergyScoreCards Minnesota are:

1. **Multifamily energy and water benchmarking is demonstrably feasible at scale in Minnesota.** The program exceeded recruitment goals, collecting utility and property information on over 550 Minnesota multifamily buildings (93 owners and property managers), and providing a benchmarking service for a treatment group (286 buildings) for two years. Key elements of the service provided are:
    - Automatic data collection from utilities
    - A subscription to an online analysis and reporting tool at the EnergyScoreCards Minnesota website (http://www.energyscorecardsmn.com/).
    - Comparison of building energy and water performance to peers using weather and/or space normalized metrics
    - Portfolio and property level reporting and analytics
    - Support from an assigned Account Manager in understanding and using the information provided in the tool

Collection of tenant-paid utilities remains a significant challenge. The pilot focused primarily on owner-paid utilities.

2. **Statistically significant energy and water savings were found in master-metered buildings receiving the EnergyScoreCards service in comparison to a control group**. Participants were randomly split into two groups: a treatment group which received the service for two years, and a control group which did not, but for which energy and water was tracked by Bright Power. Results of a comparison between these groups after two years of the service showed:
    - Master-metered buildings (i.e. buildings where the owner pays for all utilities in the building) in the treatment group experienced a significant decrease in energy consumption by the second year of the pilot relative to the control group, about a

5% reduction for a typical master-metered building. Master-metered buildings accounted for 17% of the analyzed buildings.
    - 80% of master-metered building savings occurred on heating. Treatment group participants reduced heating consumption (on a weather-normalized basis) by 7%.
    - Master-metered buildings in the treatment group decreased their water usage by 30% in the second year compared to the control group.
    - Energy and water savings in non-master-metered buildings in the treatment group did not appear statistically significant in this study. A statistical analysis conducted after the fact suggests that a larger data set would have been needed to verify the small changes observed in this group.
    - As a utility scale program to produce energy or water savings, benchmarking appears cost-effective for master-metered properties, with potential for extending the benefits to other building types in a larger or longer program. The value of savings produced in master-metered buildings during the pilot ($269,380) is 2.15 times the cost of providing the service to the master-metered buildings ($125,435). Because a large portion of costs were one-time (for program design and launch) and savings only began in the second year, the cost-effectiveness of long-term program would improve over time, assuming savings persist or deepen each year. For instance, in a hypothetical 10 year program targeting master-metered buildings, cumulative savings would be $7.79 for every $1 spent, assuming savings start in the second year and continue each of the remaining years at the same level.
3. **Benchmarking was used by participants for many purposes beyond near term energy and water savings.** Documented uses of benchmarking by participants in this program include:
    - To track the results of energy and water improvements
    - To inform long-term capital planning
    - To inform operations and maintenance
    - To enable competitions
    - As a business management tool to assist with budgeting, key performance indicators, and other asset management functions
4. **Benchmarks for typical energy and water performance among Minnesota multifamily buildings were developed** and can provide owners, program managers or policy-makers perspective on the potential for energy and water savings in their buildings, and how to target future efforts.
5. **A participant survey and Account Manager experience documents the importance of hands-on support as part of a benchmarking service.** Documented strategies to engage participants and help them benefit from the service include:
    - Provide dedicated support staff alongside benchmarking software
    - Build a relationship with owners as a long-term partner
    - Provide benchmarking services at a portfolio level
    - Coordinate with other technical providers/ programs to bridge to action

There are several avenues for future research and program development to build on these findings, including:

- Use benchmarking as a component of a more comprehensive multifamily retrofit or energy management program to improve long-term program results.
- Replicate this experiment in different locations, with more buildings, or with varying experimental design (e.g. offering more time, including a variety of service levels, tighter integration with utilities, adding more hands-on technical assistance for owners).
- Inform the evolution of policies for energy and water benchmarking and disclosure to increase the impact of these policies to drive long-term energy and water savings.

Background

What is energy and water benchmarking for multifamily buildings?

As a business practice, benchmarking is a measurement process used to identify certain performance characteristics and compare performance to a baseline standard and over time. Energy and water benchmarking involves comparing building consumption to other similar buildings or to the same building over time. Energy and water benchmarking is a growing real estate practice and is widely seen as an important tool to drive energy and water savings (Wood, 2011; Krukowski, 2014). Utility bills are an ideal data source for benchmarking because they rely on existing hardware. However, utility data is typically available only to account holders and only on paper bills or online utility company portals. The raw bill data requires significant collection, processing, analysis, and presentation to provide meaningful building performance benchmarking.

The notion that a building or portfolio has "benchmarked" energy and water consumption implies that the building owner, manager, or another party has:

- collected utility bills or billing data for a building or portfolio,
- performed some analysis to (at minimum) aggregate annual consumption at a building or property level,
- Compared consumption to other peer buildings or to the same building over time using metrics normalized by weather, building size, and/or other characteristics.

This process can be done by hand using paper bills and a calculator, using a spreadsheet, or using one of a number of benchmarking software tools available for buildings of different types.

Multifamily buildings are benchmarked in the same way as commercial buildings or single family homes, with an added complication that the large number of tenants often makes collecting whole building utility data very challenging. Bright Power's national database of over 18,000 multifamily buildings suggests that only 20-30% of multifamily buildings are master-metered, meaning that the owners pay for all utilities used in the building.

In the remainder, building energy consumption and payment responsibility is split between owners and tenants, and the portion paid by owners or tenants varies depending on systems, climate and metering configuration. Collecting whole building energy usage in non-master-metered buildings requires getting utility bills from all residents, which can increase the number of data points required by more than an order of magnitude and also involves getting authorization from individual residents who are the utility account holders. For this reason, whole building energy consumption is particularly challenging to collect for multifamily buildings, and often owners focus solely on the bills they pay. EnergyScoreCards can assess performance of owner-paid utilities alone, benchmarking buildings against a set of peers where owners pay for the same portion of utilities. Owner-paid energy and water consumption is the primary focus of the benchmarking in the EnergyScoreCards Minnesota pilot.

How do real estate companies manage energy and water?

Managing utilities is one component of the job of owning or managing real estate. Ultimately, building owners, property managers and tenants are responsible for paying energy and water bills, for installing and maintaining the energy- and water-using equipment, and for their behavior or operations that impact energy and water use. Looked at from the perspective of a building owner, *benchmarking* is one component of *energy and water management*, alongside other activities including:

- Providing building services that require energy and water (e.g. heating and cooling)
- Maintaining and operating building equipment
- Assessing the feasibility of energy and water upgrades
- Design and engineering of energy and water systems
- Managing budgets for utilities and for capital upgrades
- Installing capital upgrades (e.g. new lights, windows, boilers, toilets)
- Verifying proper installation of capital upgrades
- Design and construction of new buildings or major rehabs
- Accessing financial incentives or programs for building upgrades
- Paying utility bills
- Choosing energy suppliers
- Communicating with tenants around building comfort, health and energy and water use
- Securing subsidies for utilities (for some types of affordable housing)
- Billing tenants for energy and water use (for buildings with sub-metering or other mechanisms for resident billing)

Real estate companies vary in how they handle energy and water. Organizations may have written energy and water policies, or be required to report on environmental performance to investors or funding agencies. For some large corporate owners, whole business teams may be devoted to energy and water management.

On the other hand, for small owners, a single person may handle all aspects of energy and water management along with several other real estate functions. While some organizations make voluntary public commitments to energy and water initiatives or goals,[1] others do not recognize the need and instead view utilities as a cost they must bear but cannot control.

The diagram in Figure 1, developed by the US Environmental Protection Agency (EPA), shows one view of the "Energy Management Process." Benchmarking is key at several key points in this process (driving commitment, helping set goals and measuring progress), but other steps require services/activities far beyond the scope of 'benchmarking' (US EPA, 2013).

[1] For examples of energy and water initiatives, read about the Better Buildings Challenge at US DOE (2015) or the Global Real Estate Sustainability Benchmark (GRESB).

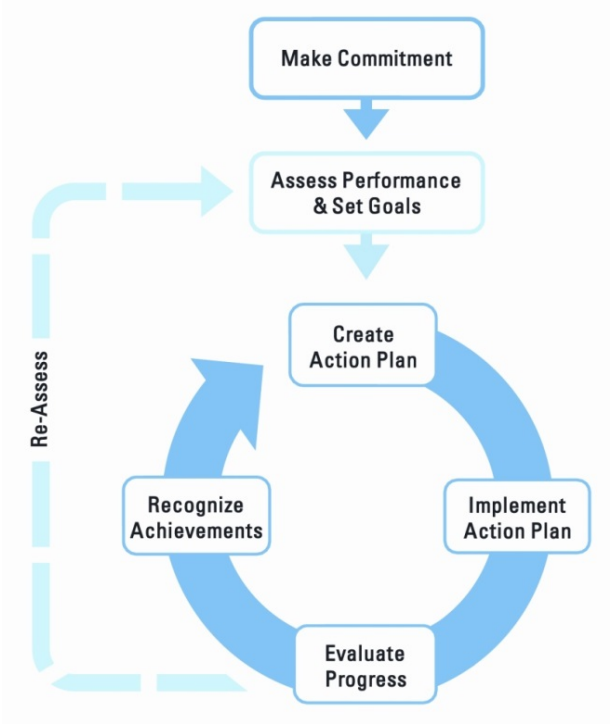

Figure 1: Energy Management Process

As with other aspects of energy and water management, benchmarking is ultimately an activity performed by people as part of running buildings. It is heavily impacted by the people who perform the activity, their available time, their level of training, the organizational priority given to benchmarking, and the technical tools and resources at their disposal.

Benchmarking services and software

Some building owners or property managers use benchmarking services, typically including an online software platform, which may include some or all of the following:[2]

- Collection and aggregation of utility billing and consumption data
- Analysis and reporting at a building and portfolio level
- Comparison to peer buildings
- Tracking of energy and water projects
- Support, training, and assistance with other energy management services (e.g. energy procurement, utility bill processing, energy audits)

While analyzing utility bills can be done in spreadsheets, using a service can have advantages justifying the cost usually associated with third-party services. With a constant influx of monthly utility bills and additional building data, benchmarking software stores and analyzes

[2] A recent white paper by Seattle reviewed features and uses of three other benchmarking services alongside EnergyScoreCards and EPA's Portfolio Manager tool.

usage information that building owners may find difficult or impractical to manage by themselves.

This pilot program is based around one particular benchmarking service, EnergyScoreCards, launched by Bright Power in 2010. EnergyScoreCards is one of a small number of services on the market specifically designed for multifamily buildings. The tool automatically retrieves utility bills and uses billing data and basic property information to generate scorecards allowing users to quickly see how their multifamily building's consumption compares to others, identify the most promising areas for upgrades, and watch trends. Outside of the pilot, EnergyScoreCards is offered as a paid subscription service to building owners, property managers, agencies, lenders and others.

In addition to the private tools like EnergyScoreCards, the US Environmental Protection Agency (EPA) created ENERGY STAR® Portfolio Manager to help property owners and managers benchmark their buildings using an online interactive tool. Since 2011, over 260,000 commercial buildings were benchmarked with current energy and water usage that building owners can compare against their own building profile. Portfolio Manager requires the use of whole building data, and as a result was first only offered to commercial buildings, given the challenge of collecting whole building data on multifamily properties. In 2014, ENERGY STAR Portfolio Manager introduced a 1-100 score for multifamily buildings for the first time (Portfolio Manager, (n.d.); ENERGY STAR, 2014). Unlike EnergyScoreCards, Portfolio Manager only provides a score when the building has whole-building data, it does not break down energy into end-uses, it does not automatically retrieve utility data (although some utilities can send data to it directly), and it does not have human support to help users understand and act on the results.

The Opportunity of Benchmarking

In addition to owners and property managers, benchmarking has potential uses for utilities and for governments as a policy or program tool.

For Utilities

Utilities or government energy agencies could leverage benchmarking to support energy saving goals in conjunction with utility programs. For instance, if a benchmarking service was offered by a utility,[3] it could serve as:

- an incentive for owners to participate in programs
- a way to drive participation in programs by alerting owners to energy and water waste
- a first step to gradually engage owners in energy and water management
- a tool to assess potential savings from a pool of program applicants
- a filter for utility programs to identify good candidates and high-savings opportunities
- a way to qualify buildings to receive certain incentives based on potential savings or need

[3]See (Krukowski, 2014) for more information on incorporating benchmarking into utility programs.

- a measurement and verification tool to verify savings from programs and provide a flag for projects needing course correction
- a way to portray energy savings to owners even when utility rates are rising.

A number of utilities offer commercial or single-family residential benchmarking tools or programs, and a more limited number offer multifamily benchmarking in conjunction with current programs (Institute for Market Transformation, 2015). ENERGY STAR Portfolio Manager® is used by utility companies NSTAR and National Grid, among others, as a way to increase energy efficiency savings through their incentive programs (Portfolio Manager, (n.d.)).

For government policies or programs

Across the country, cities and states are starting to require benchmarking for larger buildings. As of this writing, fourteen cities, two states, and one county in the U.S have passed policies requiring benchmarking and disclosure. Ten cities currently have policies that include multifamily residential buildings meeting the minimum square footage requirement (Institute for Market Transformation, 2015).

Municipal benchmarking policies[4] are often driven by three motivations:

- The need for data on current energy use to target and plan energy savings activities.
- The ability of benchmarking results to provide market transparency in real estate transactions.
- The ability to measure progress on adopted carbon reduction policies and goals.

Several state energy agencies run programs (often using funds collected through utility ratepayers) that use benchmarking to support multifamily retrofit efforts:

- The New York State Energy Research and Development Authority (NYSERDA) has used benchmarking to first qualify and then verify the savings from projects in its Multifamily Performance Program (MPP). Buildings can even earn an additional incentive if they verify – through benchmarking – that a project has achieved a high savings target in the first year after retrofit. As a result, NYSERDA has a rich database showing the actual performance of projects and has learned valuable lessons about the efficacy of its program, depth of achievable savings, and issues among participants in different parts of the state. For instance, an analysis of NYSERDA's data in 2014 found an average 87% realization rate (i.e. the percent of projected savings achieved in the first year) across the program (Robbins & Parrington, 2014).
- In Massachusetts, the Low Income Multifamily Energy Retrofits program has offered a year of free benchmarking to all eligible buildings, using the data to help target projects and track results (LEAN, 2010).

[4] For more information on specific state and city policies, reference ("San Francisco",2014) and (Agallaco & Freech, 2014)

State and federal housing agencies have also begun to use benchmarking as a tool to track specific programs or the long-term impacts of energy and green standards. Many of these agencies already have green standards in place for new development and benchmarking can inform how much investment is warranted in energy and water improvements on a given property (Kaufman & Bartolomei, 2015). Many agencies already require regular reporting of owner or tenant utilities in order to set subsidy levels, so benchmarking may be a natural fit for these agencies or owners who are already collecting utility data on an annual basis.

Some examples of housing agencies using benchmarking currently include:

- The Pennsylvania Housing Finance Agency (PHFA) contracted with Bright Power in 2010 to benchmark and track the success of its weatherization through Smart Rehab program and is currently planning to benchmark new developments to assess the impacts of green development standards
- The US Department of Housing and Urban Development (HUD) requires benchmarking for a year pre and post-rehab for all projects going through the Mark to Market Green Initiative (and previously for all projects in the Green Retrofit Program) (US HUD, 2009).
- HUD has recently performed a benchmarking pilot study with Public Housing Authorities, encouraging Public Housing Authorities to use EPA's Portfolio Manager to manage utility consumption, and exploring it as a means to collect utility information from the Housing Authorities (US HUD, 2013).
- NYC Housing Preservation and Development (HPD) is currently considering a program to make benchmarking a standard tool used across the HPD portfolio.
- The Minnesota Housing Finance Agency (Minnesota Housing) was involved in funding and this pilot and using the tool, and 127 pilot buildings were part of Minnesota Housing's portfolio.
- The New Jersey Housing and Mortgage Finance Authority provides additional points to developers who agree to benchmark their properties after completion (Kaufman & Bartolomei, 2015).

Previous Research

Previous research relevant to this pilot includes studies in two primary areas:

- energy benchmarking as a driver for energy reduction
- characterization of energy and water use in multifamily buildings in Minnesota

Previous to this study, benchmarking has proved to be an effective driver in energy reduction in some types of buildings. OPower, a Virginia-based software company, found that single family residential electricity customers who viewed their monthly utility bill in comparison with their neighbors' usage showed a statistically significant household decrease in energy usage of 2% (Power Systems Engineering, Inc., 2010). Interestingly, other forms of marketing and incentives were found to have no effect on behavior and energy reduction. A number of utility companies around the world have adopted this peer comparison approach as a tool to achieve modest but widespread energy reductions across their residential customer base.

For larger buildings, research is limited. Portfolio Manager® Data Trends found buildings that benchmark on a regular basis reduce energy consumption by 2.4 percent per year, on average (ENERGY STAR, 2012). Because it lacked a control group, this finding is not robust as the changes may have been due to factors outside of benchmarking.

A recent study by Resources for the Future (RFF) used a statistical approach to conduct a "natural experiment" to compare the performance of buildings just below and above the size threshold for mandatory benchmarking in the "early adopter" cities that have had required benchmarking for several years. This study, released in 2015, found a statistically significant savings for buildings required to meet the benchmarking laws (Palmer & Walls, 2015).

In terms of characterization, the recent CARD funded Minnesota Multifamily Rental Characterization Study sampled multifamily buildings (5 units or more) in the state to develop a statistical representation of the current building stock and benchmark general energy usage. The study detailed current heating systems, identified energy efficiency opportunities, and surveyed tenants and owners.

What gap(s) did this research intend to fill?

EnergyScoreCards Minnesota is the only large-scale effort to date to benchmark multifamily energy and water consumption in Minnesota, the first pilot to evaluate the feasibility of multifamily benchmarking in Minnesota, and the first experimental test of the impacts of multifamily benchmarking in the country. As such, it provides unique contributions to industry understanding of the limitations and potential of benchmarking, as well as the current issues around utility data collection in the state.

In Minnesota, over 600,000 people (11%) live in apartments; over $1.2 billion is spent on operating multifamily buildings across the state annually, based on 2013 estimates. Results from this study will assist owners, utilities and governments around the state move toward reducing this costs and improving control over utilities for owners and residents ("National Multifamily Housing Council", 2015).

Nationally, the potential savings from multifamily energy efficiency are significant. The United States has about 18 million apartments, condos and other dwellings in buildings of five units or more, representing nearly $22 billion a year in energy costs for building owners and residents alike. The U.S. could save $3.4 billion per year with energy improvements in the multifamily and affordable housing stock (McKibbin, 2013).

While benchmarking is widely viewed as a "best practice" critical to capturing energy and water savings potential, most buildings are not currently benchmarked. Most cities, utilities and owners have not yet recognized the need or practical feasibility of adopting benchmarking as a business practice or policy. Some may be interested in benchmarking, but lack the experience or confidence to undertake it. This study hopes to spur increased and better informed approaches to benchmarking as part of capturing the vast efficiency potential in the multifamily building stock.

How to read this report

This report contains information interesting to different audiences:

- **Building owners** considering adopting benchmarking should review the Impacts section to understand how the practice might affect their portfolios. The Energy and Water Benchmarks for Minnesota Multifamily Buildings section provides a quick reference for comparison to MN building norms.
- **Utilities or program administrators** looking to use benchmarking will find ideas for designing a benchmarking program, and can build on the successes and challenges described in the Methodology, Results, and Discussion sections.
- **Policymakers** designing benchmarking or comprehensive energy management requirements for multifamily buildings will find insights for policy design in the Methodology, Results, and Discussion sections.

Along with this Final Report, an Impact Evaluation and a Process Evaluation were prepared in conjunction with partner Center for Energy and Environment. Those evaluations provide a more detailed look at the quantitative statistical analysis (Impact Evaluation) and a qualitative survey of participants (Process Evaluation).

Methodology

This pilot program aimed to answer the following questions:

- Is multifamily energy and water benchmarking a feasible strategy to implement at scale in Minnesota?
- How do Minnesota multifamily buildings use energy and water?
- What are the impacts of multifamily benchmarking? Specifically:
    - Energy and water savings
    - Energy- and water-conservation actions taken
    - Participation in Conservation Improvement Programs[5]
    - Cost-effectiveness
    - Demonstrated uses of benchmarking

This section will discuss how the pilot was implemented to address these questions, and specifically, the program design, recruitment, data collected, methods of collection, group assignment, the benchmarking service, data integrity, participant tracking, and analysis of data performed in the impact and process evaluations.

Program Design

EnergyScoreCards Minnesota was designed as a pilot program to study the impact of an energy and water benchmarking service in 500+ Minnesota multifamily properties. The effort was funded by a Minnesota Department of Commerce, Division of Energy Resources (DER) Conservation Applied Research Program (CARD) grant, the Xcel Energy Emerging Technologies Grant Program, and a Multifamily Rental Energy Efficiency grant from Minnesota Housing.

The EnergyScoreCards Minnesota pilot was designed as a two year experiment: a treatment group received two years of free access to the EnergyScoreCards service, and a control group was tracked in EnergyScoreCards, but did not have access to the service until after the second year, allowing a comparison of outcomes between the two groups.

The EnergyScoreCards service included an online benchmarking tool, automated utility data retrieval, training materials, and support and outreach from an assigned Account Manager who guided participants in learning about the energy and water consumption in their buildings.

The phases of the program included:

I. Coordination: managing the overall process and project partners, as well as producing the program design
II. Setup: developing the automated data connection with Xcel Energy,

[5] The Conservation Improvement Program (CIP) refers to utility ratepayer funded energy efficiency programs required by Minnesota Statute 216B.241.

III. Initialization: recruitment of participants, property and utility information collection, historical utility data collection, and participant assignment
IV. Deployment: Activation of EnergyScoreCards services, initial owner training and support, ongoing utility data collection, automatically generated feedback to property owners, hands-on user support and training, access for control group (after 2 years).
V. Evaluation: First Year Evaluation, Process Evaluation, Impact Evaluation, and Final Report
VI. Progress Reports, Meetings, and Invoices: monthly status reports and invoices, as well as phone conferences and update meetings with funders.

Recruitment

EnergyScoreCards Minnesota was offered as a free pilot program to interested multifamily building owners or managers who opted to sign up. Initial outreach and recruitment was necessary for both treatment and control group buildings, because critical building and utility access information could only be collected directly from building owners or managers. Eligibility was as follows:

- Open to market rate and affordable rental properties
- Open to buildings with ten or more units
- Open to properties in the service area of Xcel Energy, CenterPoint Energy, and/or Rochester, Austin, Owatonna, St. Cloud and Mankato utilities
- Open to buildings with at least ten months of existing operating history as of pilot launch in early 2012
- Townhomes and condominiums were NOT eligible

To be considered for participation all buildings were required to:

- Complete a brief property survey
- Authorize EnergyScoreCards Minnesota to collect owner-paid utility data for the duration of the pilot
- Enroll a maximum of 25 participating buildings per owner/manager[6]
- Properties with ongoing performance contracts were NOT eligible

Outreach was conducted through several methods:

- Creation of a public website
- Multiple open webinars
- Email blasts from Minnesota Housing and the Minnesota Multi-Housing Association (MHA)
- A phone and email campaign to contact eligible owners based on lists from Minnesota Housing
- In-person outreach presentations

[6] Originally the maximum eligible buildings per portfolio was set at 10, but was later expanded due to strong interest from several larger portfolios.

All EnergyScoreCards Minnesota outreach messaging was informed by research on influence[7]. Funders and respected membership organizations assisted with outreach, including Minnesota Housing, Metropolitan Consortium of Community Developers (MCCD), local landlord associations, existing service providers, and utility companies. The team also solicited outreach assistance from people with personal relationships with owners and managers, including existing board members, former colleagues, and even family friends. Messaging highlighted the limited number of buildings that could participate, as well as the number of owners and properties that had already signed up. Outreach required persistent personal contacts by Account Managers, sending personalized e-mails and phone calls where we asked potential participants to commit to signing up, and offered assistance in completing application materials.

The original goal for the pilot was to enroll 500 buildings. Recruitment efforts led to the submission of 582 buildings, 561 of which were accepted into the pilot.

Group Assignment

All organizations accepted into the pilot were randomly assigned to the treatment group or control group. The treatment group received access to the EnergyScoreCards service beginning in fall 2012 for two years. The control group was tracked in the software tool, but did not receive access to it until late 2014.

The organizations were randomly assigned between the treatment and control groups. This design allowed the pilot to compare energy and water use in buildings that received access against those which did not, testing the impact of the EnergyScoreCards service. An evaluation partner, Center for Energy and the Environment (CEE), used a stratified, group-randomized approach to split the pilot group participants into the treatment and controls groups and to balance the groups across many factors, so that the characteristics of the two groups were largely similar in terms of building age and size, the parties responsible for various utilities, and starting energy performance. For organizations with multiple buildings in the pilot, all buildings were placed in the same group to avoid potential cross-contamination if the organization had buildings in both the control and treatment groups. Basic information on the treatment and control groups at the time of analysis is shown in Table 1.

	All	Treatment	Control
Organizations	93	46	47
Properties	561	286	275
Sq ft	31,246,310	16,013,082	15,221,258
Units	29,075	14,393	14,682

Table 1: Composition of Treatment and Control Groups

[7] For details on psychology of influence, reference (Cialdini, 1984).

Benchmarking Service

EnergyScoreCards is a benchmarking service offered by Bright Power. The subscription service includes access to an online software tool and hands-on guidance and support from Bright Power staff. Typically, the service is offered to owners and property managers of multifamily portfolios. Over 18,000 properties (600,000+ units of housing) are currently tracked in EnergyScoreCards.

Participants assigned to the treatment group in the EnergyScoreCards Minnesota pilot had free access to the EnergyScoreCards service for the two years of the pilot (the control group receiving one free year after the conclusion of the pilot), including the software, training materials, and an assigned Account Manager who guides participants in learning about their buildings, energy and water consumption, and using that information.

Software Tool

The EnergyScoreCards tool is an online benchmarking tool tailored to multifamily buildings. Figure 1 shows a sample property scorecard for one of the buildings in the pilot. The letter grades for energy and water efficiency metrics indicate how the property compares to other Minnesota buildings in EnergyScoreCards. Grades are assigned for owner energy (i.e., all energy paid for by the owner), as well as end-uses: cooling, heating, electric baseload, fossil fuel baseload and water. Efficiency grades are shown alongside spending to guide the user to target areas for improvement.

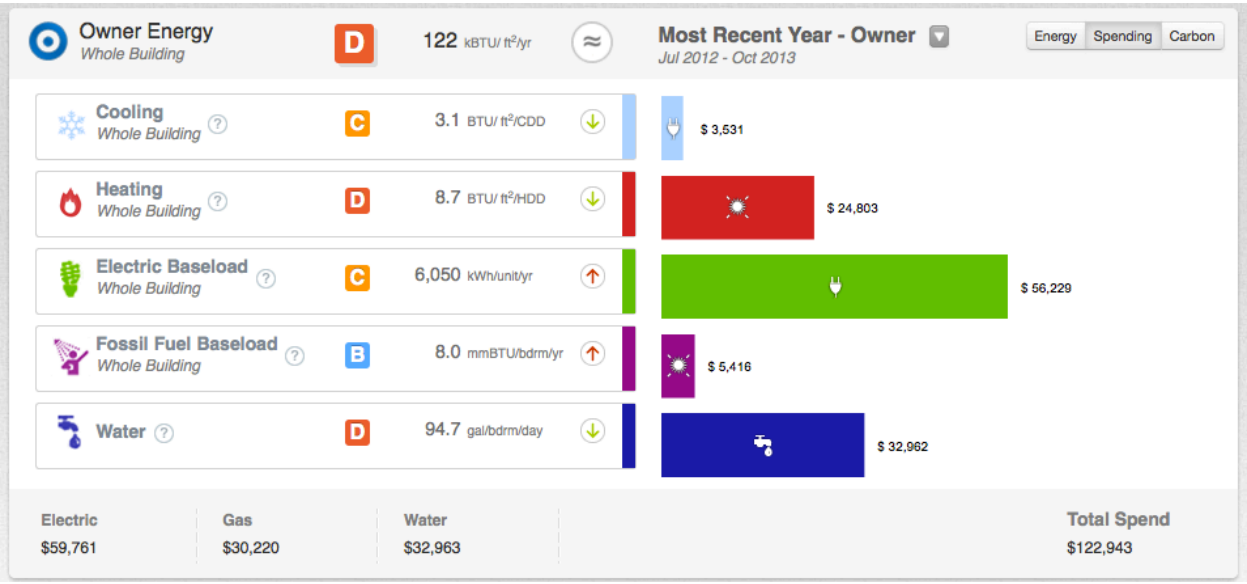

Figure 2: Example Property ScoreCard

EnergyScoreCards can compare buildings based on whole-building data or based on owner-paid utilities only, comparing to buildings with similar owner-paid utilities (i.e. similar meter configuration). (This is notably different from EPA's Portfolio Manager, which requires whole building data to compare building energy performance.) The flexibility in EnergyScoreCards to provide insight based on similar owner-paid utilities is important to many multifamily owners;

most voluntary EnergyScoreCards subscribers focus primarily on owner-paid utility accounts. In the majority of pilot buildings, owners pay for heat and hot water in the whole building and the electric baseload and cooling in the common areas. An Owner ScoreCard for such a building offers feedback on how the heating and hot water heating performs throughout their whole buildings, feedback on how electricity and cooling performs in the common areas, and overall building performance compared to similarly configured buildings in Minnesota. Below is an example of ScoreCard feedback for the owner-paid energy only. Each end-use is identified as serving either common areas or the whole building, and each end-use and the overall owner energy is graded against peers, accounting for the metering configuration.

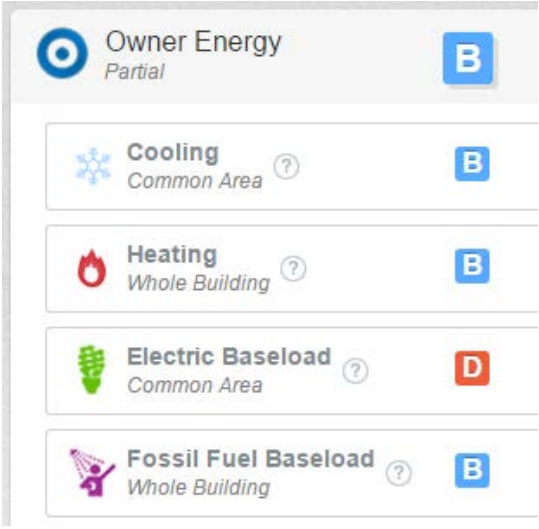

Figure 3: Owner Energy Grades

For buildings where owners choose to work with tenants to collect tenant utility data, they can view their data in two ways. The Owner ScoreCard provides feedback on owner-paid utilities and the Total ScoreCard provides whole building feedback. Below is an example property where tenant data was collected and both an Owner ScoreCard and a Total ScoreCard are available.

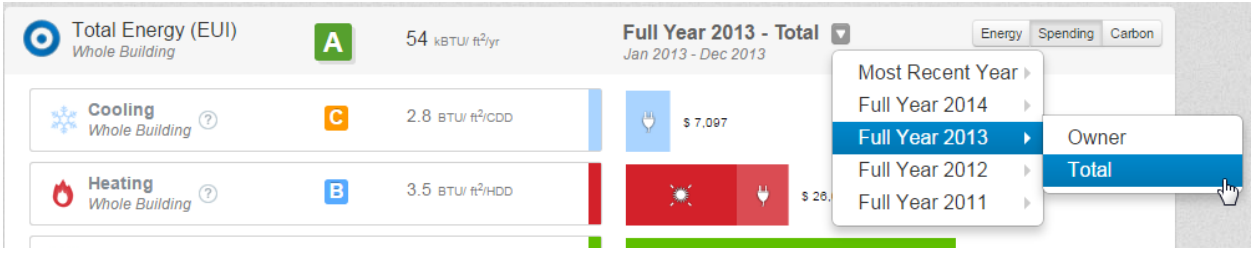

Figure 4: Owner and Total ScoreCards

Additional features of the tool include:

- optional owner tracking of energy events (e.g. energy retrofits or other upgrades)
- monthly reporting
- year to year comparisons
- portfolio reporting
- automatically generated alerts.

Below are some examples of the tool features listed here.

Figure 5 shows the Portfolio Dashboard, which provides the user with a broad overview of their whole portfolio, a quick glance at the distribution of performance, and totals for energy use, spending, number of properties, units, and square footage.

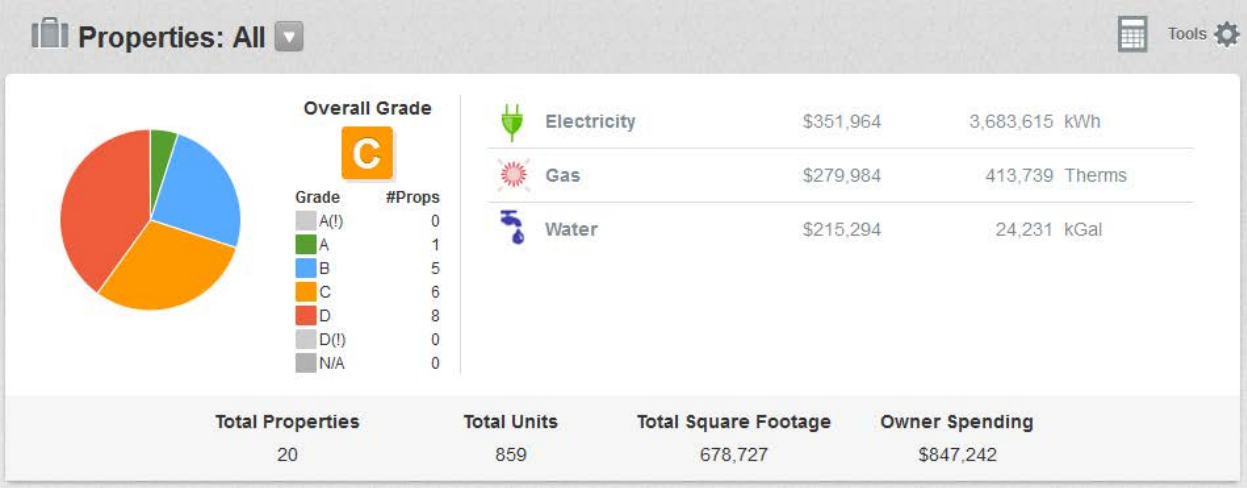

Figure 5: Portfolio Dashboard

Figure 6 shows a year-to-year comparison for one property. Here, the indices and grades are displayed for two years side by side. It shows the change from one year to the next in the Difference column to highlight whether the building energy and water consumption is going up or down.

Indices	Full Year 2012 - Owner		Most Recent Year - Owner		Difference		Units
Energy Index	75	D	67	C	-11%	-8.00	kBTU/ ft²/yr
Cooling Index	0.0	N/A	0.0	N/A	-	0.00	BTU/ ft²/CDD
Heating Index	7.3	D	6.7	C	-9%	-0.60	BTU/ ft²/HDD
Electric Baseload Index	466	B	445	B	-5%	-21.0	kWh/unit/yr
Fossil Fuel Baseload Index	9.9	C	8.2	C	-17%	-1.70	mmBTU/bdrm/yr
Water Index	108.7	D	101.9	C	-6%	-6.80	gal/bdrm/day

Figure 6: Year-to-year comparison

Figure 7 shows a portfolio report called My Properties in Context. The green bars represent each building in the user's portfolio, and the gray bars represent other peer comparison buildings. This highlights how the user's portfolio is performing with respect to energy in the context of peers.

Figure 7: Portfolio Report - My Properties in Context

Figure 8 shows an example of an alert. Several types of alerts are sent to users when action is needed to address a problem or data issue.

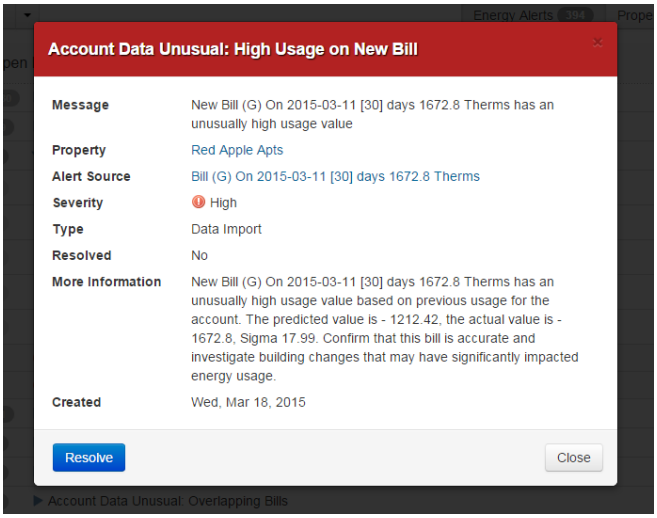

Figure 8: Example Alert

The EnergyScoreCards tool is regularly being improved on an ongoing basis. During the pilot, two significant changes occurred. The user interface, and therefore the look and feel of the tool aesthetically, was updated in July 2013. This change affected the user experience, but the substantive content of EnergyScoreCards remained the same. Additionally, EnergyScoreCards rolled out alert distribution during the pilot period, in May 2014. This provides a user with the option of subscribing to receive alerts by email each month.

Utility Data Collection

Collecting and storing utility bill information is a critical piece of the EnergyScoreCards service. A majority of EnergyScoreCards customers and all pilot participants use the tool's Automatic Bill Retrieval feature. Utility data is automatically loaded into EnergyScoreCards and stored in the tool for each utility account. The dates, consumption and cost for each bill are stored in the system. Utility accounts are identified by fuel and labeled as 'owner' or 'tenant' (if the latter are available) based on who pays the bill.

EnergyScoreCards self-updates with automated retrieval. When owners log into the tool, they find new bills, the most up-to-date performance information about their buildings, and new alerts spurred by the new bills.

Support

In addition to the online tool, the EnergyScoreCards service includes support and training from an assigned Account Manager, as well as access to resources and events provided to all EnergyScoreCards subscribers.

Account Managers

Each treatment group member was assigned an Account Manager to maximize their use of the EnergyScoreCards tool and resources. Account Managers served as primary contacts for technical questions, helped with reporting and interpreting, and were a resource for information about opportunities. Account Managers for the pilot were Janne Flisrand of Minnesota Green Communities (MNGC) and Billy Weber and Patrick Smith from the Center for Sustainable Building Research (CSBR) at the University of Minnesota. Account Managers provided each participant with an orientation to the tool and their initial benchmark at the launch of the pilot, regularly performed check-in calls with the participants, and directed participants to applicable resources, including available utility rebate programs. Whether over email, phone or in-person, these points of communication have included:

- Answering specific questions from the participant.
- Training on how to use various features of the tool.
- Troubleshooting issues or questions around data or analysis in the tool.
- Sharing sample reports or opportunities identified in the tool.
- Sharing tips or resources around best practices for energy and water management.
- Discussing possible next steps to act on information received (e.g. pointing toward a utility program that might assist with an area of high consumption).
- Brainstorming ways to use the information for portfolio planning.
- Tracking savings from upgrades undertaken during or before the pilot.
- Coaching contacts as appropriate (e.g. developing a case for investment or action to leadership or colleagues).

Regular EnergyScoreCards clients, outside of the pilot, receive similar support from Bright Power staff.

Resources

A series of quick guides, tips, and worksheets were developed for the Minnesota participants. Participants could access these resources on the EnergyScoreCards Minnesota website, and Account Managers provided resources to participants to augment interactions. Additional resources are also available on the help site accessible through the EnergyScoreCards tool. Some examples of these resources are provided in Appendix A: Tools for EnergyScoreCards Minnesota.

Newsletters

Newsletters were sent via email to all treatment group members throughout the pilot. Some newsletters were Minnesota specific, while others are general EnergyScoreCards and Bright Power newsletters. Seven newsletters were sent in the treatment phase of the pilot, and featured announcements about upcoming webinars, case studies, energy tips, pilot updates, and information about relevant energy or water programs.

Webinars

Treatment group members were invited to participate in Bright Power and EnergyScoreCards webinars, which were offered on various topics throughout the treatment phase; seven webinars in total were provided. Webinars included presentations, screen-sharing within EnergyScoreCards, and interactive question and answer with attendees.

Data Collection

The main types of data collected during the pilot included:

- Property information: this was collected directly from all participants, who voluntarily signed up for the pilot at no charge and were asked to submit an Agreement and Property Survey. The Property Survey included property information, such as property name, address, square footage, number of units and bedrooms, and metering configuration (i.e., whether the owner or the tenant pays for electricity, cooling, heating and/or hot water used in the apartments).
- Utility data – owner-paid: participants provided some information about their utility accounts, including account numbers and login information to utility websites, in addition to the Pilot Program Agreement. The Agreement provided authorization for Bright Power to access the relevant utility information on owner-paid utility accounts, which were then used to collect utility data throughout the pilot. At least one year of historical utility data was collected to provide a baseline benchmark of energy performance.
- Utility data – tenant-paid: treatment group members were able to collect tenant utility data, but in order to do so, had to collect tenant authorizations and account information. Because of the effort required to collect that data from a useful sample of the units at each property, very few organizations chose to collect tenant data.
- Conservation actions taken: treatment group members were asked to enter conservation actions into the Energy Events feature of the EnergyScoreCards tool, but control group

members were not given access to EnergyScoreCards until the pilot was completed and could not record energy events during the two year study. The Process Evaluation survey conducted by CEE at the conclusion of the two years of service included questions on the number and type of conservation actions taken by both groups, but there are concerns with the quality of the data collected.

- Conservation Improvement Program (CIP) participation: Bright Power and program partners collected data on pilot group members' participation in utility rebate programs directly from the utilities for the years of the pilot, 2013 and 2014. Requests were made to the seven major utilities in the pilot area. Data collected included the number of buildings from each group that received rebates during the pilot and the energy savings claimed for those rebate measures.

More information on the data collected and methodology of the collection process can be found in the Impact Evaluation and Process Evaluation.

Data Integrity

The EnergyScoreCards software has built-in data checks to maintain data completeness and accuracy. These include:

- ScoreCard metrics have built-in thresholds for reasonable results, and are flagged for further investigation if they are out of range
- Property information is flagged if data seems out of reasonable range (for example, if square footage per unit was very high)
- All owner-paid utility accounts are included in the Owner ScoreCard evaluation, and must all have sufficient bills to provide analysis
- Each account must have a minimum of 235 days of bills for a year to be analyzed
- Outlier bills are excluded from analysis to reduce the impact of estimated bills or utility errors

For the analysis of the impact on energy and water usage between the treatment and control groups, ScoreCards were required for both the baseline year, 2012, and the second year of the pilot, 2014. This required all utility accounts for all analyzed properties to have a minimum of 235 days of bill data.

This pilot evaluation included a third-party evaluation from the Center for Energy and Environment (CEE). CEE audited and verified the EnergyScoreCards data methods, statistical analysis, and results of the pilot.

For both the treatment and control group members, data collected on energy actions taken or energy events that had occurred was meant to be collected with assistance from the Program team and Account Managers. For information collected from the treatment group, team members helped ensure that information made sense and was filled out correctly. Data on actions taken was also collected through surveys during the Process Evaluation. For the control group, no data was collected directly from the control group until the end of the pilot period. As all data was self-reported, there was no verification (e.g. contractor invoices or details on actions), and the people surveyed may not have had full information about actions taken at all properties in question (e.g. most properties have multiple people involved with actions, but

typically only one was surveyed), the data quality is poor and did not provide enough information to analyze the difference in actions taken by the treatment and control groups.

Data Analysis

Owner data was analyzed using EnergyScoreCards methods, which creates a weather-adjusted model for each utility account for every annual time-period. Utility account models are rolled up to provide a weather-normalized Owner ScoreCard, including an Owner Energy Index and Owner End-Use Indices (i.e. indices for heating, cooling, baseload, etc.). For energy and water savings analysis, these weather-normalized indices were used to calculate savings and compare the treatment group to the control group.

The weather-normalized indices calculated by EnergyScoreCards were used as the inputs to additional statistical analyses to assess differences between the treatment and control groups. This included tests to determine if there had been a statistically significant change in each group over the pilot period and tests to determine if one or more variables impacted this change. For instance, regressions were used to see if building square footage, baseline Energy Usage Index (EUI), building age, or the treatment itself (receiving the EnergyScoreCards service) affected energy and water changes during the study. Results measured at the 95% confidence level were considered statistically significant and are reported as such in the results section below.

More detail on the data analysis methodology is available in the Impact Evaluation.

Deviations from Original Design

In a few areas, the pilot methods were changed from the original design. These areas include:

- Tenant data collection
- Parking garages

Tenant Data Collection

Original goals for the pilot included the collection of data from 10% of units at participating properties. When designing the pilot, this seemed achievable for two reasons. First, the required tenant authorizations had been demonstrated as accessible, requiring limited information from residents and a generic form accepted by all utilities. Second, the automatic data feed and confidentiality agreement with Xcel Energy would offer tenant data without collecting online account log-in information for individual tenants. A privacy policy change at Xcel Energy significantly changed authorization requirements; Xcel-specific forms and more detailed information were required from tenants, making the effort of collecting tenant data more time-intensive than planned. Because of this change, the goal for tenant data collection was

eliminated from the scope of work. A small number of motivated buildings did access the tenant data collection supported by the pilot.[8]

Parking Garages

The prevalence of parking garages at properties in the pilot was an unanticipated complication. The guidance provided to participants during the sign-up period and initial property information collection for the pilot did not include specific guidance on how to report parking garages. Sometimes, garage square footage was included in the total building square footage numbers provided; sometimes, energy used in the garages was not separately metered from the rest of the property, and had to be included. Additionally, parking garages in Minnesota range in energy needs – some are heated or semi-heated, some are open-air, some have snow melt systems. As the pilot launched, the team realized that including parking garage square footage in the property square footage made properties look much more efficient and disguised real inefficiencies. Mid-way through the pilot, an effort was made to subtract garage square footage from the total square footage at all properties with parking garages to more accurately represent the property performance.

Evaluation and Documentation

As a pilot program designed to study benchmarking as a strategy, we documented the process and results in several ways:

- Throughout the pilot, the team submitted monthly status reports to DER, including status updates for each pilot phase, schedule and methodology deviations, and a Lessons Learned section. The Lessons Learned section provided qualitative summaries of lessons learned in the implementation process, anecdotes of participant interactions, and other lessons and perspective on the pilot experience. Documenting experiences in real time allowed aggregation of lessons, many of which are synthesized in this report.
- Account managers documented participant interactions in a shared document throughout the pilot. Interactions included email or phone contact, orientation and trainings, and regular in-person or phone check-ins. Account Managers tracked high-priority topics for participants and next actions for accomplishing their goals.
- Three evaluations took place during the pilot: the First Year Evaluation, the Process Evaluation, and the Impact Evaluation. The major points from those evaluations and reports are presented in the impacts section below:
    - The First Year Evaluation provided some analysis of the energy and water changes after Year 1 and captured experiences Account Managers had with participants in using the tool. This reflection on the pilot allowed the team to generate mid-course corrections and improve the impact of the pilot.

[8] Outside of the pilot, many owners collect tenant data when required for utility allowance calculations, (which may be required by HUD and Minnesota Housing to determine subsidies) or by municipal disclosure laws in places like New York City and Washington, DC.

- The Impact Evaluation at the end of the second year studied the quantifiable impacts of the service comparing the control and treatment groups using statistical methods. The Impact Evaluation was performed by Bright Power and audited by CEE to provide third-party validation of the methods and results.
- The Process Evaluation, conducted by CEE, was based on phone surveys with Account Managers and participants, as well as program documentation. It sought to qualitatively assess the effectiveness of the EnergyScoreCards service, as well as provide insight into how multifamily building owners and managers perceive, analyze, and implement energy- and water-saving measures.

Results

The following section describes the primary findings on three principle questions explored in the EnergyScoreCards Minnesota pilot:

- Is multifamily energy and water benchmarking a feasible strategy to implement at scale in Minnesota?
- How do Minnesota multifamily buildings use energy and water?
- What are the impacts of multifamily benchmarking? Specifically:
  - Energy and water savings
  - Energy- and water-conservation actions taken
  - Participation in Conservation Improvement Programs
  - Cost-effectiveness
  - Demonstrated uses of benchmarking

Additionally, this section discusses the major results from the team's experience with the pilot:

- What engagement strategies were successful?

Is multifamily energy and water benchmarking a feasible strategy to implement at scale in Minnesota?

EnergyScoreCards Minnesota has demonstrated that multifamily energy and water benchmarking is feasible both as a service for owners and as a component of a utility or municipal program for energy and water efficiency in Minnesota. Key pilot outcomes that demonstrate feasibility include:

- There was strong interest in energy and water benchmarking by property owners, and the project team exceeded its initial recruitment goals for a total of 582 buildings signing up, 561 of which were accepted (well over the goal of 500 buildings).
- The majority of participants were able to submit the required building information with minimal assistance. This meant both that the minimum information required to benchmark buildings was readily available from building owners and that the tool for collecting this information (in this case a spreadsheet template which is uploaded to

EnergyScoreCards) functioned as a practical tool for collecting minimum data for participation.

- Minimal time commitment was required of owners on data upkeep. Automated mechanisms for collecting utility data allowed them to view metrics, analysis and reports with (mostly) current utility data during the program with no user manual data entry.
- Most (though not all) participants in the treatment group engaged with the service, logging into the tool on multiple occasions, participating in phone calls, meetings and email correspondence with Account Managers. Figure 9 shows each participant organization (one blue bar per organization) and the number of logins for each participant for the entire pilot period. Although engagement levels were widespread, only 7 participants did not log in. On average, participants logged in once every 2 months throughout two-year the pilot.

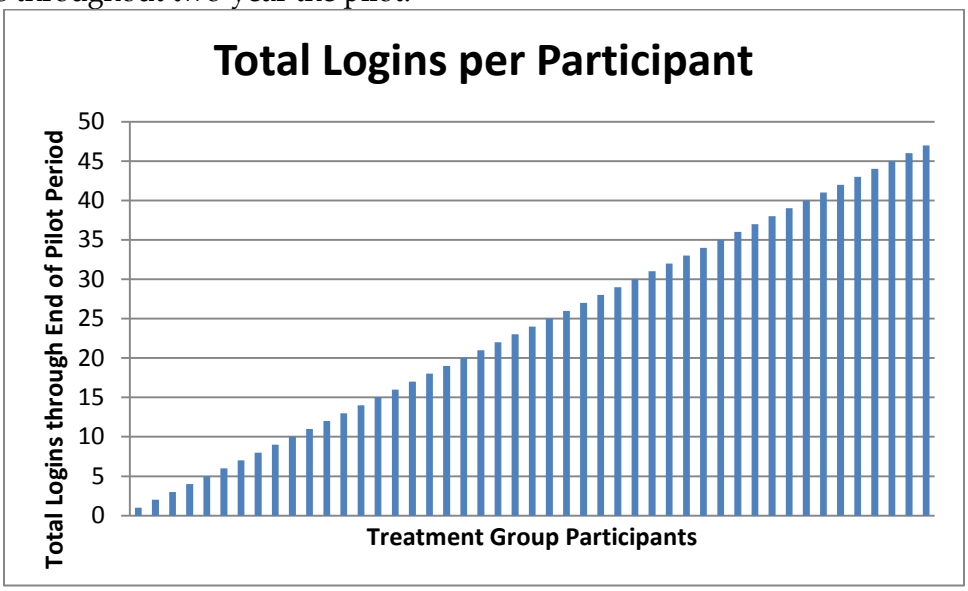

Figure 9: Logins per treatment group participant

- The EnergyScoreCards Minnesota team provided a benchmarking service including a software tool and Account Manager support within the anticipated project budget.
- The project had one key delay due to coordinating project startup but once the project was underway, it was completed on schedule.

For owners as a real estate business strategy

Energy and water benchmarking is demonstrated as a feasible strategy for owners to adopt as part of how they own and manage properties. Most owners who expressed interest in participating were able to provide all property and utility data required to complete submission for a total of 561 properties from 93 organizations that were ultimately accepted into the pilot.

In addition to the feasibility of an initial benchmark, most treatment-group participants appear to have made use of the service:

- Account Managers tracked nearly 400 major contacts among the 46 treatment group organizations, averaging quarterly contact points for each organization throughout the two years.
- According to the Process Evaluation survey (conducted by a third-party, CEE), 95% of surveyed participants were very satisfied or somewhat satisfied with the EnergyScoreCards tool experience (Figure 10), 84% said they would be willing to participate in the EnergyScoreCards Minnesota program again (Figure 11). 93% rated the service, specifically the account manager emails and calls, as very helpful or somewhat helpful (Figure 12).

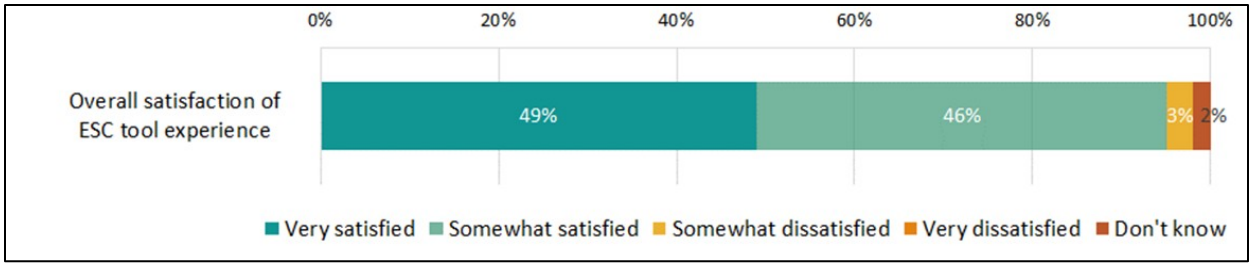

Figure 10: Participant satisfaction with the tool

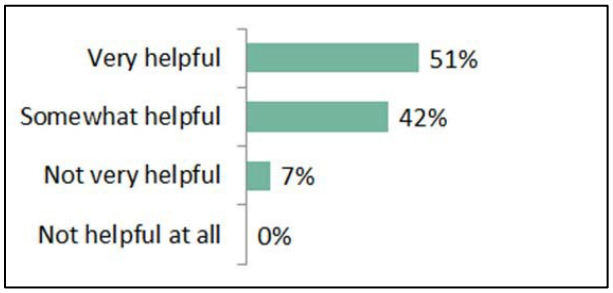

Figure 11: Helpfulness of Account Manager calls or emails

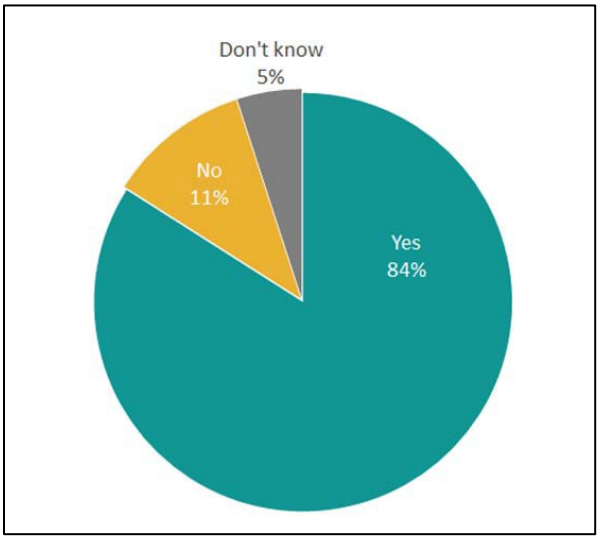

Figure 12: Willingness to Participate in EnergyScoreCards Minnesota again.

As part of Conservation Improvement Programs

Integrating benchmarking into CIP or other programs in Minnesota appears feasible based on program experience in three areas:

- **Recruitment:** Recruitment goals were exceeded, in part due to strong interest on the part of owners. Recruitment strategies are discussed in more detail below, but the overall result suggests that a program with targeted outreach offering free or subsidized benchmarking should be able to find ready participants. Process Evaluation survey

results suggest that cost is a barrier for ongoing use of a benchmarking service, so a subsidy from a program could enable owners (especially of smaller buildings) to adopt the practice.

- **Cost:** The cost of the benchmarking service delivered is modest compared to the cost of large equipment upgrades (though not compared to rebates on small pieces of equipment). Adding benchmarking as a program element to a "one-stop-shop" or other comprehensive multifamily retrofit program would not dramatically change the cost of program delivery.
- **Data Collection:** Data collection for owner paid accounts, though challenging, was manageable and largely successful. This was in part a result of restricting eligibility to certain utility territories. Programs run by utilities (or subcontracted by utilities) have additional data collection options for their own territories to further reduce data collection costs over those in this pilot. In areas where electricity, gas and water are provided by different companies, utilities interested in providing benchmarking should expect to collaborate, or at least incorporate data from other providers; benchmarking only one fuel (e.g. electric use only) is significantly less informative since large portions of energy use may be missing.

Benchmarking potentially serves several purposes in a utility program, described further in the Background and Discussion sections of this report.

City or state governments

Municipalities who set and regulate multifamily housing standards or who are developing policies to decrease the release of climate-changing gases could require (and enforce) benchmarking reporting as a tool to measure compliance with standards, to trigger improvements, or to target programs. The experience in this pilot suggests that such a policy in Minnesota would not impose an excessive burden on owners. Evidence from the pilot that supports the feasibility of benchmarking requirements for multifamily include:

- Data collection, including property information and *owner-paid utility information*, from owners is feasible
- Time commitment for owners is non-trivial but possible with automatic data retrieval from utilities
- Benchmarking provides benefits to owners when paired with a service like EnergyScoreCards

Successful implementation of a policy that requires *whole building energy benchmarking* would require collaboration with utilities to ensure tenant data access and application processes were simple.

State agencies, like Minnesota Housing, could use or require benchmarking as part of their refinancing/rehabilitation consolidated RFP applications to serve two of their goals:

- Providing accurate utility cost numbers to include in underwriting, in order to credit efficient proposals with projected lower utility spending.
- Helping architects and underwriters assess the cost-effectiveness of proposed energy and water updates at the time of application

As of this writing Minnesota Housing is exploring the feasibility of potential uses for benchmarking.

What are the Impacts and Uses of Multifamily Benchmarking in Minnesota?

The impact of multifamily benchmarking in Minnesota was quantified in the measurable difference between treatment and control groups in terms of:

- Energy and water savings: Master-metered buildings in the treatment group saved 5% in energy and 30% in water compared to the control group
- Energy- and water-conservation actions taken: 9% more treatment group buildings participated in electric rebate programs than control group buildings

This section also discusses the cost-effectiveness of the pilot, and cost-effectiveness of potential long-term programs in the future, as well as demonstrated uses of benchmarking, as seen in this pilot.

Energy and Water Savings

Results of the statistical analysis showed master-metered buildings, where the owner pays for all utilities in the building, experienced a significant decrease in their Owner Energy Index of 4.5 ± 1.6 kBTU/sqft/year by the second year, relative to the control group, about a 5% reduction in site energy use for a typical master-metered building.

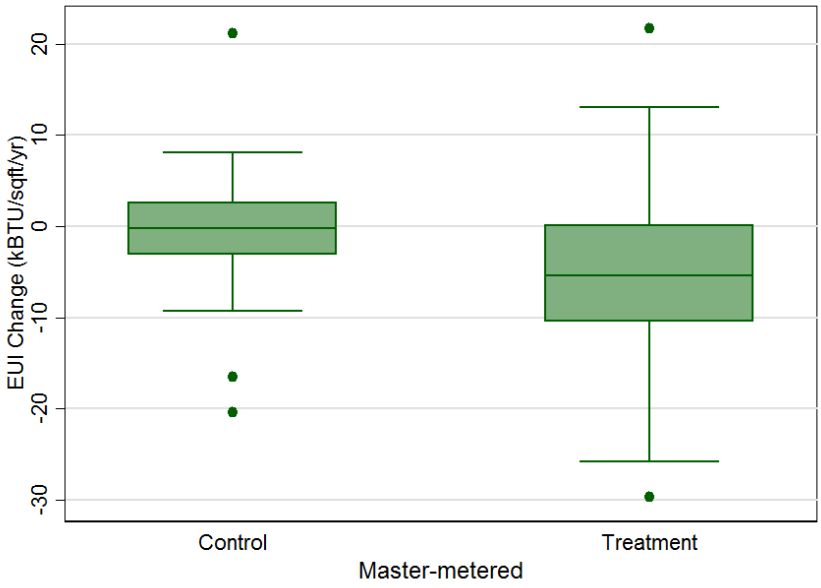

Figure 13: Site Owner Energy Index change for master-metered buildings

Master-metered buildings accounted for 17% of the analyzed buildings, and this change represents a total savings of 7,242 mmBTU/year.

Master-metered buildings found savings primarily in heating, where treatment group participants decreased their Heating Index by 0.48 ± 0.17 BTU/sqft/HDD, about a 7% reduction in heating for a typical master-metered building. Heating savings represented 82% of the overall observed savings in master-metered buildings.

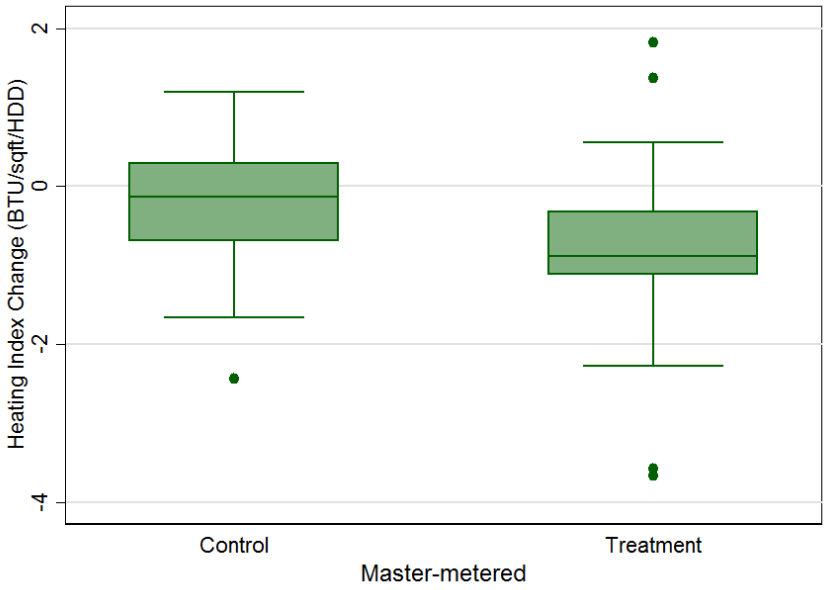

Figure 14: Heating Index change for master-metered buildings

Energy savings in master-metered buildings amounted to 443,780 kWh/year in electricity and 57,289 therms/year in natural gas.

Master-metered buildings in the treatment group decreased their water usage by 24 ± 9 gallons/bedroom/day in the second year compared to the control group, a 30% reduction in water for a typical master-metered building. This is a total savings of 18,820 kGal/year.

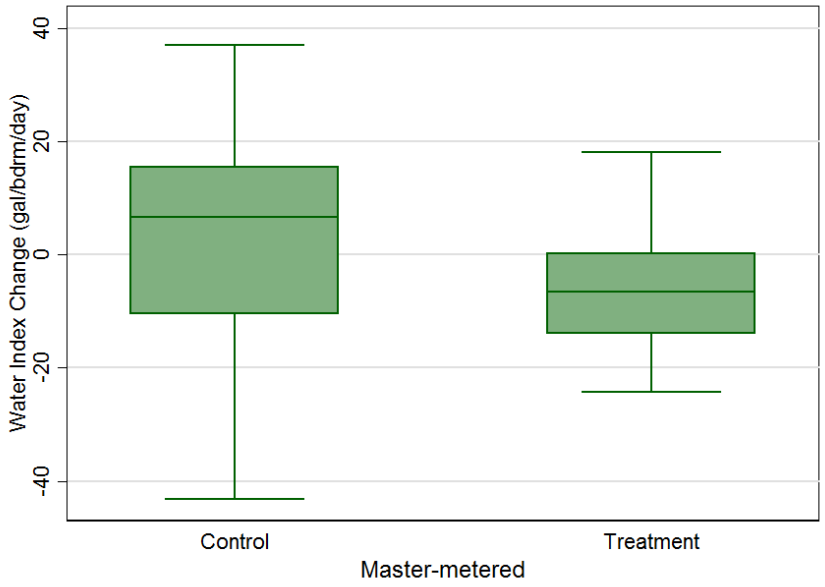

Figure 15: Water Index change for master-metered buildings[9]

Interestingly, master-metered buildings in the treatment group showed only marginally significant energy and water savings after the first year. That is, observed energy and water savings were only statistically significant after two years of benchmarking. This suggests that the benefits of benchmarking take time to appear in multifamily buildings, where the process of receiving feedback and taking action requires interaction and approval of many individuals or sometimes different departments, assistance from outside vendors or programs, and improvements are completed over multiple budgeting cycles.

Energy and water savings observed in non-master-metered buildings in the treatment group were not statistically significant in this evaluation. The pilot was not able to conclude why significant savings were measured in master-metered buildings only. More about the difference between master-metered buildings and other building types are discussed in the Discussion section.

Table 2 and Table 3, below, show the savings observed at buildings with the three most common metering configurations. Only master-metered buildings show statistically significant changes (P value < 0.05).

[9] Outliers were removed from the Water Index Change graph to prevent the y-axis from being skewed.

Metering Configuration	Number of properties	Savings Impact (kBTU/sqft/yr)	P value
Master-metered	85	4.49	0.007
Central heat and hot water	347	0.38	0.715
Central hot water only	39	0.06	0.978

Table 2: Energy savings for three most common metering configurations

Metering Configuration	Number of properties[10]	Savings Impact (gal/bdrm/day)	P value
Master-metered	50	23.9	0.013
Central heat and hot water	121	4.5	0.432
Central hot water	12	0.7	0.918

Table 3: Water savings for three most common metering configurations

Given the small shift in Owner Energy Index in non-master-metered buildings, and level of *variance* in the shifts observed across the data set, observing a statistically significant change of magnitude in those buildings would require analysis of about 790 buildings in at least 158 portfolios, given the clustered randomization method used in this pilot. The term "variance" here refers to the spread of different changes observed in buildings across the data set.

Energy- and Water-Conservation Actions Taken

Utility Conservation Improvement Program (CIP) records showed a statistically significant difference in participation in electric rebate programs between the treatment and control groups. 19% of treatment group properties participated in at least one electricity rebate program over the two year period, while only 10% of control group properties participated.

[10] Water data was not required as part of the pilot, and fewer buildings collected water data than energy, reducing the sample size of water for each metering configuration, when compared to energy sample sizes.

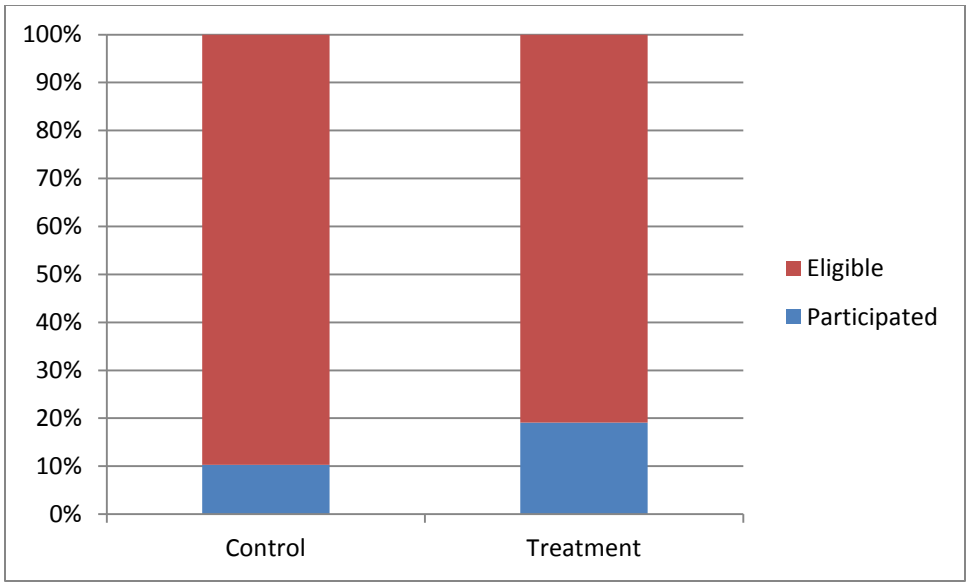

Figure 16: Percent of eligible buildings that received in electric CIP rebates

For gas rebate programs, there was no statistically significant difference between treatment and control group participation. Applying the overall average increase in rebate uptake to the master-metered buildings, we estimate that 16% of observed electric savings, 72,419 kWh, is jointly attributable to the EnergyScoreCards service and the increased participation in rebate programs. Total observed electric savings was 443,780 kWh, so annual electric savings attributable only to the treatment (total savings minus jointly attributable savings) is 371,361 kWh.

Data from the phone surveys of participants conducted as part of the Process Evaluation showed minimal differences in conservation actions taken between control and treatment groups. Because of difficulty in attaining high-quality survey data on actions, it was concluded that a different study design would have been needed to accurately assess the differences in conservation actions taken by members of both groups.

Cost-effectiveness

Cost-effectiveness of the program in producing energy and water savings was estimated in two scenarios. Each scenario uses the same savings – those observed for master-metered buildings only (net of joint rebate savings) – but different cost assumptions as described below and detailed in the Impact Evaluation Report.

First, the full cost of the EnergyScoreCards Minnesota program ($728,940) was 2.7 times greater than the year-two savings in master-metered buildings ($269,380).

Second, the pro-rated cost of the EnergyScoreCards Minnesota pilot for master-metered buildings only is $125,435. For this group the $269,380 of savings over the two year pilot are 2.15 times the cost. In a hypothetical long-term program targeting master-metered buildings, service costs per year would be significantly reduced since a large portion of program costs were associated with program design and launch. Energy and water savings would be expected to

persist or deepen over time. In a 10 year program $7.79 of savings are produced for every $1 spent on master-metered buildings, assuming savings continue at the levels observed in year-two of the program for the remaining 8 years. A full break-down of cost assumptions for this scenario is included in the Impact Evaluation Report.

Demonstrated uses of benchmarking

Participants in EnergyScoreCards Minnesota used benchmarking in a variety of ways, some of which appear to have served valuable functions in their businesses even without producing savings during the pilot period. The following demonstrated uses are illustrated by anecdotes from one or more participants in the EnergyScoreCards Minnesota pilot:

- **To track the results of historical energy and water projects**
  - One participant had insulated and replaced windows before the pilot and wasn't sure whether expected savings had materialized given a cold winter. EnergyScoreCards allowed them to see savings on a weather-normalized basis (Figure 17). During the pilot, they replaced a boiler and were able to see increased savings.

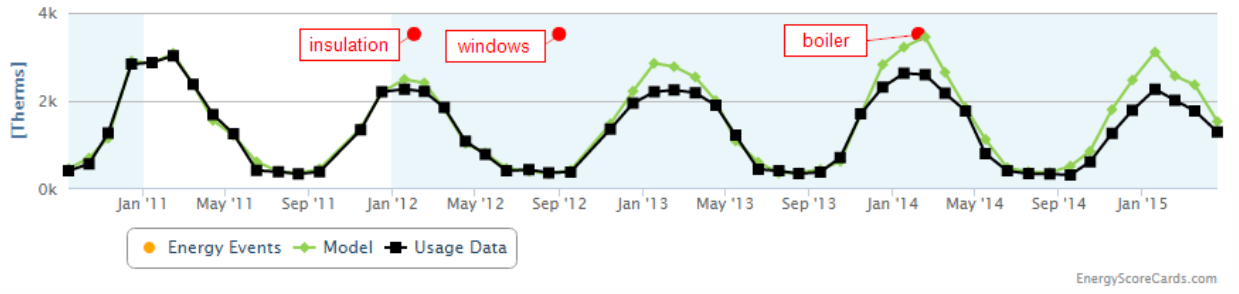

Figure 17: Gas savings after insulation and windows (marked by red dots). Savings are apparent in the space between the green line (adjusted baseline) and the black line (actual gas consumption). Increased space between green line and black line after boiler installation shows additional savings.

  - Another participant, a high-rise senior property, had implemented major energy and water upgrades, just before the pilot began. The first year of the pilot allowed the owner to quantify the actual return on investment and whether it was performing as expected. In fact, the project showed significant water savings and modest gas savings, but an increase in electricity (Figure 18). Because the pilot launched at the time of a major change in which he'd invested significant time and effort, he became more engaged with EnergyScoreCards than other peers at the same organization.

Usage By Fuel	Pre-Rehab - Owner	Full Year 2012 - Owner	Difference		Units
Energy Usage	17,420	17,162	~	-258	mmBTU
Electric Usage	775,845	823,801	6%	47,956	kWh
Gas Usage	147,724	143,512	-3%	-4,212	Therms
Water Usage	17,723	14,226	-20%	-3,497	kGal

Figure 18: Year-to-year comparison showing the energy and water impacts of a rehab

- One participant implemented a water-heater upgrade that unfortunately did not show savings in the first year after installation (Figure 19). EnergyScoreCards helped identify this underperformance, although the reason was not uncovered by the owner during the pilot.

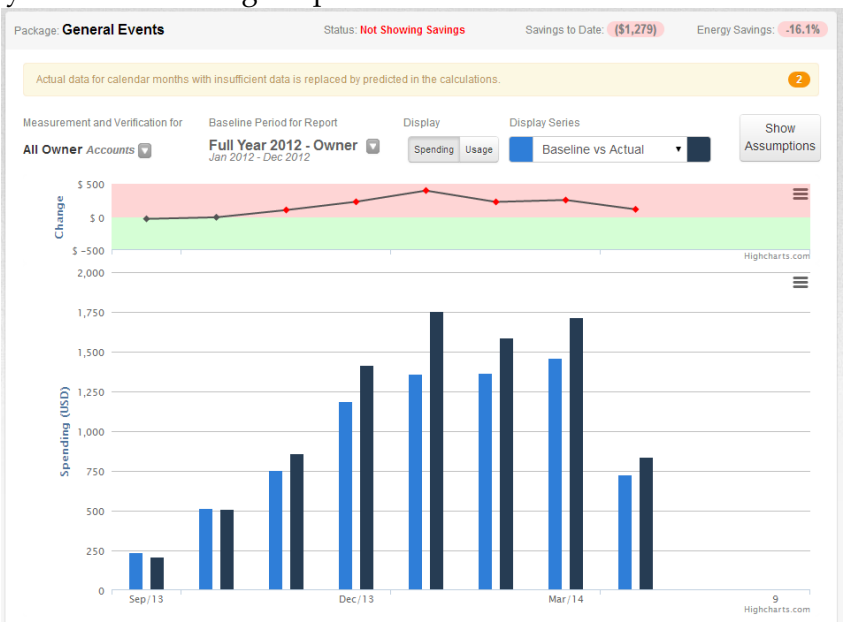

Figure 19: Water heater replacement not showing savings. Black bars (actual consumption) are higher than the adjusted baseline (blue bars)

- **To inform capital planning**
  - For another participant, EnergyScoreCards provided a tool for quantifying savings from a project for replicating it at other identical buildings (Figure 20).

Owner Grade	Total Sqft	Owner Spending	Payment Code	Fuel Code
B	43,500	$20,605	(T)TOO	EGG
B	43,500	$17,736	(T)TOO	EGG
B	43,500	$20,764	(T)TOO	EGG
C	43,500	$21,925	(T)TOO	EGG
B	43,500	$17,230	(T)TOO	EGG
B	43,500	$16,677	(T)TOO	EGG

Figure 20: A snapshot of 6 of 11 buildings in one portfolio with uniform construction and size.

The owner had tested a new heating/hot water configuration in one building, and the results suggested the upgrade would be cost-effective if implemented *at the point of replacement,* that is, at the end of the life of the existing system. However, the savings did not justify replacing fully functional equipment. This owner noted the return on investment and planned to repeat the upgrade on other properties at the time of replacement, outside of the period of the pilot.

- Another participant with a strong focus on energy efficiency in recent years used the information in EnergyScoreCards to inform a long-term planning effort, helping set specific targets for buildings and prioritize efforts based on need and potential savings.

- **To inform operations and maintenance**
  - Two participants had already implemented apparently effective operations and maintenance practices to reduce water consumption across the portfolios with good results. As shown in Figure 21, each portfolio showed savings at most properties, with one or two outliers. EnergyScoreCards was used to quickly highlight the poor performers for intervention:

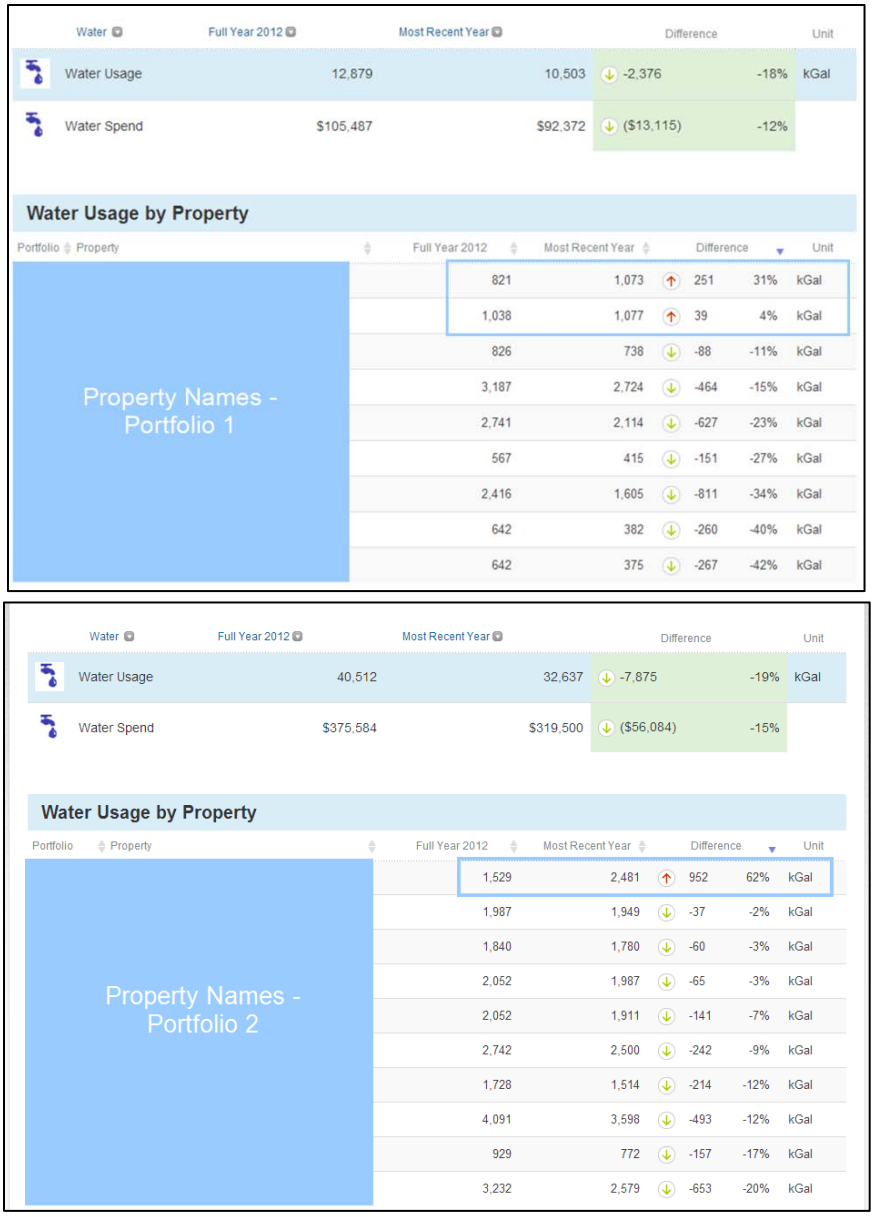

Figure 21: Two portfolios with good water performance and a small number of water problems

- Another participant identified opportunities for savings on heating which became apparent after portfolio-wide increases were observed using weather-normalized analysis (Figure 22) during the pilot. The organization is now planning a retro-commissioning effort to optimize the heating systems in place, many of which are relatively new and likely need a tune-up rather than replacement.

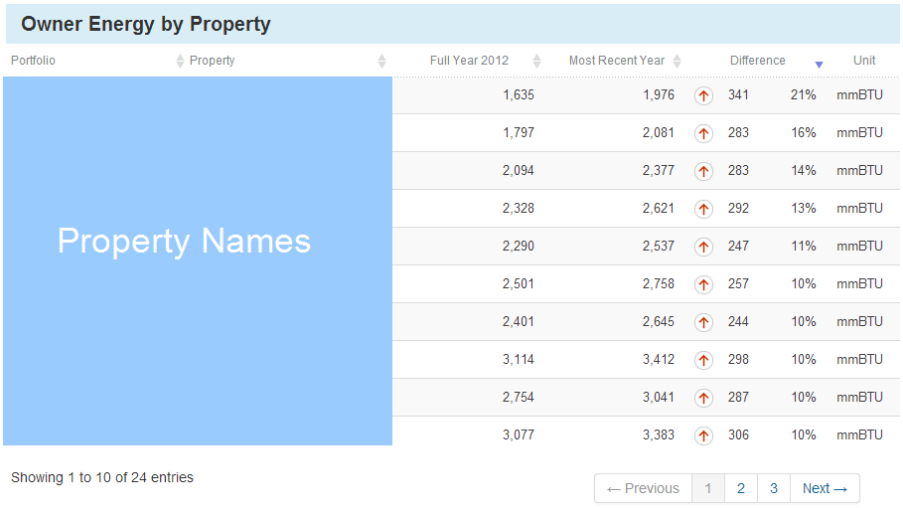

Figure 22: Portfolio-wide heating increases for one participant

- **To enable energy competitions**
  - One participant with a number of very similar properties used EnergyScoreCards to enable a portfolio-wide energy competition between residents. They used their newsletter as a mechanism for promoting energy efficiency and generated a sense of competition by talking about it amongst themselves. The property had seen some significant capital improvements in the prior few years, so residents had seen management model a commitment to improvements. EnergyScoreCards results were shared regularly with building residents and unleashed resident behavior which resulted in an overall 11% portfolio wide savings during the pilot period and consistent reductions across all properties on a weather-normalized basis (Figure 23).

Figure 23: Consistent savings from a portfolio energy competition

- **For budgeting, key performance indicators (KPIs), regular business tracking**

- One participant, a market-rate developer with a focus on energy efficiency design saw EnergyScoreCards as a means of tracking energy and water performance to inform ongoing management, whether or not immediate savings opportunities were found. At the conclusion of the pilot, they were one of the organizations who signed up for a subscription, added 5 properties, and used the tool to pull consumption, spending, and budget numbers for quarterly and annual reporting.

Energy and Water Benchmarks for Minnesota Multifamily Buildings

This section presents benchmarks for typical energy and water use and cost in Minnesota multifamily buildings developed by CSBR based on the study data set. These benchmarks reflect only owner-paid energy and water use and in many cases are not whole building data. These benchmarks can be used as a quick reference for owners, program managers and policy makers to answer questions such as:

- How does my building compare to others of a similar type?
- What is typical use and cost for buildings of a certain type?
- What is the breakdown of energy use in each building type (i.e. What are the broad areas where this energy is being used?)
- To understand the best areas to target for energy improvements in different segments of the Minnesota multifamily building population.

In addition to the energy and water benchmarks presented in this section, Appendix B includes some samples of the types of additional analysis which could be performed with this type of building consumption data.

Owner Energy Benchmarks

For the purposes of benchmarking, energy consumption and spending of buildings in the study data set are divided into five "profiles" or common types based on the payment structure and occupancy type:[11]

1. Buildings housing families, singles and couples where the owner pays heat and hot water and residents pay cooling and apartment electricity.
2. Buildings housing elderly and disabled residents where the owner pays heat and hot water and residents pay cooling and apartment electricity.
3. Buildings housing families, singles and couples where the owner pays all utilities in the building.

[11] Within the EnergyScoreCards software, A, B, C, and D grades are assigned based on a similar approach to comparing building performance to peer buildings. Grades are assigned by quartile (e.g. buildings in the best quartile for efficiency receive an A grade, buildings in the worst quartile receive a D grade).

4. Buildings housing elderly and disabled residents where the owner pays all utilities in the building.
5. Buildings of all occupancy types where the owner pays hot water and residents pay cooling, heating and apartment electricity.

For each profile, EnergyScoreCards was used to calculate a set of performance indices, as defined below. All metrics reflect owner-paid energy only:

- Owner Energy Index (kBTU/Sq ft/year) which represents the total annual weather--normalized energy consumption on all owner--paid energy accounts divided by the total multifamily square footage (which includes common area and residential space).

- Owner Heating Index (BTU/Sq Ft/HDD) which represents the total weather--normalized heating consumption on all owner--paid accounts divided by the square footage of space being heated by owner--paid accounts and the HDD in a typical year. Note that heating index may contain both electricity and gas if both fuels are found to have some association with HDD.

- Owner Electric Baseload Index (kWh/unit/year) which represents the baseload (non--seasonal) electricity use (e.g. excluding any heating or cooling consumption) on all owner--paid accounts divided by the number of residential units.

- Owner Fossil Fuel Baseload Index (mmBTU/bedroom/year) which represents the baseload (non--seasonal) gas consumption (excluding heating and in rare cases cooling gas use) on all owner--paid accounts divided by the number of bedrooms.

Table 4, below summarizes the key characteristics of each type, and includes median values for owner energy use, and indices for cooling, heating, electric baseload and fossil fuel baseload.

Building Type Number	Occupancy Type	Utility Payer*				Number of Buildings (n=531)	Average Number of Units per Building	Average Year Constructed	Median Owner Indices				
		In-Unit Electric	Cooling	Heating	Domestic Hot Water				Owner Energy Index	Owner Cooling Index	Owner Heating Index	Owner Electric Baseload Index	Owner Fossil Fuel Baseload Index
1	Family, Couples and Singles	T	T	O	O	322	41	1961	58	0	5.2	695	8.2
2	Elderly and Disabled	T	T	O	O	76	57	1989	46	0	3.8	2212	6.2
3	Family, Couples and Singles	O	O	O	O	51	65	1966	76	0	5.6	3777	8.7
4	Elderly and Disabled	O	O	O	O	39	81	1980	68	0	4.1	4719	7.1
5	Family, Couples and Singles	T	T	T	O	43	73	1990	26	0.5	5.7	1867	6.3
*T denotes tenant paid utility; O denotes owner paid utility													

Table 4: Key Characteristics of Building Types

On the following pages, figures provide additional detail for each building profile:

- Summary characteristics and a breakdown of site energy usage and cost for each building type
- A table showing both the median and 75th percentile for energy use benchmarks. 75th represents the worst, most inefficient quartile for each building type, so buildings falling above this number may have strong opportunities for improvements.

A few observations cut across all of the profiles. First, heating is the dominant area of owner-paid energy consumption in all types except for #5, where heating is paid by tenants and not included in the owner bills which are being analyzed. This can be seen clearly in the consumption breakdown graphs and in Figure 24, for instance, which shows the strong relationship of the heating index to the overall energy index, since heat is the dominant area of consumption (see Figure 24 which plots heating efficiency vs. building efficiency for buildings in building type #1). In terms of energy cost, however, electricity becomes dominant for profiles #3 and #4, where the owner is responsible for in-unit as well as common area electricity. This reflects the greater electric load paid for by the owners of this building type and the fact that electricity is generally a more expensive fuel than natural gas per unit of energy. Second, there is no clear relationship between the gross energy spending at a property and the owner energy efficiency. Gross energy spending is largely driven by the size of the property, so this also suggests there is not a strong effect of building size on efficiency in this data set (for example as shown in Figure 25 for buildings in building type #1).

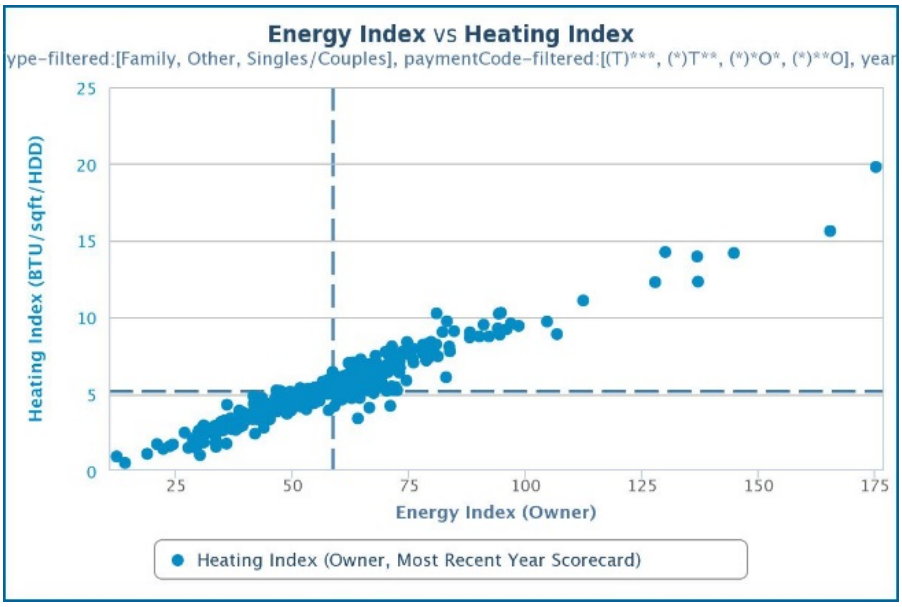

Figure 24: Energy Index v Heating Index, building type #1

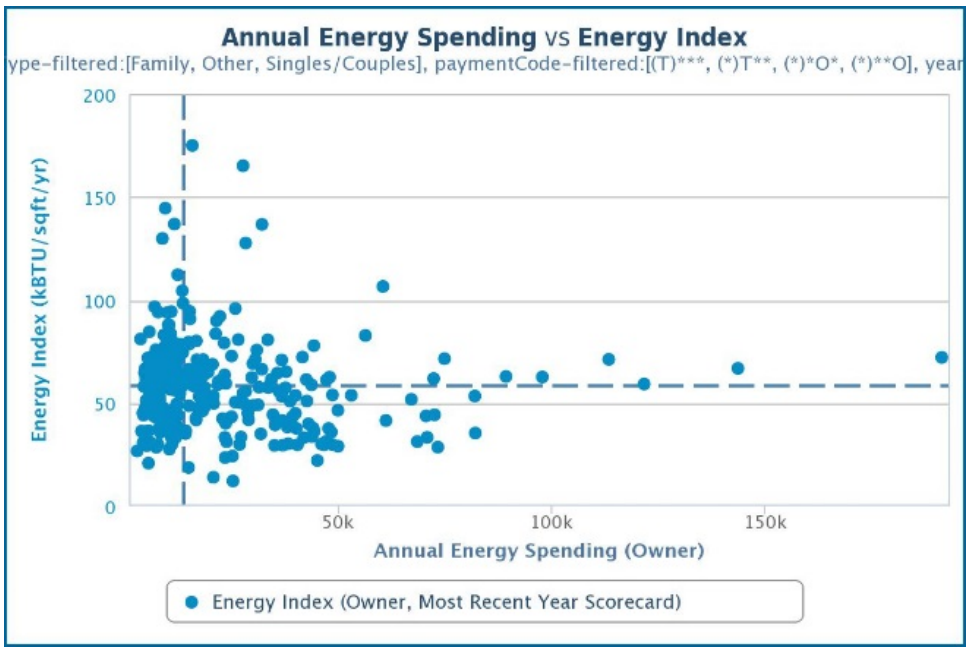

Figure 25: Annual Energy Spending v Owner Energy Index, building type #1

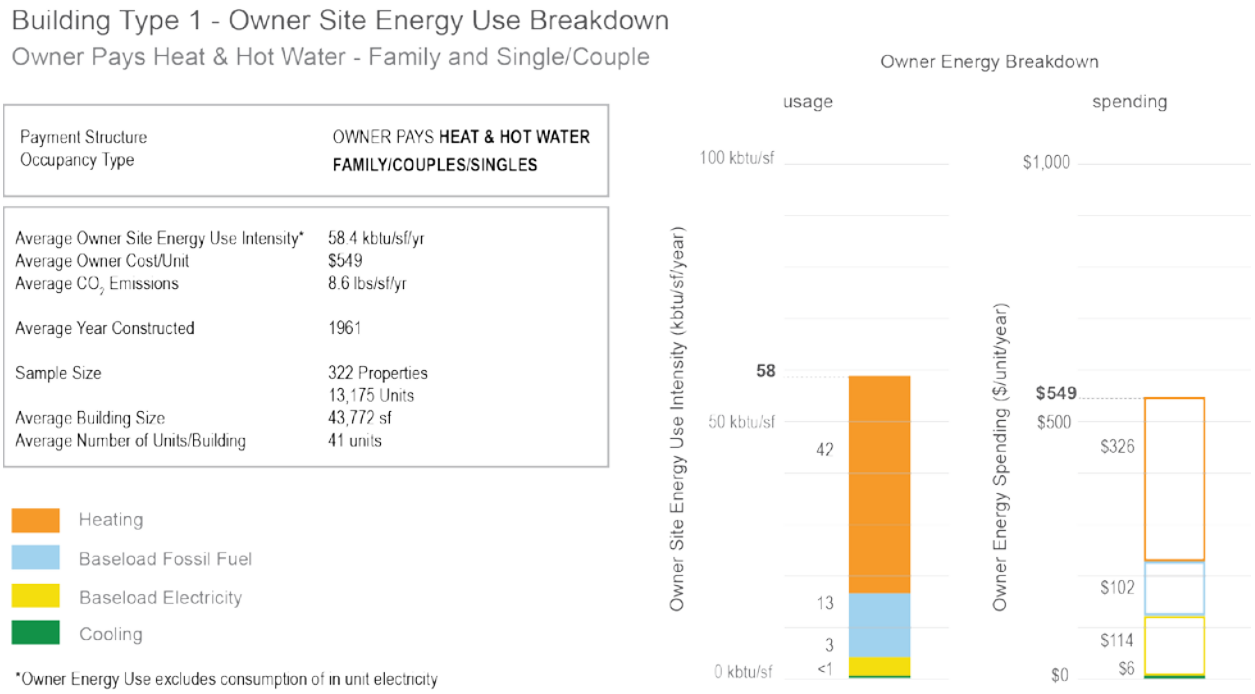

Figure 26: Building Type #1: Owner Energy Index Breakdown
(Owner Pays Heat and Hot Water, Family and Single/Couple Occupancy)

	median	75%
Owner Cooling Index (BTU/ft2/CDD)	0.00	0.84
Owner Heating Index (BTU/ft2/HDD)	5.20	6.43
Owner Electric Baseload Index (kWh/unit/yr)	695	1284
Owner Fossil Fuel Baseload Index (mmBTU/bdrm/yr)	8.22	10.12

Figure 27: Building Type #1: Median and 75% Quartile Energy Use Metrics by End-Use

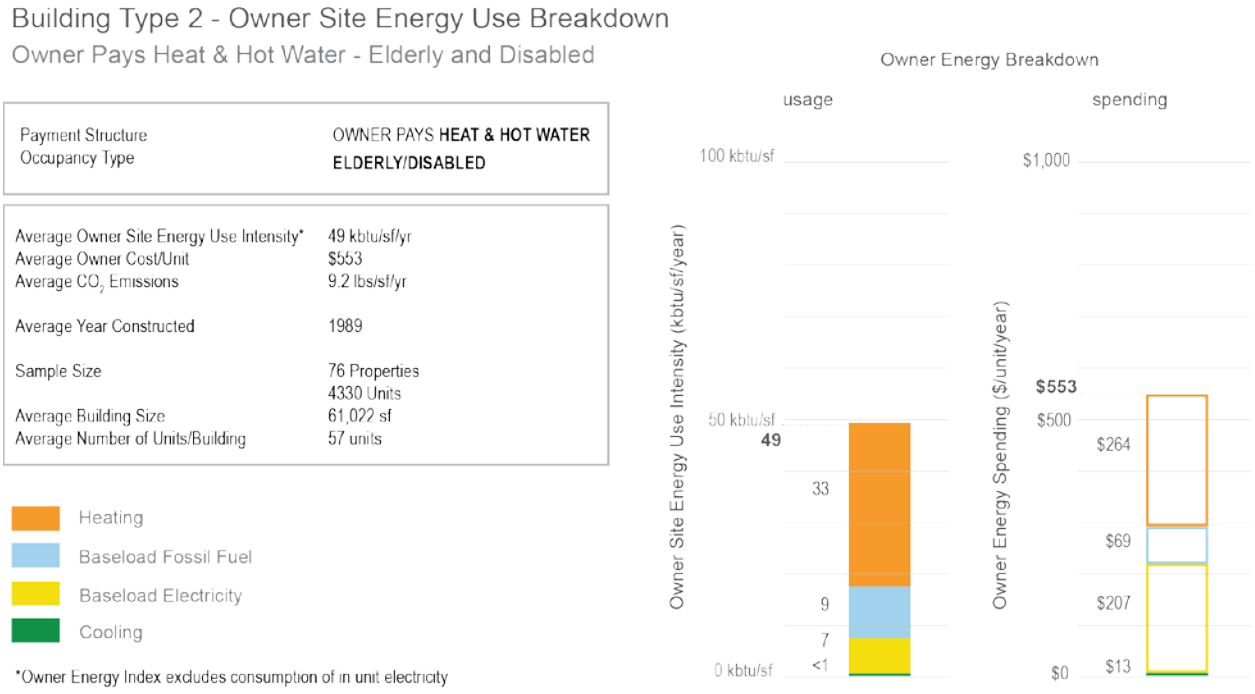

Figure 28: Building Type #2: Owner Energy Index Breakdown
(Owner Pays Heat and Hot Water, Elderly and Disabled Occupancy)

	median	75%
Owner Cooling Index (BTU/ft2/CDD)	0.00	2.65
Owner Heating Index (BTU/ft2/HDD)	3.84	4.85
Owner Electric Baseload Index (kWh/unit/yr)	2212	2518
Owner Fossil Fuel Baseload Index (mmBTU/bdrm/yr)	6.24	7.84

Figure 29: Building Type #2: Median and 75% Quartile Energy Use Metrics by End-Use

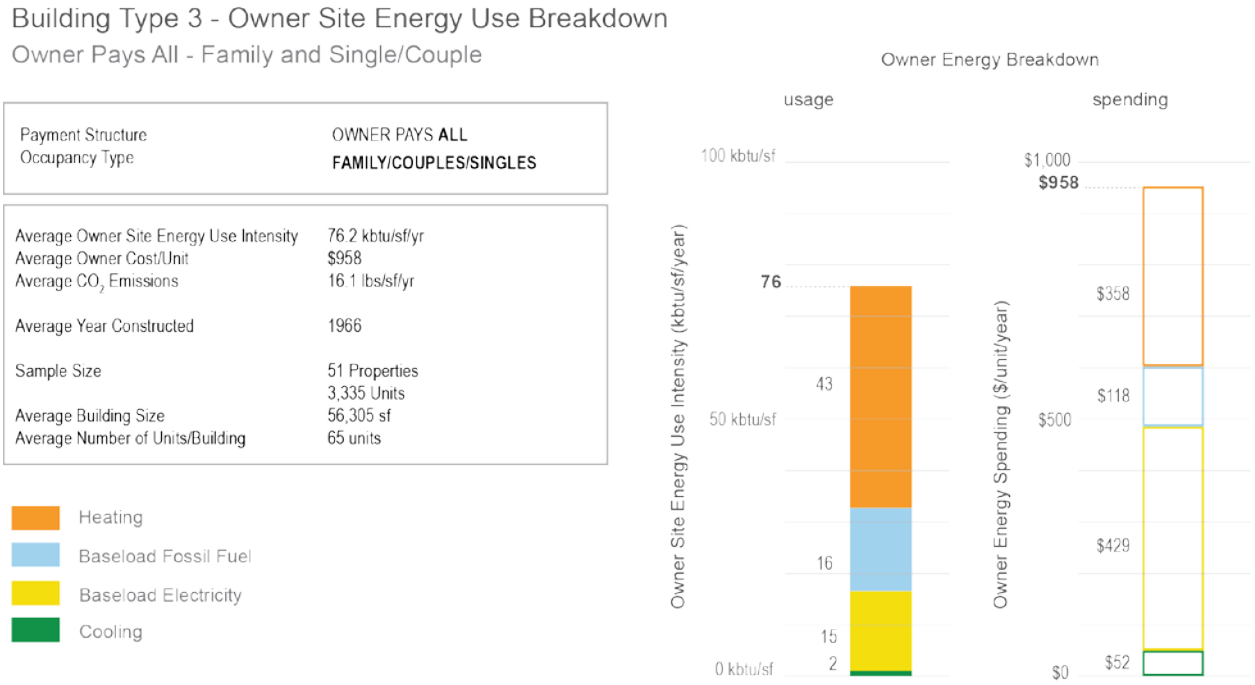

Figure 30: Building Type #3: Owner Energy Index Breakdown
(Owner Pays All Utilities, Family and Single/Couple Occupancy

	median	75%
Owner Cooling Index (BTU/ft2/CDD)	0.00	3.04
Owner Heating Index (BTU/ft2/HDD)	5.63	6.75
Owner Electric Baseload Index (kWh/unit/yr)	3777	4706
Owner Fossil Fuel Baseload Index (mmBTU/bdrm/yr)	8.68	12.56

Figure 31: Building Type #3: Median and 75% Quartile Energy Use Metrics by End-Us

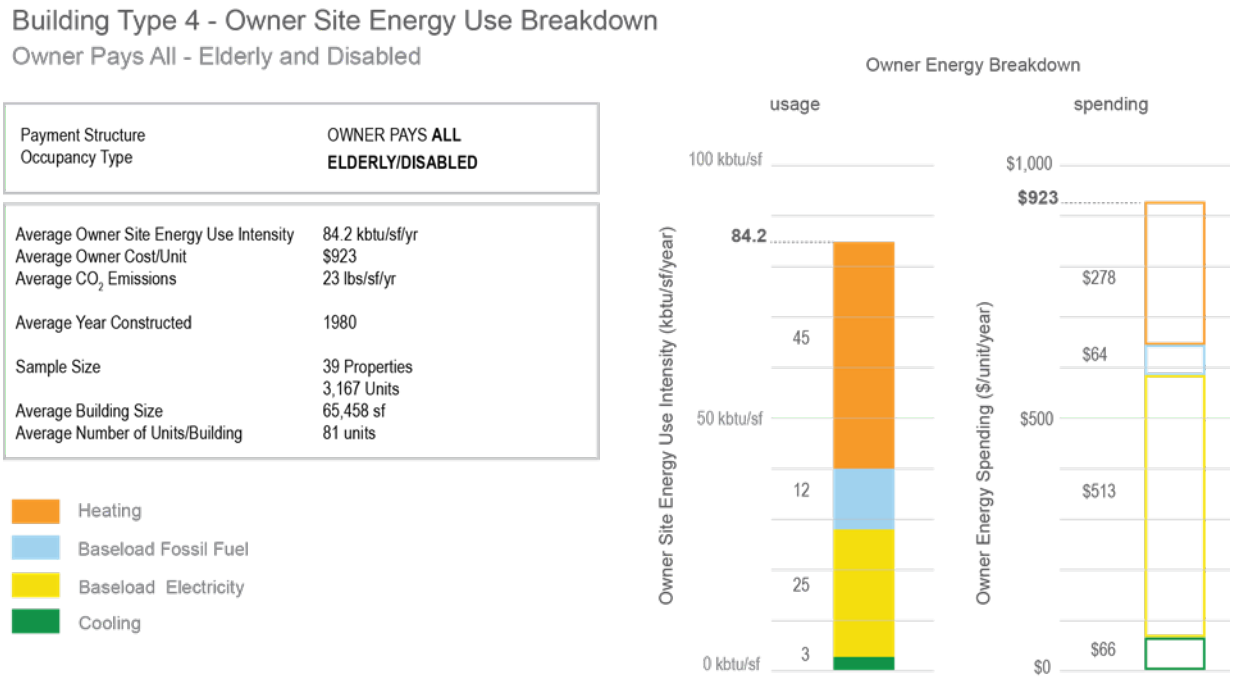

Figure 32: Building Type #4: Owner Energy Index Breakdown (Owner Pays All Utilities, Elderly and Disabled Occupancy

	median	75%
Owner Cooling Index (BTU/ft2/CDD)	0.00	4.87
Owner Heating Index (BTU/ft2/HDD)	4.14	7.19
Owner Electric Baseload Index (kWh/unit/yr)	4719	6241
Owner Fossil Fuel Baseload Index (mmBTU/bdrm/yr)	7.08	8.71

Figure 33: Building Type #4: Median and 75% Quartile Energy Use Metrics by End-Use

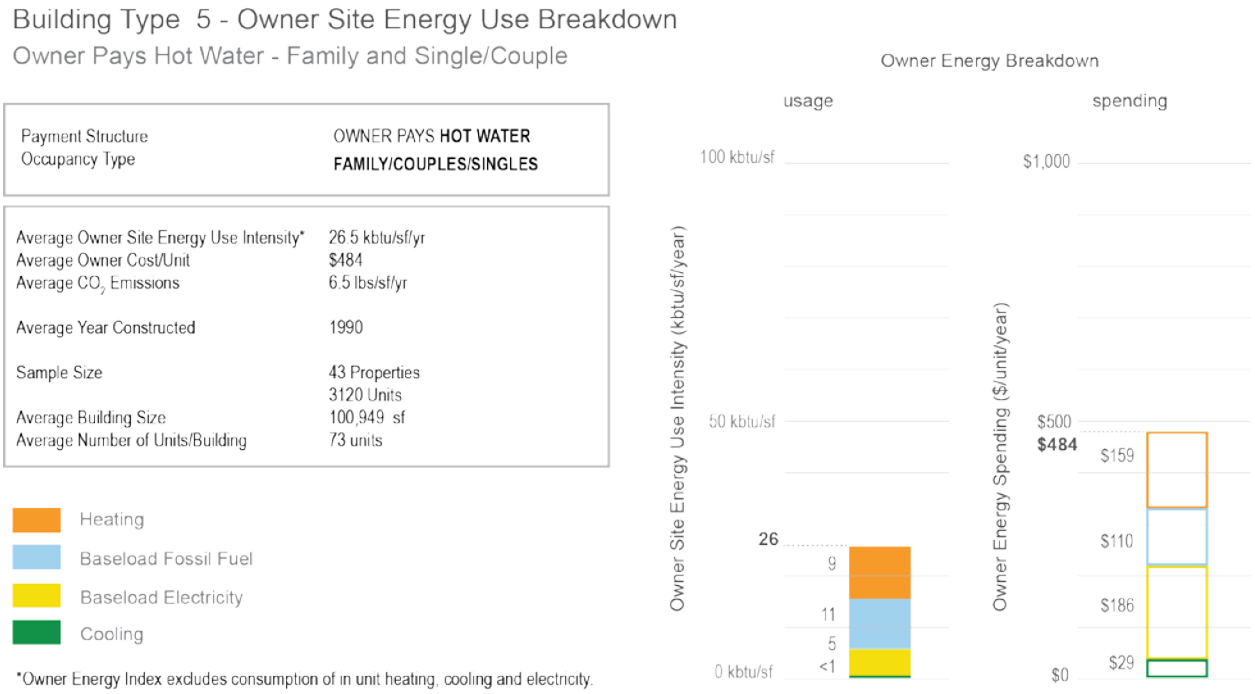

Figure 34: Building Type #5: Owner Energy Index Breakdown (Owner Pays Hot Water, Family and Single/Couple Occupancy)

	median	75%
Owner Cooling Index (BTU/ft2/CDD)	0.50	10.90
Owner Heating Index (BTU/ft2/HDD)	5.70	15.50
Owner Electric Baseload Index (kWh/unit/yr)	1867	2481
Owner Fossil Fuel Baseload Index (mmBTU/bdrm/yr)	6.32	7.66

Figure 35: Building Type #5: Median and 75% Quartile Energy Use Metrics by End-Use

Water Benchmarks

Along with electricity and gas, water use was benchmarked through the program for a subset of buildings (213 buildings out of the 561) in Minneapolis and Saint Paul, where automatic retrieval for water data was provided. Because water uses (e.g. toilets, showers, sinks, limited landscape irrigation) are relatively consistent across all properties and all buildings are master-metered for water, buildings are only grouped by occupancy type. Generally, water consumption and spending is higher on a per bedroom basis in family properties as shown in Table 5.

	Water Use (gallons/bedroom/day)		Cost $ /year		Number of C-D Properties	Potential Water Savings (gallons) if brought to median	Potential Cost Savings ($) if brought to median
Occupancy Type	Median	75%	Median	75%			
Family/Couples/Singles	74	98	$250.67	$323.48	112	101,458,888	$754,813
Elderly/Disabled	71	82	$165.13	$262.80	31	10,485,841	$193,110

Table 5: Water use data and potential savings by occupancy group

What engagement strategies were successful?

This section highlights the successful strategies for participant engagement during the pilot in both initial recruitment and ongoing engagement.

Recruitment

- **Persistent outreach.** In the recruitment phase, the project team and partners were persistent in contacting possible participants, with frequent follow-ups via personalized emails and phone calls. Contact and support throughout the data collection phase was crucial to collecting enough information to complete the submissions.
- **Leveraging trusted local partners.** Outreach was conducted with the assistance of funders and respected membership organizations, including Minnesota Housing, Metropolitan Consortium of Community Developers, local landlord associations, existing service providers, and utility companies. The prior experience of two of the three Account Managers with affordable and market-rate housing providers proved a major asset to recruitment, offering existing relationships and insights into specific owners' motivations. For instance, some former colleagues of pilot partners recruited their own landlords to participate; in one instance, family connections offered a trusted personal introduction to the chair of the local landlord's association.

- **Education.** A program offering refrigerator or boiler replacements is easy to understand. Benchmarking is a newer energy concept and inherently less tangible. We developed presentations and materials to educate potential participants on what benchmarking is, and highlight potential uses (e.g. to target improvements or quickly identify changes in use that could signal equipment failure). The need for education continued beyond recruitment as ongoing engagement.
- **Transparency on funding and motivation for service.** Property managers are frequently contacted with offers that are too good to be true, from vendors, programs, or others. This leads to a healthy skepticism about services, particularly those offered for free. Working with trusted organizations to spread the word and co-present the benchmarking pilot was important in successful recruitment. For example, one for-profit participant submitted properties at the encouragement of Minnesota Housing, but did not return Account Manager phone calls when access to EnergyScoreCards began. When the Account Manager finally connected after several months, it became clear that the property owner was skeptical of the program's motivations. Once the funding sources were explained, he engaged.
- **The importance of hands-on assistance with initial data collection** is discussed below and was important to both initial recruitment and ongoing engagement.

Ongoing Engagement

Barriers to successful engagement

Even with successful recruitment, software, and analysis strategies, ongoing engagement is critical; benchmarking triggers actions to produce actual energy savings only through review, discussion, and modification. The barriers to successful engagement observed in the EnergyScoreCards Minnesota pilot include:

- **Lack of clear responsibility for energy and water management:** One of the largest barriers in benchmarking is the lack of a designated staff person to manage energy and water usage within a participating organization. For a number of participants, the primary contact was a property manager responsible for tracking and reporting on utility bills, but that person was not empowered to make capital decisions or direct maintenance staff on practices. One Account Manager organized a meeting with representations at multiple levels of management and even when leadership expressed commitment to addressing the high energy and water use in the portfolio, no single person was assigned as accountable for results. This lack of a direct area of responsibility is a huge hurdle in establishing a stable and well-tracked energy and water benchmarking program.

- Lack of engagement by organizational leadership: Another challenge in building widespread engagement and support is a lack of communication between site staff and upper level management. A few portfolios or properties were submitted by an owner or senior manager with the intent to assign direct participation to staff, a process which was not always communicated clearly to either EnergyScoreCards Minnesota staff or within participant organizations. In these cases, Account Managers and the related project work was met with mistrust or resentment which slowed the engagement process.

Upper level management buy-in is also required for accomplishing a portfolio-wide approach to energy and water management. Two owners or managers directed staff to submit properties to EnergyScoreCards, but delegated participation to site management. It was difficult to communicate with them because of their dispersed on-site locations, and what was started as a portfolio benchmarking effort became a building-by-building engagement approach, limiting the potential for savings.

- **Competing Priorities:** Core work tasks (e.g. maintaining occupancy, unit turnover processes, maintaining health, safety and welfare in the property, compliance) for the staff at properties had a higher priority than engaging with the benchmarking service, and some staff struggled to make time for engagement. Many participants were asked to engage by supervisors but not briefed on the amount of time and commitment that was required for benchmarking and tracking their buildings. This time conflict is illustrated in the process evaluation survey results showing lower satisfaction with the amount of time it took to participate in EnergyScoreCards Minnesota (Figure 36). This is an inevitable tension in a benchmarking service that requires time from building owners: if they don't engage, they are likely not to benefit, but if they do, it will take some of their time away from other tasks. The time constraints may explain other owners who signed up but later refused to participate or those who never considered the program at all.

  At a supportive housing property, the property manager was interested in and capable of energy and water management. She felt overwhelmed by the idea of getting up to speed on something so foreign and outside her core responsibility as energy and water management. Despite participating, she did not end up with sufficient time to implement improvements where there were opportunities.

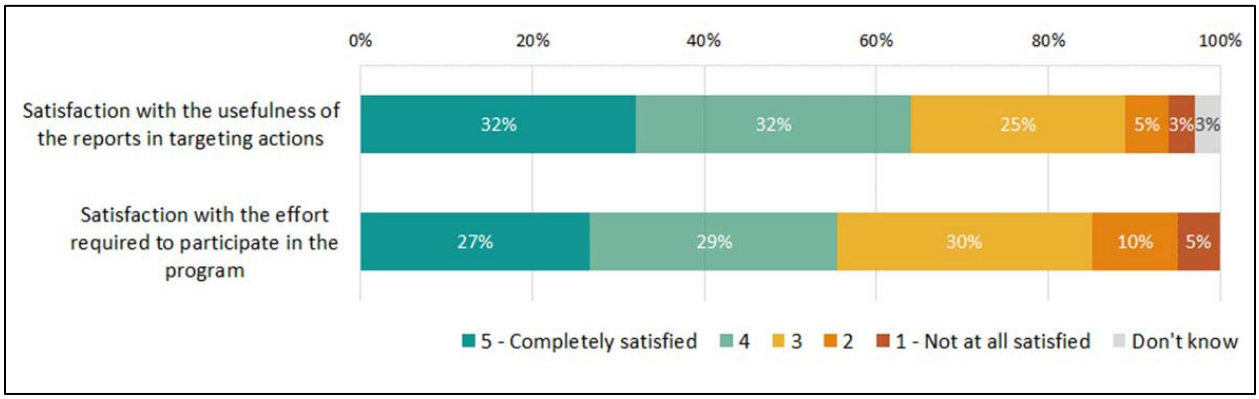

Figure 36: Survey result: Usefulness of service, Satisfaction with effort required

- **Staff or ownership transitions:** A few properties were sold or had staff transition during the two years of the pilot. Transferred properties were allowed to continue in the pilot, but participation was not always communicated during the change of ownership. As a result, Account Managers had to identify and connect with the new contacts, and restart the orientation and education process.

  One portfolio was managed by a firm whose owner passed away during the pilot. Uncertain about the future of the firm, staff could not make any changes to the buildings or processes. Several months later, the buildings were acquired by new management firms, and the Account Manager was able to reengage. By the time the Account Manager made contact with

the new managers, there were only a few months left in the pilot and therefore there was limited time to understand the building's performance and take action.

- **The assumption that utility usage cannot be managed:** Owners and managers often view utility use as a fixed cost, believing building age, characteristics unique to their property, and tenant behavior are the primary factors determining energy and water use:
    - One participating manager shared her certainty that the problem was the tenants. She observed that they leave windows open in the winter and either didn't care or didn't understand that they should be closed. Because the tenant behavior was the cause of the high use, there was nothing she could do. In fact, open windows may be a sign of overheating, a problem that managers can address in centrally heated buildings.
    - Another participant focused on building features. When contacted about unusually high baseload electricity use, one property manager blamed the building's on-site services as the energy culprit. "Our building is unique, so it cannot be compared to other buildings," she said. Other participants had similar assumptions about the non-seasonal electric consumption.
    - Participants who managed either new or old buildings often believed their buildings were respectively over- or underperforming and had preconceived notions that there was no potential for energy improvement (e.g. old buildings can't perform like new buildings, new buildings are already good enough).

  In fact, the Impact Evaluation found that building age and tenant behavior do not appear to be limiting factors in achieving energy and water savings. Master-metered buildings of all ages showed significant savings during the pilot, and owner bills are heavily impacted by tenant behavior in master-metered properties since they cover in-unit electricity, heating, hot water and cold water.

- **Lack of multifamily-focused energy programs:** Most utility programs where the pilot was offered were not designed to serve multifamily properties specifically, and often owners would not find success with utility programs even after being successfully referred by Account Managers. Problems with the local utility program offerings for multifamily during the pilot included:
    - Only one utility had a multifamily specific program; others had standard lighting retrofit options (for common space only), a standard natural gas rebate program initially designed for commercial properties, and two subsidized audit program offerings.
    - Gas programs and electric programs were separate, requiring an owner to contact multiple different programs to address, for instance, electric and gas heating equipment.[12]
    - Programs addressing tenant spaces were generally separate from programs applicable to common spaces.

[12] As of this writing Xcel Energy and CenterPoint are preparing to launch a joint one-stop-shop multifamily program addressing both electric and gas measures.

- Utilities were unable to recommend specific trade partners or contractors to assist with implementation. Some programs (e.g. Xcel refrigerator rebate program) were oversubscribed during the pilot period.
- Some programs had restrictions (e.g. a requirement to install condensing boilers to receive an incentive) that made improvements impractical for some multifamily properties (e.g. steam heated buildings). As a result, even some activities which would have produced deep savings were not eligible for support.

Successful engagement strategies

- **Dedicated engagement staff**. The pilot was designed with dedicated Account Managers assigned to support each participant throughout the pilot. Having Account Managers proactively engage participants, notify them of sudden changes or problems, and assist with learning about the tool was critical to the pilot's success. This level of support is not necessarily assumed in all benchmarking services. An alternative program might have included only the software with technical support available on call.

  Effective Account Managers support required tracking engagement. During the pilot, the level of engagement among participants was measured by tracking the number of logins per property by each participant, and tracking the number of interactions between the Account Manager and participant.

- **Build a relationship.** The support service worked best when Account Managers built a long-term, trusted relationship with the participant where participants were confident Account Managers understood their goals, their needs, and could offer help.

  Relationship-building began as soon as access was launched for participants. The assigned Account Manager welcomed participants with an introduction, information on how to access the program, and a request to set up a one-on-one orientation webinar. It also included a request to complete a short survey where participants were invited to reflect on and share their goals. The survey gathered information on their goals and motivations and ensured Account Managers were connecting with the right person. Each organization participated in a personalized one-on-one orientation. It was tailored to explore the motivations and make-up of building or portfolio management staff and began exploration of the participants' properties. A few examples are shown in Table 6.

Participant areas of interest (from survey)	**Benchmarking orientation focus**
Recent energy and water capital improvement	How to measure savings from projects
Desire to outline future capital needs	Identifying large opportunities
Understanding how buildings were compared to other similar properties	Exploring benchmarks across portfolio

Table 6: Adapting to participant interests

Account Managers contacted participants personally on a regular basis via phone calls, emails, and in-person meetings. An effective contact strategy began with an email containing portfolio-specific observations from EnergyScoreCards and then following the email with a phone call.

To develop a habit of using EnergyScoreCards, Account Managers offered resources that used EnergyScoreCards to address managers' primary responsibilities in their day to day work. These included using the tool for to assist with annual budgeting, to improve marketing, or to support tenant engagement. Participants reported, in the Process Evaluation, that they used the tool in these ways and found it helpful.

- **Importance of education:** Education was integrated into follow-up contacts over the course of the pilot, building in complexity as people gained skill in using EnergyScoreCards or began to understand the energy use patterns in their portfolio. Coaching from Account Managers was crucial to continued engagement and increasing understanding of the benchmarking data as well as a sense of what could be done to improve performance. Coaching on how to best use EnergyScoreCards software and understanding the benchmarking results continued through the conclusion of the pilot.

  Ongoing education was critical to overcome the perception that utilities cannot be managed, and build a sense of efficacy and control around utilities. When we were able to overcome these perceptions and enable an owner/manager's sense of efficacy, we saw instances of great momentum. One maintenance manager worked with a portfolio of cooperative buildings and wanted to act, but his supervisor believed that tenant behavior was the reason for the high utility use. The Account Manager worked with the maintenance manager to identify strategies he could implement within his existing budget and then used EnergyScoreCards reports to show the supervisor that the effort had been successful. A part of one report for that property is shown in Figure 37.

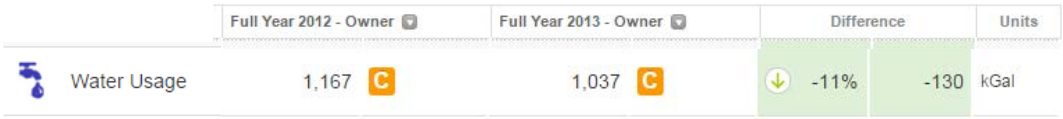

Figure 37: Water savings from implemented measures

Upon seeing the reports, the maintenance manager was authorized to implement more capital-intensive improvements. Developing effective communication materials that counteract the inaccurate perception that building age or tenant behavior is the primary factor determining energy use is needed to increase owner and manager sense of efficacy.

- **Benchmark portfolios, not buildings.** Working with entire portfolios allows several actions that increase the value of the service for owners/managers including the ability to:
  - Look across the properties and choose where to begin investing based on the intersection of high usage and larger sized buildings.

- Compare similar buildings within a portfolio that owner is very familiar with, and so allows a more detailed comparison than to unknown peer buildings in the EnergyScoreCards database.
- Allow deployment of portfolio wide strategies (e.g. energy competitions, staff training, replicating successful energy or water projects).
- Allow portfolio wide business reporting on energy use, consumption, spending, and budgeting to investors.

One participant had a portfolio of similar buildings, and used EnergyScoreCards to engage residents. Due to the interest of the residents and the willingness of the owners, and enabled by the identical design of each of the buildings, the property manager developed innovative resident engagement activities. These were entirely master-metered properties, so the resident engagement was directed to reduce use energy use entirely invisible to residents. This was only possible because the multiple buildings within the same portfolio were benchmarked and compared to one another.

The disadvantages of not tracking an entire portfolio became clear for several participants. One larger owner submitted several buildings, one at each property where there were multiple buildings on each site. For this owner, not having their whole portfolio in the tool proved a major limitation and reduced the value they had sought in accessing EnergyScoreCards; their participation was minimal.

- **Engage as long-term partner.** The scale and complexity of managing multifamily properties requires multi-year planning. In particular, capital improvements are planned, coordinated and funded over multi-year cycles. Simply providing a one-time benchmark to each property or six-month access to the data and analysis would not have achieved the improvements that were seen in this project. Long budget cycles, competing priorities, inevitable project delays and staff transitions meant that the statistically significant improvements seen were measurable only in the second year, and might have persisted or increased in subsequent years.

  Very early after gaining access, one non-profit participant noted there was a two year delay between identification of and implementation of potential capital improvements. They were excited about the information in EnergyScoreCards and their participation goal was identifying future capital improvements. The mechanisms of funding for affordable housing typically include a multi-year process, with a once-annual application for funding. This participant decided to purchase a subscription to EnergyScoreCards and is now in the process of making capital improvements.

- **Data collection assistance.** Starting with initial recruitment, and throughout the entire pilot, ongoing attention to data collection and quality proved an import aspect of participant engagement. During recruitment, this meant that Account Managers were available to assist with questions on the application, and performed the initial upload and review of information in EnergyScoreCards. Questions on square footage – particularly how to properly account for non-residential square footage, commercial spaces and parking garages, were often non-trivial and required additional guidance and discussion. Where possible, the team also developed strategies to fill in data gaps in the template that didn't require direct owner involvement, such as accessing information

through public property tax data records and Google Maps. Collecting utility account access information, including account number, premise number, and online log-in account information was often the greatest challenge and required multiple phone calls from an Account Manager. It is possible to imagine a large-scale benchmarking program integrated with other utility programs where utility providers themselves could simplify the utility account collection process, but for now, hands-on support from Account Managers appears necessary for many to collect data. Because the pilot included an automated data feed with Xcel Energy, the barriers were less substantial. In this way, the pilot relationship with Xcel Energy showed that data requests can be simplified if benchmarking is coordinated with a utility program.

- **Be a bridge to action and additional technical support.** Participants often needed a trusted partner to help develop the case for moving to action. Account Managers brainstormed strategies to gain organizational buy-in for action, assisted in assessing whether recommendations were prudent and worked with participants to frame recommendations for other stakeholders. Examples of bridging to action include:
    - Account Manager helped one owner of a portfolio of century-old brick buildings identify a way to improve tenant comfort while reducing costs. Gas heating had been supplemented in cold units with electric baseboard heating, an effective but expensive measure. For instance, in the property shown in Figure 38 electricity accounted for a third of heating expenses even in a building with a central gas-fired boiler. The Account Manager connected the owner to an Xcel Energy program which suggested electric heat pumps as an alternative which could reduce costs and improve comfort.

Figure 38: Property ScoreCards shows a significant portion of heating spending is electric, due to supplemental baseboard heating.

- Account Manager made direct suggestions of rebate or free audit programs which might help a participant seize an energy saving opportunity suggested by the tool. One such program, EnerChange, was recommended to several buildings

during the pilot. Account Managers not only recommended EnerChange, but provided support to participants in navigating the process, checking in on progress and offering suggestions during regular check-in calls. In some cases, buildings received free audits and subsidized upgrades from the program; in others a lack of funding or other barriers prevented the building from completing upgrades. These cases illustrate both the importance of acting as a bridge to technical support, and the fact that lack of targeted, or sufficiently well-funded multifamily programs remained a significant barrier (as noted in the "Barriers to successful engagement" section above).

- Account Managers assisted by writing memos identifying opportunities and outlining probable return on investment for presenting capital improvements recommendations to senior management.

While Account Manager support helped many participants find additional technical support, the Process Evaluation indicated that participants desired more technical assistance in implementation. Account Manager anecdotal experience also reflected that many opportunities were left on the table because additional technical support was not available outside of EnergyScoreCards Minnesota.

Discussion

The EnergyScoreCards Minnesota results suggest energy and water benchmarking is a feasible and effective approach to driving utility savings in multifamily buildings. These results answer a number of questions for both the Minnesota and national US context, and invite further investigations about the best ways to use benchmarking and improve its effectiveness as an energy and water management strategy in the future.

Why were impacts different for different building types?

One of the most striking and surprising findings from EnergyScoreCards Minnesota is that statistically significant savings were only seen in master-metered buildings. This is particularly interesting as the savings were predominantly heating savings, and the same results were not seen in properties with owner-paid heat and hot water. Some possible explanations for the different results (which are also described further in the Impact Evaluation) include:

Owners may have greater focus and incentive to reduce energy and water use where they are paying for all utilities in a building. This may mean higher per unit utility spending, larger gross spending at the property level, or a greater internal prioritization and sense of responsibility for energy and water use.

A larger data set (nearly 800 buildings) would have been needed to statistically observe a smaller savings impact in non-master-metered properties. This is supported by a statistical test called a power calculation which is included at the conclusion of the Impact Evaluation.

A longer study period might have been needed to see the effect. For instance, if owners of large portfolios chose to focus first on master-metered sites, other properties with strong opportunities might not be addressed or show impacts until years three or four.

Future studies would be needed to pinpoint the reason for the results found here and to see if statistically significant savings could be produced in non-master-metered buildings through a study that is longer, larger, or varied in other ways. It is important to keep in mind, however, that directly attributable savings are only one demonstrated benefit of multifamily benchmarking, and other uses were observed anecdotally in the pilot across all buildings types.

Three models for using multifamily benchmarking

Benchmarking as a standalone practice

The results of EnergyScoreCards Minnesota demonstrate the impacts and benefits which can be produced by using energy and water benchmarking as a standalone strategy for multifamily buildings: both direct energy and water savings, and a range of additional uses described above. Standalone multifamily benchmarking can be implemented as a voluntary best practice for building owners, or as a utility or government run program, as described below.

Benchmarking as a voluntary best practice for building owners. A number of multifamily buildings in Minnesota already use benchmarking services (EnergyScoreCards and others) as

part of their approach to managing their buildings, adopted voluntarily and with associated costs – both in service fees and staff time. As of this writing we estimate this adoption to be in the hundreds, but not yet thousands of buildings in the state. Assuming utility costs stay the same or rise and that the capabilities of these services to cost-effectively provide value to owners increases over time, there is reason to believe this will continue or grow. It is unclear, however, whether this practice will become the norm or what the cumulative impact on energy and water consumption will be. Some evidence from the pilot suggests that changes are needed to increase adoption:

a. Process Evaluation survey response suggested that while participants valued the service, most would not be willing to pay more than $200/building/year, while the EnergyScoreCards service typically costs over $500/property/year when offered directly to building owners. Some way of reducing the cost without reducing the value of the service, either through subsidies to owners or service providers could increase adoption.
b. The large number of utilities in the state creates a barrier to statewide adoption since a service like EnergyScoreCards would need to integrate separately with each utility. Standardizing data sharing protocols across utilities would reduce the cost of accessing data from utilities across the state for owners or third-party benchmarking services. [13] The costs involved in standardization for utilities and their willingness to participate are not known.

Benchmarking as standalone utility or government energy and water savings program. Following the OPower model for single family homes, utilities or governments could adopt benchmarking as a standalone program to reach energy or water savings goals. This study found that savings as high as 5% for energy and 30% for water were attributed to the benchmarking service for master-metered buildings. Future research would be needed to document this as a viable approach outside of the master-metered buildings, but the results suggest this is a cost-effective approach to achieving broad energy and water savings in multifamily buildings. Standalone benchmarking is probably limited, however, in the depth of savings that can be achieved. The 5% energy savings and 30% water savings seen for master-metered buildings in this pilot are substantially higher than the 2-3% impacts seen in other studies, and it would be reasonable to expect lower savings in future studies or broader populations.

Benchmarking as part of a holistic service

As discussed previously, benchmarking can be thought of as a part of the larger energy management process. As such, it may be implemented as one component of a larger program or service. The strong feedback from EnergyScoreCards Minnesota participants that *they wanted*

[13] A current utility data standardization effort is The Green Button Initiative. Green Button provides format, data, and access standards for utilities to provide energy information. The two major components include "Download My Data," which provides access to utility customers, and "Connect My Data," which allows customers to automate secure transfer of data to authorized third parties. This is the leading initiative in standardizing data integration nationally.

additional help to implement upgrades and fix problems supports the idea of combining benchmarking with other services. Adding benchmarking to a holistic energy- and water-saving approach could take several forms and make savings from capital upgrades or other interventions deeper, more cost-effective and more persistent if service providers:

- Use benchmarking to target the use of on-site engineers and to verify savings estimates in a retrofit program.
- Use benchmarking after installation of upgrades to ensure performance meets expectations, to target additional troubleshooting, and to respond to poor performance.
- Use benchmarking to quantify the real impacts of retrofit programs and to hone approaches over time based on post-installation data on the effectiveness of interventions.
- Offer benchmarking to a broad population of buildings and then offer retrofits to a subset that shows the strongest opportunities. In this scenario, benchmarking can provide broad and shallow benefits (savings, information, management tools) while using retrofit resources cost-effectively for deeper impact. Uptake of retrofits after an audit might increase if prompted by the clear demonstration of need offered through benchmarking.

It is important to note that this pairing of benchmarking with deeper energy management services can be done by utility program, by government programs, and by private service providers. A few differences between the benefits of each strategy are listed below.

Benchmarking as part of a holistic, private service. In this model, a private, holistic service is offered by a third party to a portfolio of buildings. In a private service, flexibility may be offered to incorporating the whole portfolio of buildings across utility territories or even across the country. Additionally, an organization subscribing to a private service forms a long-term partnership with the third party. The long-term relationship is critical to utilizing benchmarking as part of the ongoing energy management cycle, throughout the life of the buildings.

Benchmarking as part of a holistic program. In the case where a utility or public agency offers a holistic program including benchmarking, available subsidies may encourage a broader range of organizations to participate, compared to a private service. In addition, some portion of the utility data may be easily accessed, if the program is run by or in partnership with a utility.

In either case, directly tackling the barriers, and employing the successful engagement strategies described in this report (e.g. benchmarking portfolios not building, engaging as a long-term partner, building a trusted relationship, using dedicated engagement staff) should enhance results over the long-term.

Benchmarking as a mandated building practice

Cities in Minnesota could consider adopting requirements for multifamily benchmarking as a tool to drive savings and inform city policy on energy or water efficiency. The results of this pilot suggest that this would be a feasible for owner-paid utilities only, given the current data practices in the state regarding authorization and disclosure of tenant utility data. Utilities in other cities with multifamily benchmarking requirements have implemented some form of sharing anonymous, aggregate tenant utility data with owners that does not require individual

tenant authorizations, something critical to collecting and submitting whole building data to the city possible. Some examples of utilities currently providing aggregate tenant utility data in cities with required benchmarking include ConEd in New York City, ComEd in Chicago, and Pepco in Washington, D.C. The Public Utilities Commission in Minnesota is currently reviewing this topic.

Would benchmarking mandates produce the types of benefits seen in this pilot? EnergyScoreCards Minnesota tested one service which goes significantly beyond simply collecting and submitting data to satisfy a mandate. Feedback from participants in the Process Evaluation and the experience of Account Managers suggest that a mandate would not produce the same results for all 'covered' buildings. Requiring benchmarking and disclosure, however, would introduce many new owners to the process of benchmarking, expand the market for benchmarking and energy management services providers, and potentially offer residents or prospective buyers transparency in utility costs.

Future research

Future research should seek to replicate a large scale experimental study of benchmarking to further expand the understanding of the impacts of benchmarking and hone in on the most cost-effective and impactful benchmarking approaches.

Since the field of large scale benchmarking research is still nascent, many possible, untried approaches remain. Some simple variations on EnergyScoreCards Minnesota could test the impacts of multifamily benchmarking by changing one or more aspects of the program design such as:

- Offering more than one benchmarking treatment, for instance:
  - Providing more robust set of software tools
  - Providing more or less Account Manager support alongside the software
  - Coupling the service with hands on engineering or technical services
  - Coupling the service with monetary incentives for upgrades
  - Providing a less robust and cheaper set of software and human support services, to find the minimal level needed to produce these benefits
- A three to five year study
- A larger study, both in terms of the number of buildings and the number of participating organizations
- A study which uses whole building data, including both owner and tenant accounts
- A study in different locations
- A study that included variability in incentive structures and levels and utility price environments

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Appendix A: Tools for EnergyScoreCards Minnesota

EnergyScoreCards Minnesota provided a number of supporting documents to assist participants in the benchmarking process. These tools were broken into worksheets, check lists and other informational guides on different subjects. The documents were available as PDF downloads at the [EnergyScoreCards Minnesota website](http://energyscorecardsmn.com/tools) (http://energyscorecardsmn.com/tools).

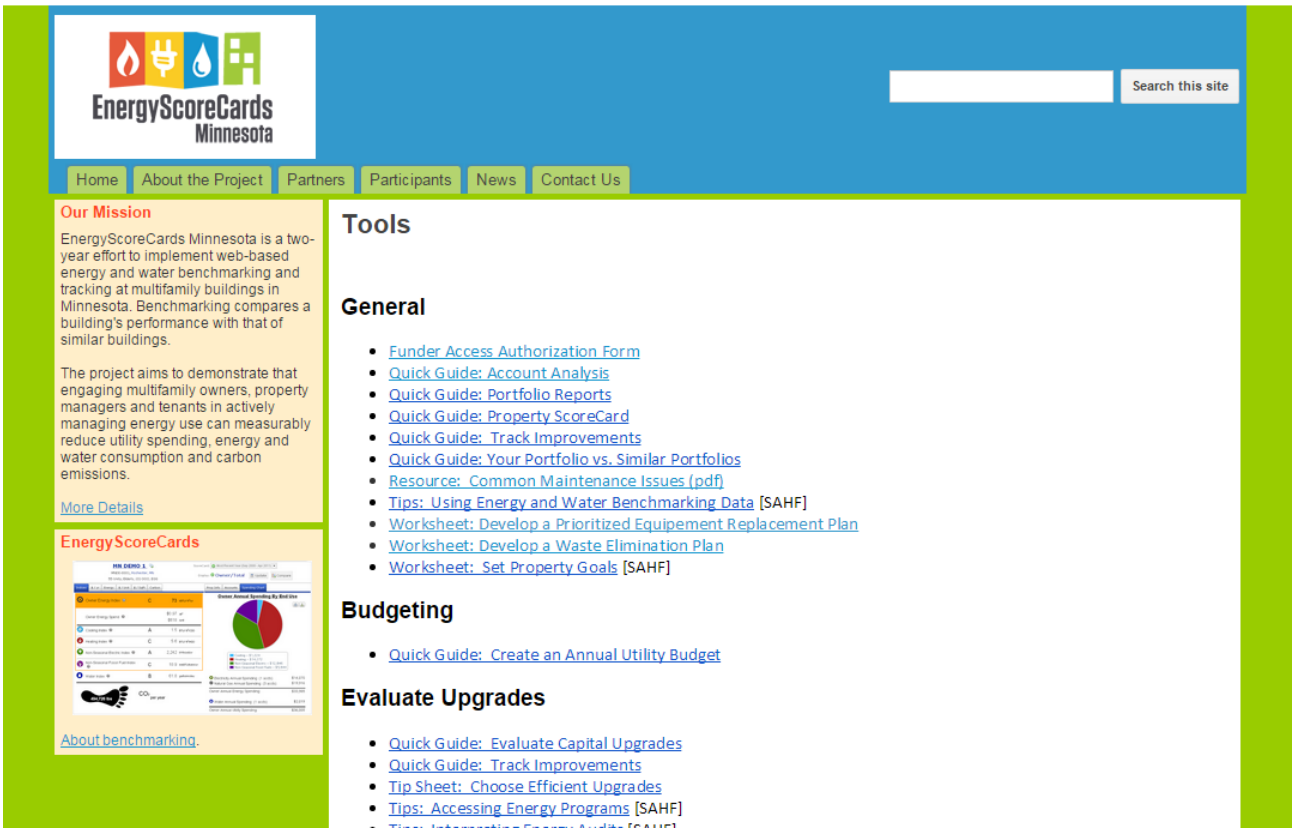
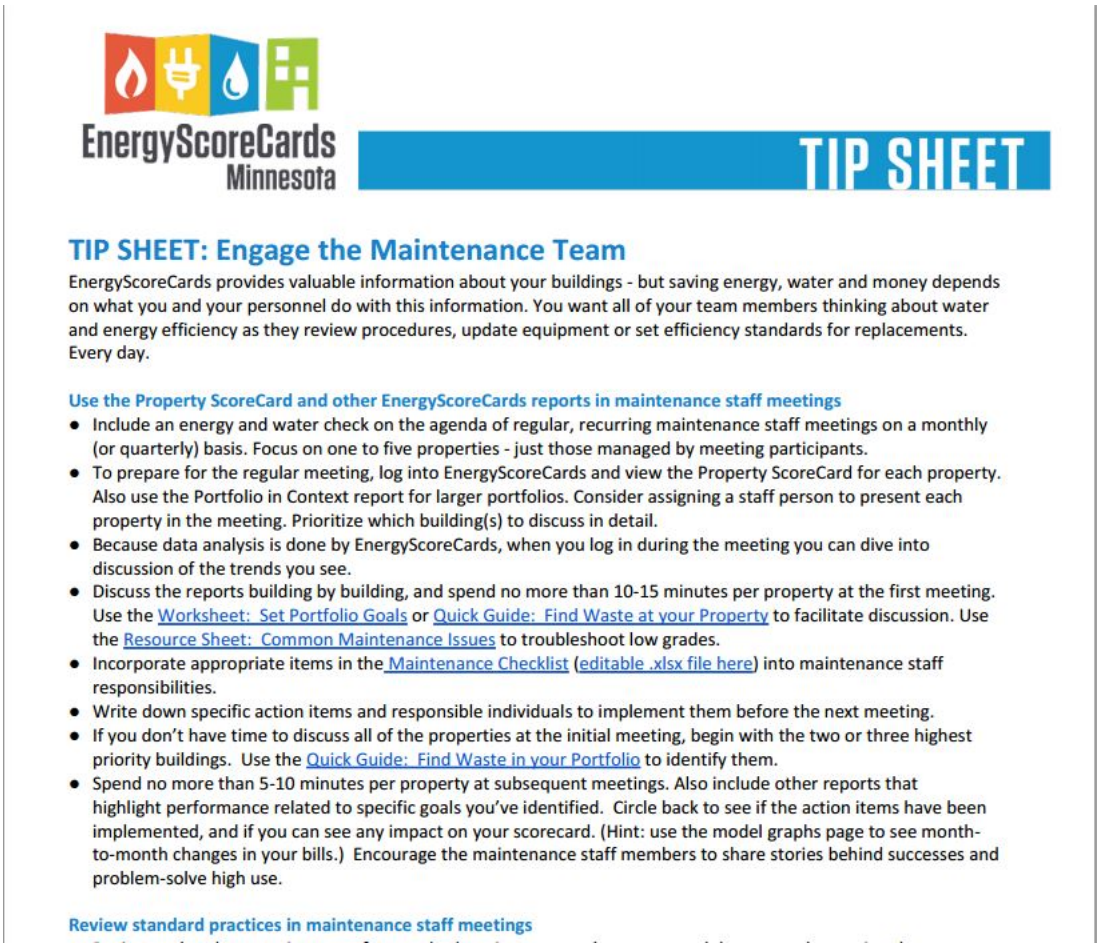


Figure 39: Main Tools Page



EnergyScoreCards Minnesota

TIP SHEET

TIP SHEET: Engage the Maintenance Team

EnergyScoreCards provides valuable information about your buildings - but saving energy, water and money depends on what you and your personnel do with this information. You want all of your team members thinking about water and energy efficiency as they review procedures, update equipment or set efficiency standards for replacements. Every day.

Use the Property ScoreCard and other EnergyScoreCards reports in maintenance staff meetings

- Include an energy and water check on the agenda of regular, recurring maintenance staff meetings on a monthly (or quarterly) basis. Focus on one to five properties - just those managed by meeting participants.
- To prepare for the regular meeting, log into EnergyScoreCards and view the Property ScoreCard for each property. Also use the Portfolio in Context report for larger portfolios. Consider assigning a staff person to present each property in the meeting. Prioritize which building(s) to discuss in detail.
- Because data analysis is done by EnergyScoreCards, when you log in during the meeting you can dive into discussion of the trends you see.
- Discuss the reports building by building, and spend no more than 10-15 minutes per property at the first meeting. Use the Worksheet: Set Portfolio Goals or Quick Guide: Find Waste at your Property to facilitate discussion. Use the Resource Sheet: Common Maintenance Issues to troubleshoot low grades.
- Incorporate appropriate items in the Maintenance Checklist (editable .xlsx file here) into maintenance staff responsibilities.
- Write down specific action items and responsible individuals to implement them before the next meeting.
- If you don't have time to discuss all of the properties at the initial meeting, begin with the two or three highest priority buildings. Use the Quick Guide: Find Waste in your Portfolio to identify them.
- Spend no more than 5-10 minutes per property at subsequent meetings. Also include other reports that highlight performance related to specific goals you've identified. Circle back to see if the action items have been implemented, and if you can see any impact on your scorecard. (Hint: use the model graphs page to see month-to-month changes in your bills.) Encourage the maintenance staff members to share stories behind successes and problem-solve high use.

Review standard practices in maintenance staff meetings

Figure 40: Sample Tip Sheet

Appendix B: Additional Analysis Using Benchmarking Data

The data set gathered through this pilot can be used for additional research and analysis. This section provides some samples of such analysis which may provide additional value for building owners or program managers but is beyond the scope of EnergyScoreCards Minnesota. Sample analyses are shown below which:

- Estimate the potential for energy savings based on the range of current building performance, shown below with one potential approach to estimating potential gas savings.
- Investigate the impact of specific building characteristics on building performance, shown below for building age and the presence of parking garages.

Natural Gas Savings Potential

An estimate of potential natural gas savings was calculated based on the finding in previous research that energy savings realized in retrofits increases in relation to the energy intensity of a building. A 2014 study, *Energy and Water Savings in Multifamily Retrofits* (Braman, Kolberg, and Perlman, 2014) derived a linear equation based on actual energy savings as compared to pre-retrofit natural gas use intensity for buildings that participated in the Energy Savers program administrated by Elevate Energy and Community Investment Corporation in the Chicago area:

$$y = 0.47x - 24.50$$

where:

x = the pre-retrofit natural gas use intensity and

y = post retrofit gas savings

As a broad approach to estimating savings potential, using results from a Chicago study seems reasonable because both the building types and improvements in the Energy Savers data set appear to be similar to the Minnesota building stock. The buildings in that study have centralized natural gas heating and hot water systems, similar to most buildings in the EnergyScoreCards Minnesota pilot.

The improvements implemented by the Energy Savers program focused primarily on heating, domestic hot water, and building envelope improvements (Braman, Kolberg, and Perlman, 2014, p.26). The most common heating equipment improvements were:

- Upgrade boiler controls (44%);
- install/upgrade boiler/furnace (40%);
- insulate pipes/ducts (23%); and

- repair/clean/tune boiler/furnace

The most common envelope improvements were:

- insulate roof/attic (37%);
- replace windows (26%); and
- air-seal roof/attic (25%).

The top two domestic hot water improvements were:

- insulate pipes/distribution system (19%); and
- install/upgrade water heater (19%).

Building systems improvements similar to these were identified by *The Minnesota Multifamily Rental Characterization Study* as strongly applicable in a high percentage of Minnesota buildings, notably, high efficiency boiler replacement; boiler controls; pipe insulation, and heating systems tune-up (Pigg, LeZaks, Koski, Bensch & Kihm, 2013).

To generate an estimate of gas savings potential for Minnesota buildings, the equation from the Chicago study was applied to buildings in the EnergyScoreCards Minnesota data set with a gas use intensity of 53 kBtu/sf/yr or greater. Table 7 shows the resulting potential gas savings by building type:

Building Type Number	Occupancy Type	Number of Buildings	Number of Units	Potential Gas Savings (kBTU/yr)*	Estimated Average Site Gas Savings kBTU/unit	Estimated Average Cost Savings/Unit
1	Family, Couples and Singles	173	6051	29309630	4844	$40
2	Elderly and Disabled	12	564	3747157	6644	$55
3	Family, Couples and Singles	31	2729	23539075	8626	$71
4	Elderly and Disabled	14	1241	9764768	7868	$66
5	Family, Couples and Singles					

*Cost and Energy Savings estimates calculated based on Energy Savers program outcomes (Braman, Kolberg, and Perlman, 2014), and an energy cost of $0.82/therm

Table 7: Potential Natural Gas Savings Estimates

Cost savings were calculated based on natural gas cost of $0.82/therm. Given the difference in climate between Chicago and Minnesota, the actual equation for potential savings would likely be different if derived from Minnesota buildings. For instance, in a colder climate one might expect a higher "action threshold" – the EUI above which savings are assumed (53 kBTU/sf/yr in this case), and deeper savings from the worst performing buildings given the colder climate

and higher gas use. Despite these potential differences, this is presented as a ballpark estimate of natural gas savings based on a set of energy efficiency measures in a similar cold climate.

Energy Impact of Garages

The data from the EnergyScoreCards Minnesota Pilot shows that multifamily buildings with parking garages use substantially more energy and have higher utility bills than similar buildings with the same occupancy type without garages. The energy loads for garages include electricity for lighting and ventilation and natural gas for heating and snowmelt systems. Data for 204 properties[14] was used to explore the impact of garages on utility use and cost.

Electric Use in Underground Garages

Common space electric baseload (kWh/unit/yr) use is on average 80% higher in buildings with garages than those without, based on data collected in EnergyScoreCards. Figure 41 shows buildings with garages in yellow (53 buildings) and those without garages in blue (151 buildings). It includes only electric baseload use[15], which excludes use associated with heating or cooling. The blue line shows the electric use trend for buildings with no garage, the red line shows the trend for buildings with a garage.

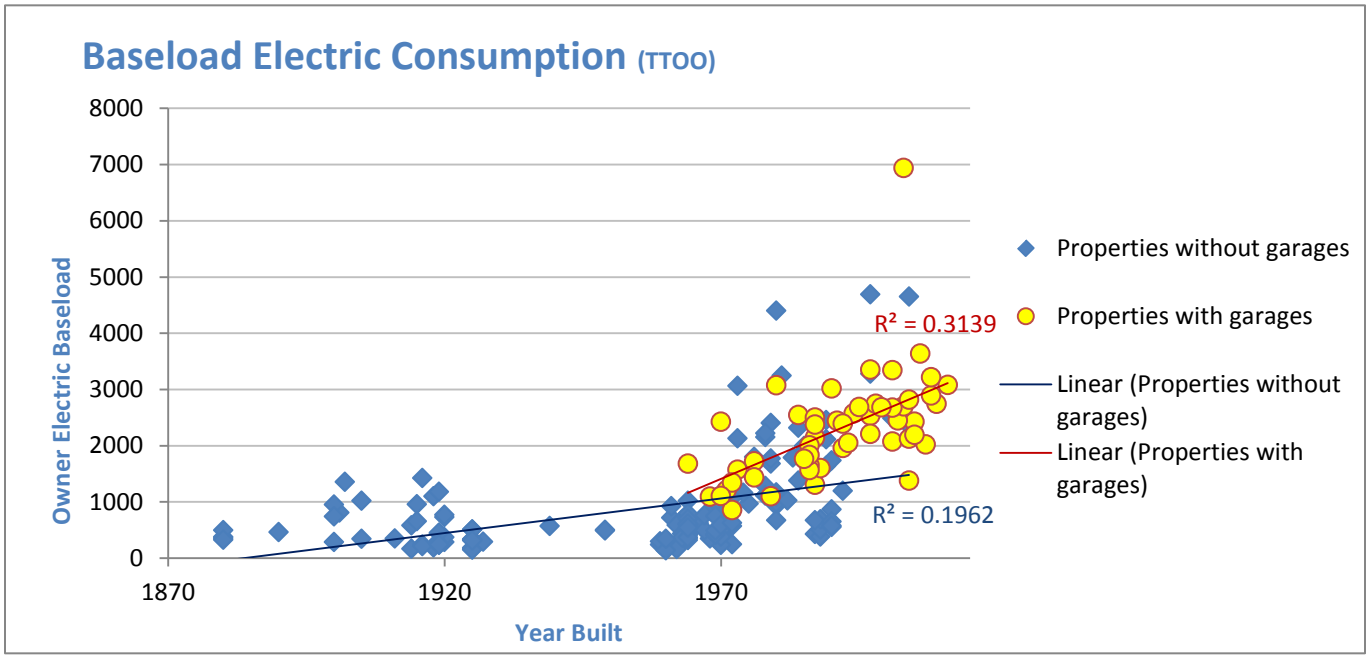


Figure 41: Electric Baseload Consumption, Buildings with and without a Garage

[14] To ensure meaningful analysis, the data set is limited to properties where tenants pay in-unit electricity and cooling and the owner pays common space electricity and all heating.

[15] Electric baseload use only includes lighting and ventilation not associated with heating or cooling.

The data shows that the average annual baseload electric cost per unit is $85 higher (80%) in buildings with garages than in those without garages ($207/unit compared with $123/unit). For the average size building with a garage in the EnergyScoreCards Minnesota pilot (70 units), that represents an additional building-wide expense of $5,937 per year. Based on the incremental baseload electric spending in the 52 buildings with garages, this cost amounts to an additional $379,677/year for garage lighting and ventilation. This analysis excludes the additional cost of garage heating and snowmelt systems.

Limiting the above analysis to properties built after 1964 (the construction year of the oldest buildings with garages in this dataset) there is a smaller 54% increase in baseload electric consumption associated with garages, a cost difference of $66 (47%) between the buildings without garages ($141, n=92) and those with garages ($207, n=53).

Natural Gas Use in Garages

Based on 93 buildings[16] of single/couple and family occupancy[17] built after 1964 in EnergyScoreCards where owners pay for all heat (including Building Types 1 and 3), garage-related heat (tempering and snowmelt systems) increases heating energy use by an additional 5% per unit.

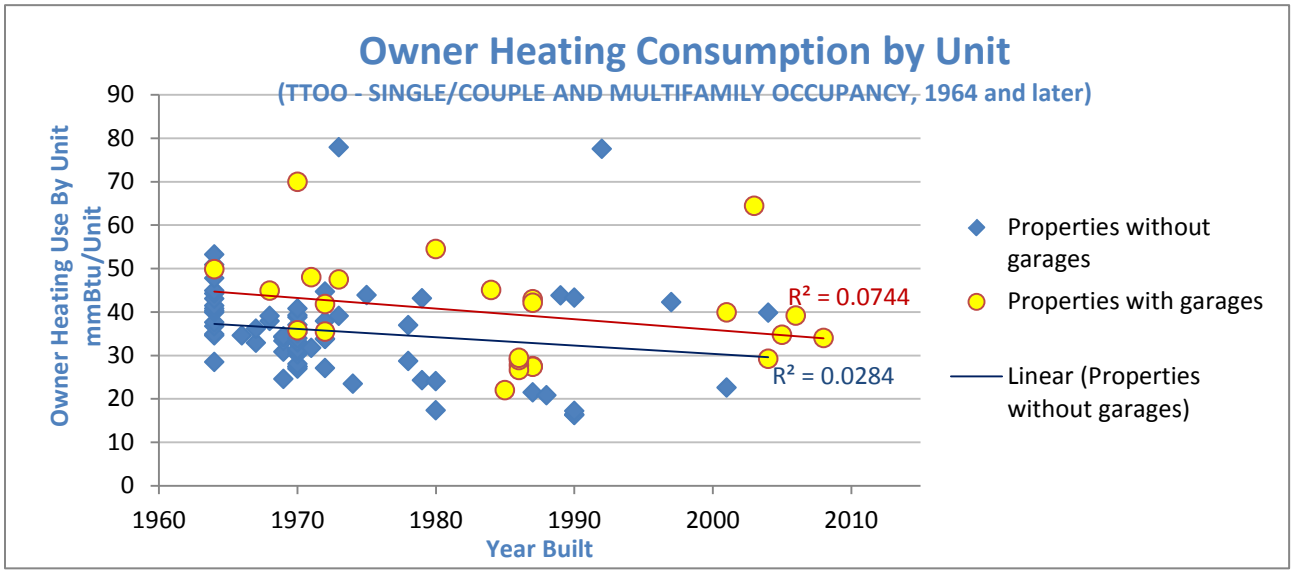


Figure 42: Owner Paid Heating, buildings constructed after 1964

Buildings with garages are larger (with median sizes of 72 units per building versus 36 units per building). On average these properties with garages use 37.1 mmBtu per unit compared to 35.3 mmBtu per unit for those without. The trend lines in this graph show that though there is

[16] For statistical reasons this analysis is limited to single/couple/family occupancy. Since the oldest properties with garages in the data set were constructed in 1964, the non-garage properties are selected from this age range. Properties here are pro-rated by their size, in number of units to evaluate average unit use and cost.

[17] The senior properties are over-represented in the garage properties after 1990, and over-represented in the properties without garages built between 1960 and 1990.

variation, this difference is consistent over the building representing a span forty years for construction dates.

Across the 93 buildings and 5,400 units, buildings without garages actually spent slightly more per unit compared to those without garages, $290 and $274 respectively in the most recent year of data, ending in late 2014. Three possibilities were identified for this small cost difference and the increased cost to non-garage properties. First, while smaller buildings use less energy overall, heating is less efficient per unit, because there is more envelope surface to lose heat per unit than in larger buildings. Second, smaller size buildings without garages spend a greater portion of their total energy cost in fixed fees. Finally, the cost difference may be due to different pricing in different utility service territories and geographies. Today's small cost difference may not be consistent over the life of these properties, as natural gas pricing is more volatile than any other utilities. For example, commercial gas pricing was 50% higher at the peak in 2008 than it is today (U.S. Energy Information Administration, 2015).

Impact of Building Age on Energy Use

Owner paid energy consumption varies significantly for every age of building, showing opportunities may exist for properties regardless of when the property was built. Two groups of building were examined: buildings in which the owner pays all utilities and buildings in which the owner pays only heating and hot water. The overall trend is similar, statistically newer buildings tend to have lower energy usage. Note that while the graph of properties where the owner pays all utilities (Figure 43) shows a total building energy use intensity, this is not true for the second group (Figure 44). The owner energy index for properties where owner pays for common area electric, whole building heating, and whole building hot water excludes tenant paid in-unit electricity.

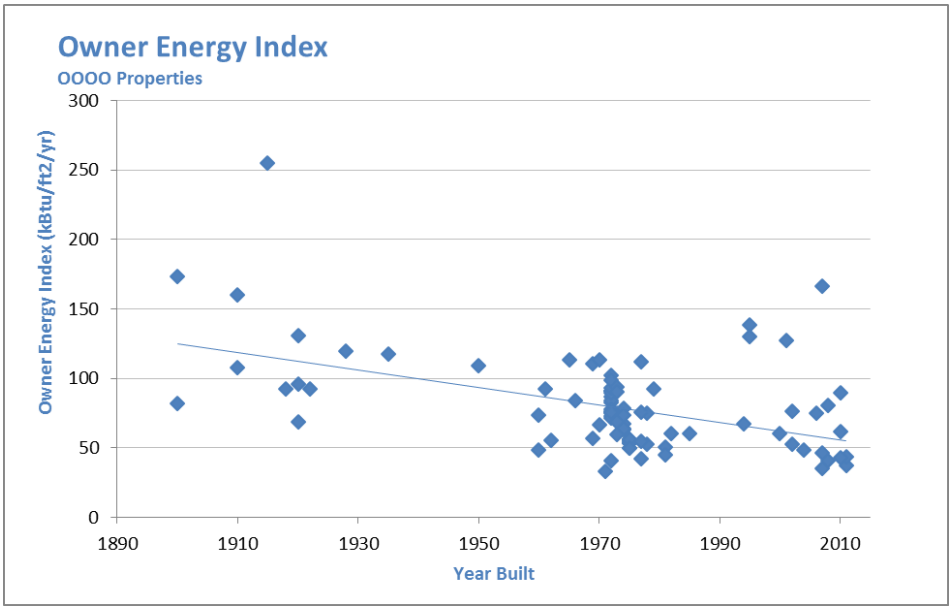


Figure 43: Owner Energy Index vs Year Built for properties where owner pays all utilities

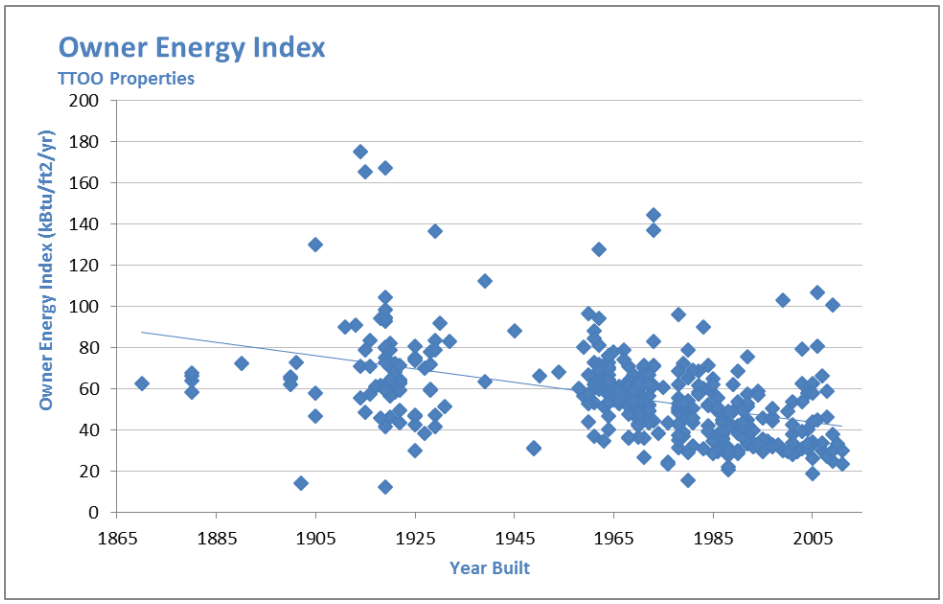


Figure 44: Owner Energy Index vs Year Built for properties where owner pays heating and hot water.

Further breakdown by energy load for properties where the owner pays all utilities (Figure 45) shows that while the overall trend shows a decrease in energy use in newer buildings, the heating load decreases and the electric use actually increases over time (Figure 46).

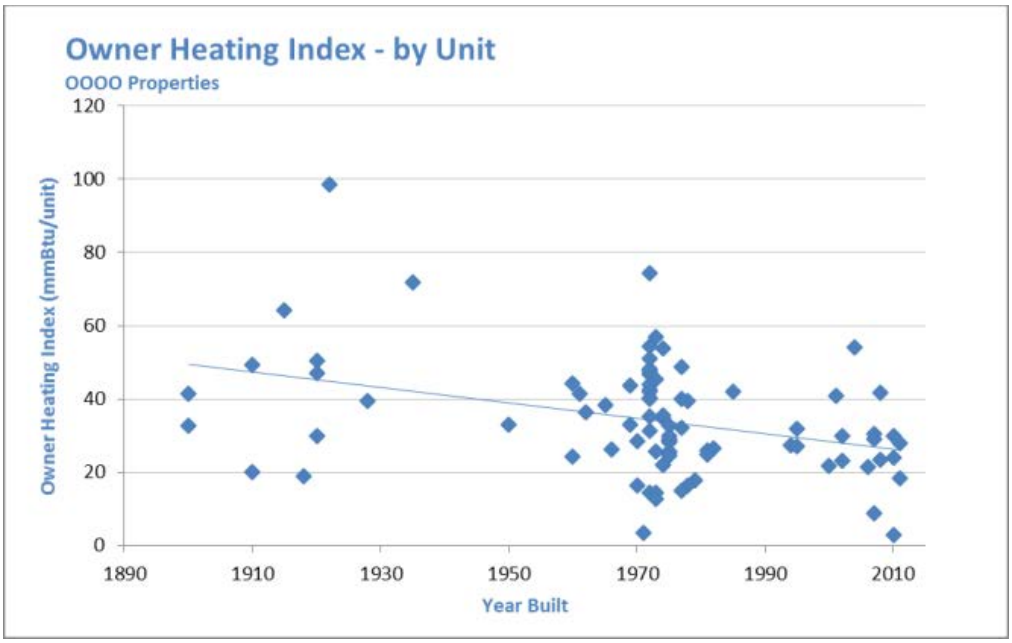


Figure 45: Owner Heating Index – by Unit vs Year Built for properties where owner pays all utilities.

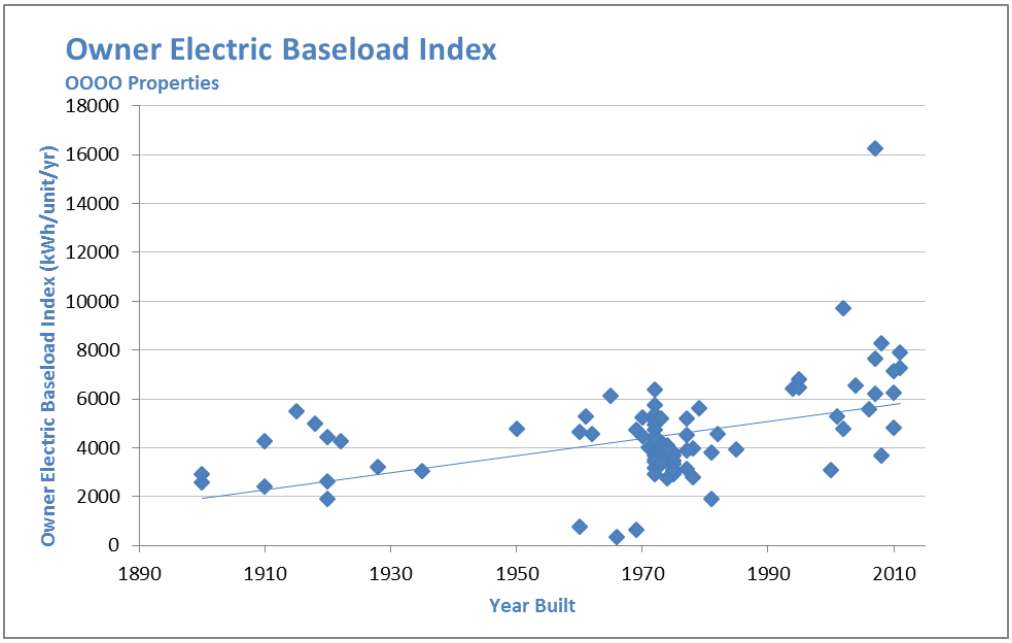


Figure 46: Electric Baseload Index vs Year Built for properties where owner pays all utilities.