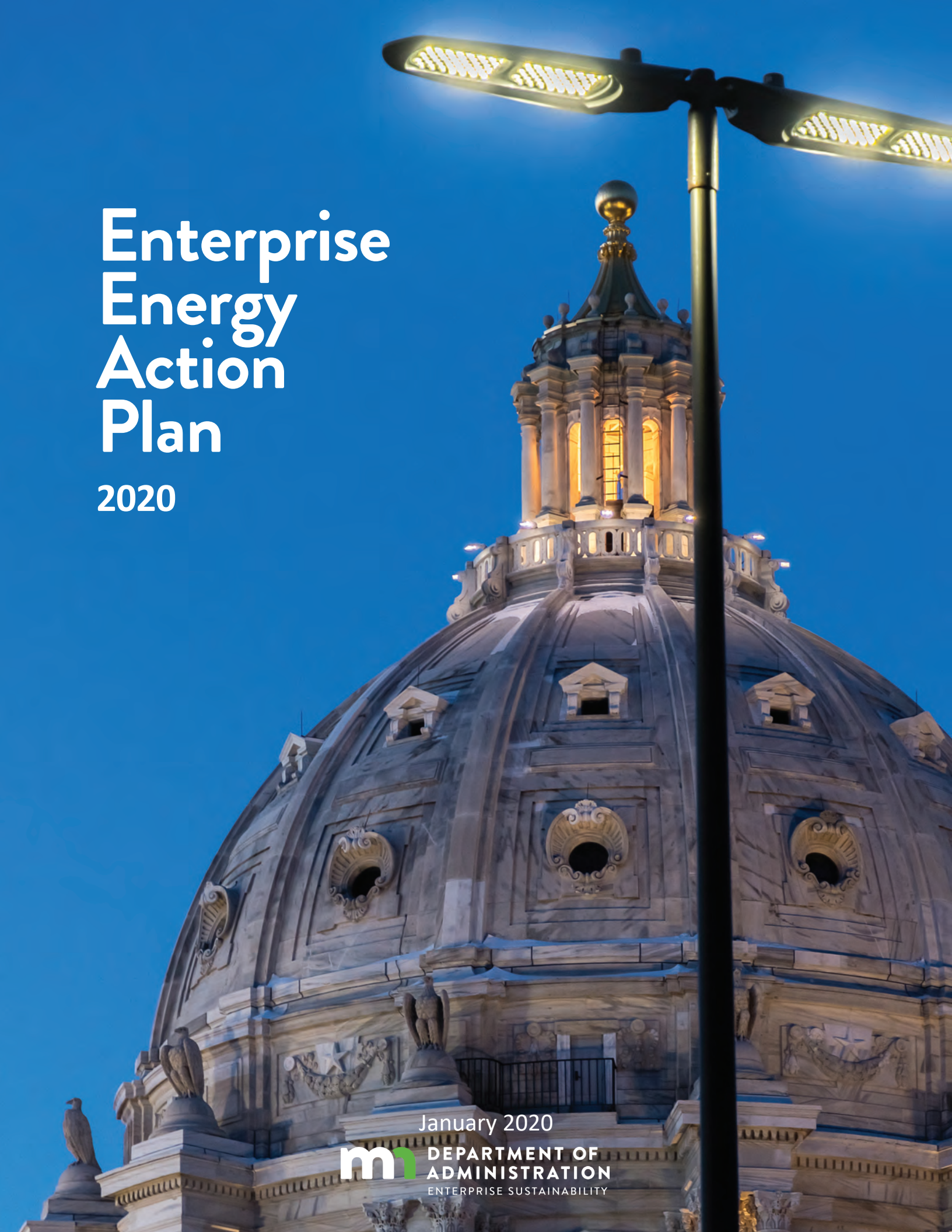


Enterprise Energy Action Plan

2020

January 2020

DEPARTMENT OF ADMINISTRATION
ENTERPRISE SUSTAINABILITY

Executive Summary

The 2027 Energy Action Plan addresses reducing the energy intensity of over 3,000 owned and leased buildings occupied in operation of state government. This plan is a companion to five other enterprise action plans currently in development. The plans ensure a coordinated pathway to achieving the enterprise sustainability goals.

Key learnings from this plan were presented to the Sustainability Steering Team on February 6, 2020. This plan is intended as a resource for agency staff and leaders. The enterprise sustainability energy, water, and greenhouse gas (EWG) workgroup will continue to develop this plan to meet the needs of state agencies and the enterprise goal of reducing energy use intensity.

Executive order 19-27, April 2019 (replacing 17-12 and 18-01), directed state agencies to reduce energy use by 30% per square foot by 2027. As of the end of calendar year 2017, state agencies have reduced energy use per square foot by 10% achieving 35% progress toward the goal.

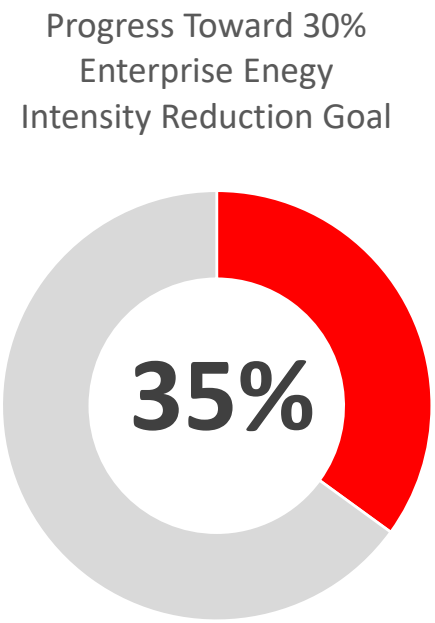
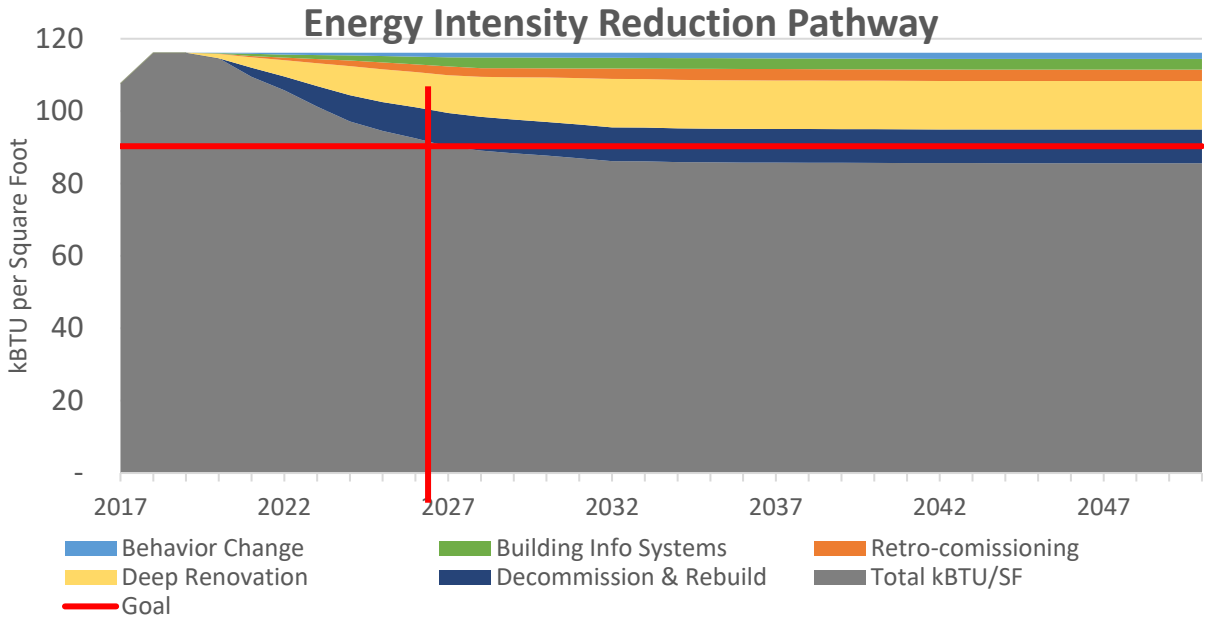


Figure 1. Progress Toward Goal

Implementation

Demonstrated in this plan, is a coordinated pathway—the *Energy Intensity Reduction Pathway*—for achieving a 30% energy intensity reduction by 2027. This pathway consists of implementing behavior change programs, better metering through building information systems, retro-commissioning buildings, completing deep energy retrofits of building envelopes and systems, and decommissioning space and replacing it with space built to SB2030 standards.



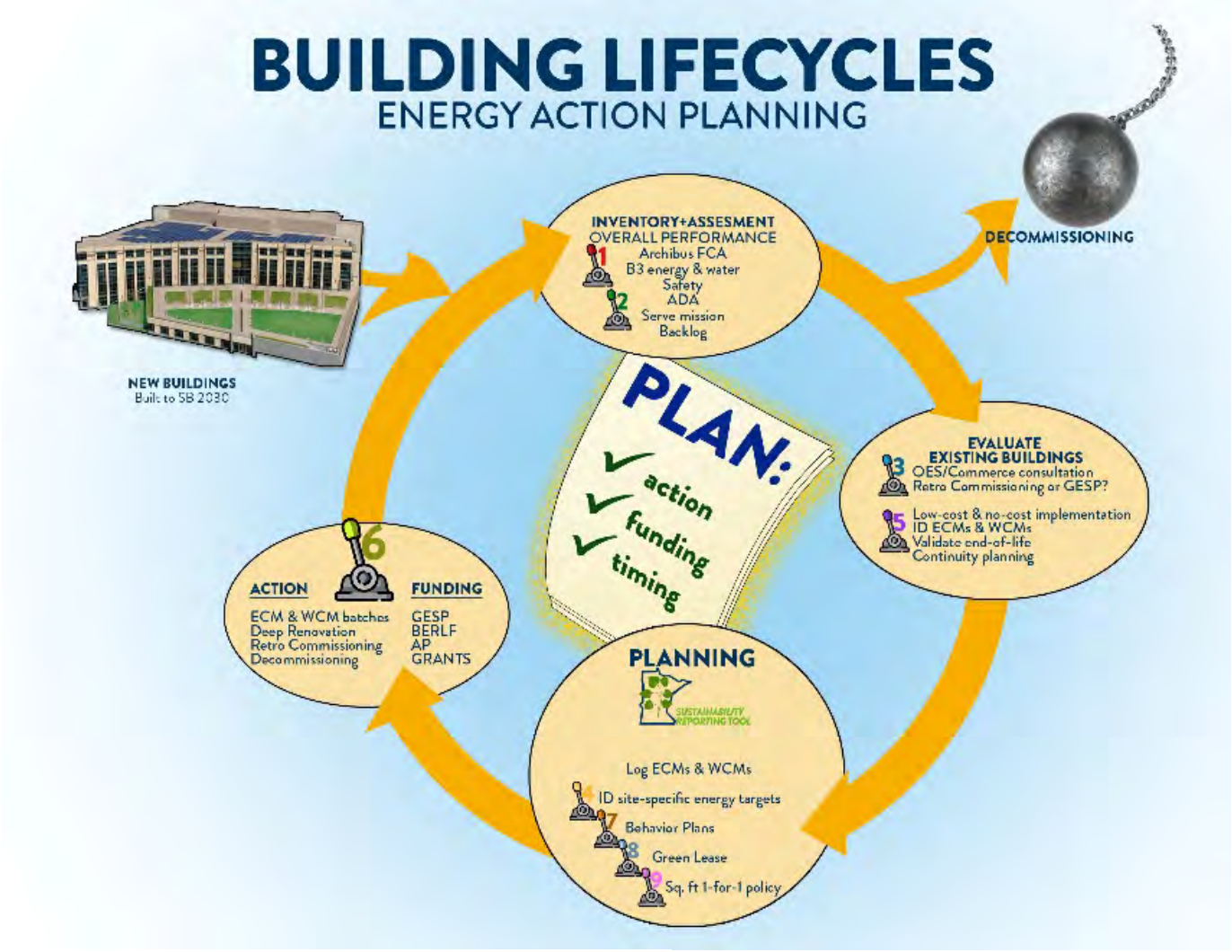


Figure 14. Building Lifecycles: Energy Action Planning

Levers – Moving Agencies Toward the Goal

Each agency will pursue levers identified in their agency sustainability action plan. There are 10 levers identified in this plan from which they may choose or they may identify additional levers. Figure 14 can be used to understand how each of these levers fits within the lifecycle of managing owned buildings. Figure 15 (section 5) can show how agencies with leased buildings could apply these levers. The ten levers described in this plan follow.

1. Track Energy Use in B3 Benchmarking
2. Identify Buildings not Meeting B3 Benchmark
3. Identify Projects for GESP
4. Set Site-Specific Energy Reduction Targets
5. Perform Energy Audits
6. Implement Best Management Practices
7. Create Behavior Programs to Conserve Energy
8. Use Green Lease Clauses to Improve Buildings
9. Decommissioning Square Footage and Replace 1 to 1
10. Plug-load audits

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1. Enterprise Energy Sustainability

Enterprise Sustainability Energy Goal

30% reduction in consumption of Energy per square foot by 2027 relative to a 2017 adjusted baseline.

Source: Executive Order 19-27

Figure 1. Progress Toward 30% Enterprise Energy Intensity Reduction Goal

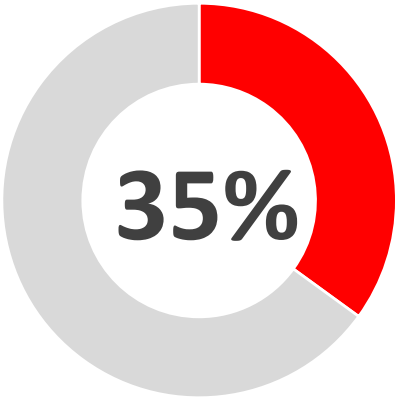


Table 1. Enterprise Energy Use Per Square Foot (kBtu/SqFt)

Agency Name	Baseline kBTU/SF	Baseline year	2018 KBTU/SF	Target	Percent Reduction Achieved	Percent Progress Toward Target
Enterprise	129	Adjusted	116	90	10%	35%

The enterprise baseline for energy intensity is 129 kBtu per square foot annually. For comparison, one might think of 129 kBtu as the same amount of energy in 1.13 gallons of gasoline per square foot. From 2005-2018 agencies took measures to reduce their energy use by 10%, achieving a 116 kBtu per square foot in 2018. The goal of 30% reduction in energy intensity will be achieved when the enteprise reaches 90 kBtu per square foot. The data used throughout this report is from the 2018 Enterprise Sustainability Annual Report. Data collection involves the 24 cabinet level agencies of the Executive Branch, reporting on owned spaces under custodial control and lease spaces over 5,000 SqFt.

1.1. Purpose & Background

In continuing with the State of Minnesota's long tradition of leadership in environmental stewardship and good governance, this plan supports the pursuit of a sustainability goal for energy use intensity. The Sustainability Steering Team defines sustainability for the enterprise.

Sustainability Defined

The State of Minnesota, as an enterprise, defines sustainability as meeting the economic, social and environmental needs of the present without compromising the ability of future generations to meet the same needs.

Source: Sustainability Steering Team

The primary policy driver of this plan is Executive Order 19-27 (EO 19-27), signed by Governor Tim Walz on April 4, 2019 (replacing executive order 17-12 and 18-01). Executive Order 19-27 directs agencies to pursue a "30% reduction in consumption of energy per square foot by 2027 relative to a 2017 adjusted baseline."

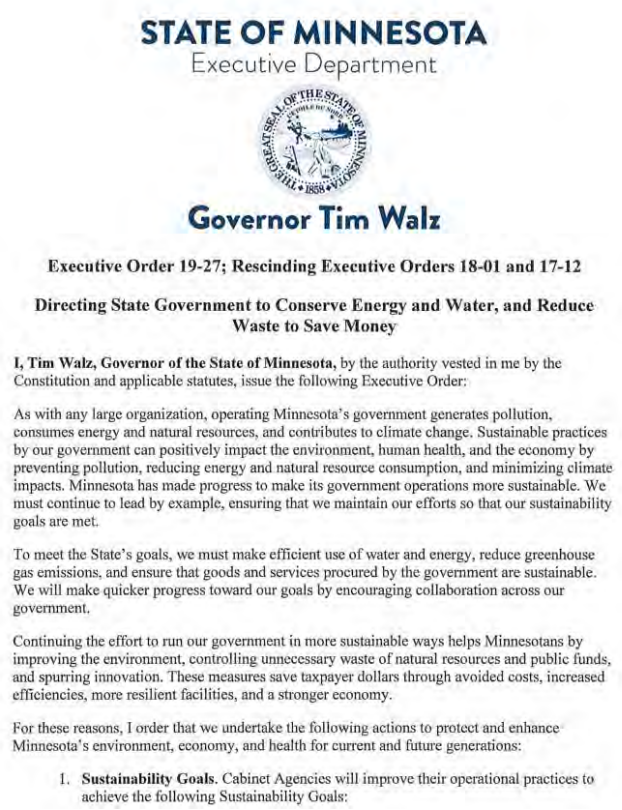
This plan relies on calendar year 2018 data, consistent with the 2018 Sustainability Annual Report and is the best available at the time of its authorship.

The Energy, Water, and Greenhouse Gas (EWG) workgroup supported the development of this plan. The EWG Workgroup has defined a vision for energy in the enterprise.

Energy Vision Statement

The State of Minnesota as an enterprise, will achieve the carbon and energy standards set forth by Sustainable Buildings 2030. Improvements will create productive, accessible, and resilient workplaces.

Source: Energy, Water, GHG Workgroup



STATE OF MINNESOTA
Executive Department

Governor Tim Walz

Executive Order 19-27; Rescinding Executive Orders 18-01 and 17-12

Directing State Government to Conserve Energy and Water, and Reduce Waste to Save Money

I, Tim Walz, Governor of the State of Minnesota, by the authority vested in me by the Constitution and applicable statutes, issue the following Executive Order:

As with any large organization, operating Minnesota's government generates pollution, consumes energy and natural resources, and contributes to climate change. Sustainable practices by our government can positively impact the environment, human health, and the economy by preventing pollution, reducing energy and natural resource consumption, and minimizing climate impacts. Minnesota has made progress to make its government operations more sustainable. We must continue to lead by example, ensuring that we maintain our efforts so that our sustainability goals are met.

To meet the State's goals, we must make efficient use of water and energy, reduce greenhouse gas emissions, and ensure that goods and services procured by the government are sustainable. We will make quicker progress toward our goals by encouraging collaboration across our government.

Continuing the effort to run our government in more sustainable ways helps Minnesotans by improving the environment, controlling unnecessary waste of natural resources and public funds, and spurring innovation. These measures save taxpayer dollars through avoided costs, increased efficiencies, more resilient facilities, and a stronger economy.

For these reasons, I order that we undertake the following actions to protect and enhance Minnesota's environment, economy, and health for current and future generations:

1. **Sustainability Goals.** Cabinet Agencies will improve their operational practices to achieve the following Sustainability Goals:

Figure 2. Executive Order 19-27, signed on April 4, 2019

1.2. Plan Scope

Energy intensity reduction is framed among sustainability goals in five other focus areas: fleet, solid waste, greenhouse gases (GHG), sustainable procurement, and water. Each agency annually updates a plan addressing the six focus areas identified in Executive Order 19-27.

This action plan addresses energy conservation and energy efficiency. These are two of five broad categories related to reducing the enterprise GHG emissions. The remaining three are discussed in the enterprise GHG and fleet plans, including switching from delivered fossil fuels to electricity, using low carbon fuels, and reducing non-combustion emissions.

Conservation
Conservation is reducing the amount of energy used by reducing the amount of service used. A simple example is turning off lights.

Efficiency
Efficiency is reducing the amount of energy used by reducing energy used for the same amount of service. An example is installing lighting systems that providing the same intensity and hours of light with less energy.

Figure 3. Deep Decarbonization

Conservation and Efficiency Measures
Efficiency and conservation may be done through a number of strategies.

- ***Behavior Programs –*** Programs designed to reduce energy use by building occupants.
- ***Building Retro-commissioning –*** A process that seeks to improve how building equipment and systems function together. Retro-commissioning improves a building's operations and maintenance procedures to enhance overall building performance.
- ***Sub-Metering*** – Installing utility meters for individual buildings and consumers. Access to consumption data enables behavior and retro-commissioning programs.
- ***Deep Renovations –*** Remodels of a building to include changes to the envelope or mechanical equipment to reduce energy use and improve the building conditions.
- ***Decommissioning–*** Decommissioning buildings, and building any new spaces designed to perform to the SB2030 standards, and leaving leases in poor performing spaces.

1.3. Planning Process

This plan originates from work done by the Office of Enterprise Sustainability, and the EWG Workgroup, and sub-teams. The workgroup is comprised of staff appointees from the 24 cabinet-level agencies of the State. The Office of Enterprise Sustainability drafted the plan, with key concepts and input from the EWG workgroup leadership including departments of Commerce, Natural Resources, and Pollution Control.

A plan overview was presented to the SST on December 17, 2018. Input from the SST was incorporated and the plan was circulated to agencies through the EWG workgroup and Sustainability Coordinators Roundtable for review and comment on March 29, 2019. Comments were addressed, and the Office of Enterprise Sustainability presented the plan to the SST in July of 2019 and February of 2020.

Table 2. Energy Use Per Square Foot (kBtu/SqFt)
Enterprise and Agencies

Agency Name	Baseline kBtu/SF	Baseline year	2017 KBTU/SF	2018 kBtu/SF	Target	Percent Reduction Achieved	Percent Progress Toward Target
Transportation	64	2008	45	49	45	23	78
Administration	54	2008	40	42	38	22	72
Military Affairs	82	2014	63	68	57	17	58
Veterans Affairs	177	2013	162	149	124	16	53
Met Council	1.36 bill kBtu	2006	1.0 bill kBtu	1.17 bill kBtu	953 mill kBtu	14	46
Natural Resources	38	2010	33	34	27	12	42
Labor & Industry	66	2017	66	62	46	6	22
Corrections	120	2010	113	119	84	1	4
Mediation Services	66	2017	66	66	46	0	0
Employment.	45	2017	45	46	32	-2	-6
Minnesota Housing	93	2016	64	95	65	-2	-7
Commerce	72	2017	72	74	50	-3	-10
Education	81	2017	81	83	56	-4	-12
Pollution Control	85	2017	86	89	60	-4	-15
Iron Range.	103	2017	56	108	72	-5	-17
MN.IT	256	2017	256	273	179	-6	-22
Public Safety	116	2017	116	125	82	-7	-24
Human Rights	60	2017	60	65	42	-8	-28
Higher Education	41	2017	41	45	29	-10	-33
MGMT & Budget	30	2017	30	32	21	-10	-33
Agriculture	208	2017	208	231	146	-11	-36
Revenue	60	2017	61	68	42	-12	-40
Health	133	2017	108	149	93	-12	-41
Human Services	101	2017	99	116	71	-15	-50
Enterprise	129.6	Adjusted	108	116	90	10	35

1.3.1. Energy Adjusted Baselines

The 30% energy intensity reduction goal is based on an adjusted 2017 energy intensity. Consumption data from 2017 was gathered for each agency. Each agency had the opportunity to adjust their baseline year by demonstrating sustained reductions in energy intensity from implemented energy conservation and efficiency measures. Several agencies created adjusted baselines, indicated in Table 3 by their baseline year. The agency baselines were aggregated to the enterprise level to produce an enterprise adjusted 2017 baseline. Table 3 shows each agency, their baseline energy intensity, for which year they are documenting their baseline, and their 2017 and 2018 energy intensity. Due to data availability the Metropolitan Council is reported in kBtu rather than kBtu per square foot.

1.3.2. Energy Goal, Levers, and Vision Statement

The Sustainability a (SST) sets the vision for socially, economically, and environmentally sustainable operations in State government. The SST is responsible for setting direction, developing priorities, and removing barriers where feasible relating to all aspects of enterprise sustainability.

On July 20, 2017 the SST approved the energy goal developed by the EWG workgroup. The workgroup developed levers over the course of meetings in 2017. The vision statement was developed by the workgroup and approved by the SST on February 15, 2018.

Levers represent strategies agencies may pursue to meet energy intensity reduction targets at their agency. Agencies will identify the levers they are pursuing, either those listed in this plan, or those they self-identify in their agency sustainability plan. In agency sustainability plans, lever selection is annually validated by the Office of Enterprise Sustainability as a viable collection of strategies to achieve a 30% reduction in energy intensity.

1.3.3. The Sustainability Reporting Tool

The Sustainability Reporting Tool (SRT) is a data collection and dash-boarding tool currently in the final stages of development. It will take in information from the energy database of record, B3. The SRT will compute the GHG emissions from energy consumption, and display key performance indicators.

Figure 4. Logo for the Sustainability Reporting Tool

1.3.4. SRT Planning Function

The SRT has a planning module custom designed to the enterprise sustainability program. Agencies will use the planning function to create plans per focus area. Agencies will select their suite of levers, input expected reductions and dollar savings, and track progress toward completed levers. Agencies will be able to define customizable action items beyond the established levers. Agency users will be able to attach documents and other supporting material per lever. OES will review and approve plans, return on investment calculations, and assumptions.

1.3.5. Plan Review and Update Cycle

The plan will be reviewed and updated annually. In September, OES will present the existing plan and begin a review process with the workgroup. Following-up on discussion and additional research, OES will distribute a draft revised plan to the workgroup in November for review and input. In December, OES will present the workgroup with a revised plan draft based on their input. After receiving the workgroup's approval, OES will present the revised plan to the SST.

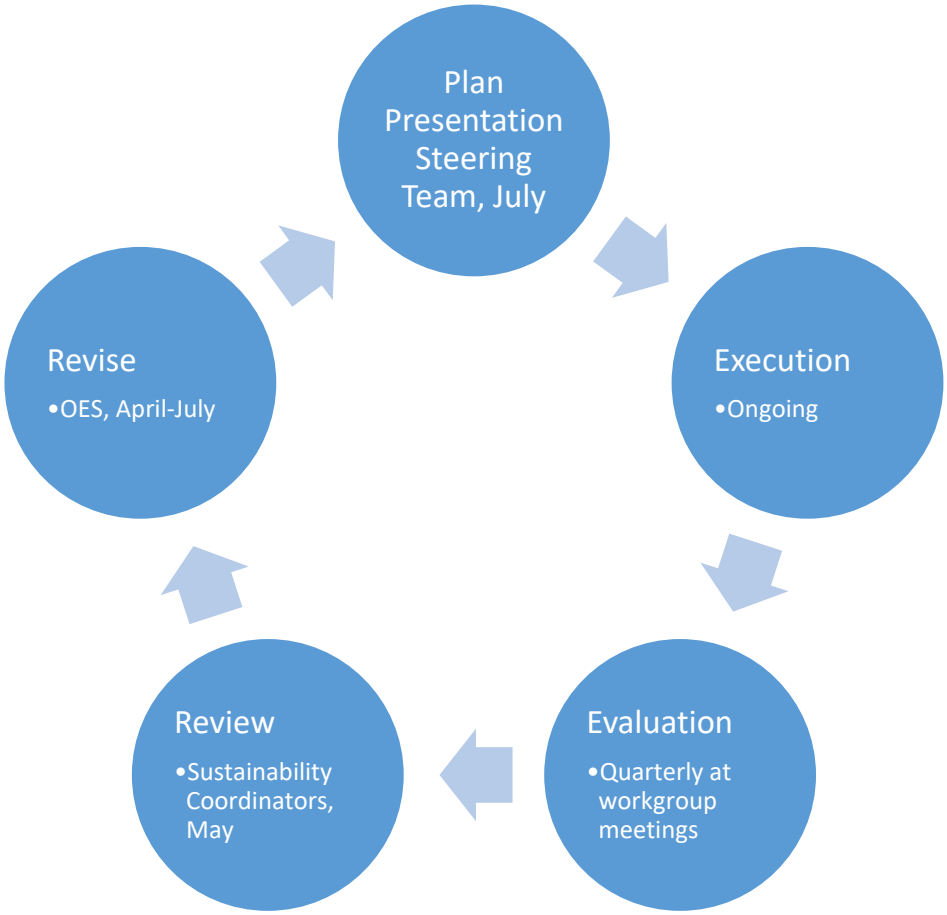


Figure 5. Plan Review and Update Cycle

2. Enterprise Energy Use

Table 3. Energy Use by Facility

	Percent of Total kBTU	Percent of Total SqFt	kBTU/SqFt	Number of Meters	Average Original Occupancy
Campus	25	24	119	193	1957
33,500 to 442,000 SqFt	28	45	73	560	1983
16,500 to 33,500 SqFt	4	10	52	391	1978
9,500 to 16,500 SqFt	3	6	54	347	1978
5,000 to 9,500 SqFt	2	3	72	323	1984
Up to 5,000 SqFt	3	6	59	1,418	1987
Equipment, Process, & Met Council	35	7	-	405	1992
Total	3,866,596,822	33,294,754	116	3,637	1988

2.1. Energy Use

The enterprise building stock varies greately based on size, age, and use. Table 3 describes energy use by facility across the enteprise in 2018. Figure 4 describes energy sources by facility across the enterprise in 2017 (at the time of publication this data was not yet available for 2018).

- The enterprise consumed 3.8 billion kBtu in 2018, up from 3.4 billion kBtu in 2017. Of the energy we consumed 46% was natural gas and 45% was electricity. Energy use is not weather normalized.
- "Campus" is a group of buildings operating on one set of energy meters, or for example one meter for natural gas and one meter for electricity. Identified in table 2 are 193 meters representing over 300 buildings located on campuses. Reducing energy intensity on these campuses is difficult without the ability to understand energy use at the building level. These campuses are the most energy intensive in the enterprise at 119 kBtu per square foot. They operate nearly exclusively on electricy (32%) and natural gas (68%). These campuses also have the oldest original occupancy date, and some have historic significance which can make them more challenging to improve.
- Table 3 shows buildings broken down by square foot.
    - Energy intensity generally increases with building size. However, buildings 5,000-9,500 sq ft in size have a disproportionately high energy intensity.
    - The largest number of buildings is below 5,000 square feet.
    - The energy source by building size varies. For example, buildings up to 5,000 sq ft have the highest percentage of propane use at 22%. While 13% of the energy source for the largest buildings is District Energy, St. Paul.
- "Equipment, Process, & Met Council" includes energy meters that serve equipment, serve Metropolitan Council's buildings, and serve the Met Council's Waste Water Treatment operations. Specifically, waste water treatment accounts for 25% of the enterprise energy use.

2.2. 2017 vs 2018 Intensity

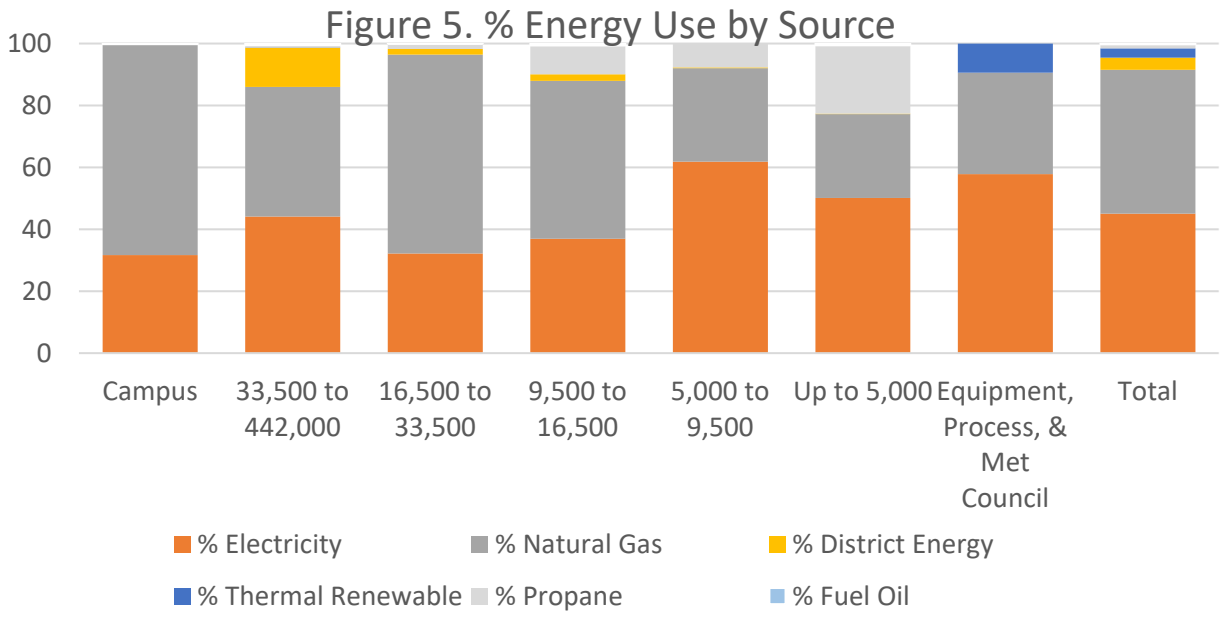
Energy use increased across the building stock in calendar year 2018 compared to 2017. A substantial portion of this increase can be explained by the fact that calendar 2018 was both a relatively warmer and colder year. In 2018, Minnesota saw 398 more heating degree days and 170 more cooling degree days than the norm. In 2017, Minnesota saw 585 less heating degree days and 442 less cooling degree days than the norm.[1] Heating degree day and cooling degree day are measurement to quantify the demand for heating and cooling.

While energy use is not a linear function of temperature, these divergent historical weather conditions help explain in part increases in heating fuel consumption. For example, natural gas consumption increased by 10% and propane use increased by 12%.

2.3. Documented Savings

In aggregate, agencies have documented a 10% reduction in energy intensity across the enterprise. This 10% reduction in energy intensity has translates to avoided costs. In 2017 and 2018 annual avoided costs due to energy conservation measures were $7.6 million and $9.2 million respectively.

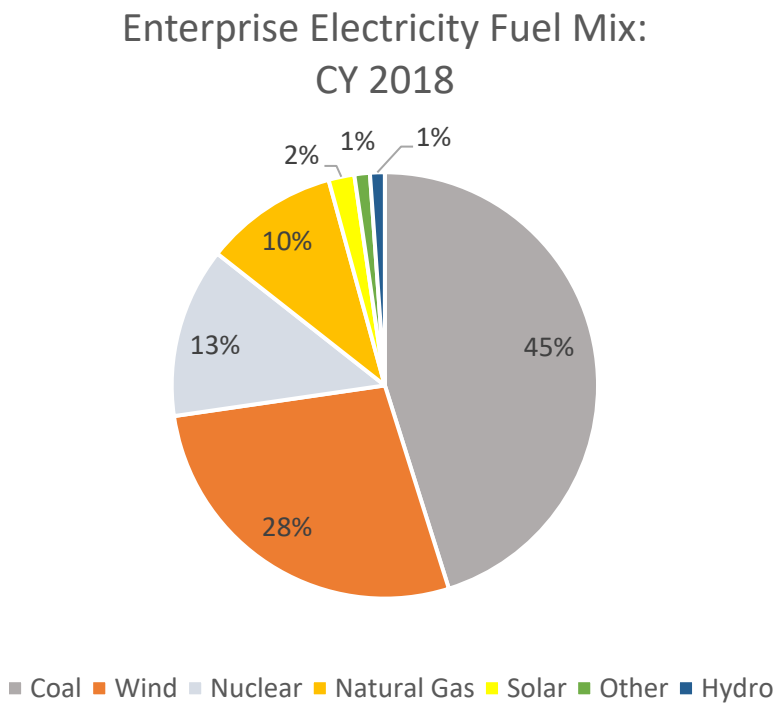
2.4. Energy Source



[1] 2019. Create a Minnesota Heating/Cooling Degree Day Table. MN DNR. Accessed online at https://www.dnr.state.mn.us/climate/historical/energy.html on June 28, 2019.

The enterprise's primary sources of energy are electricity and natural gas, 45 and 46% of energy use respectively. The next largest source of energy is from District Energy, providing heating and cooling to the Capitol Complex and other Downtown Saint Paul buildings. District energy provides 4% of the enterprise's energy use. Renewable thermal energy largely from the combustion of biosolids in waste water treatment provides 3% of the energy used by the enterprise, propane provides 1% and fuel oil provides less than 1%.

Figure 6 shows the enterprise electricity fuel mix. The enterprise electricity fuel mix reflects the aggregate of the fuel mix of the electricity being delivered to each of our electricity consuming facilities around the state and the on-site or procured renewable energy.



Each utility's fuel mix is different. A facility in Northwestern MN will have a different fuel mix than a facility in the Metropolitan area. Different facilities also have differing amounts of additional renewable energy. For example, on the Capitol Complex, approximately 34% of electricity is renewable above and beyond the grid mix. This additional renewable comes from Xcel Energy through a program called Renewable*Connect Government, and is a mix of solar and wind energy.

Of all electricity consumed by the enterprise 45% is generated from coal, 28% is from wind, 13% is from nuclear, 10% is from natural gas, 2% is from solar, 1% is from other sources (petroleum), and 1% is from hydro. Renewable electricity (wind, solar, and hydro) is 31%. The total carbon free (renewable plus nuclear) is 44%.

Overall, the enterprise's renewable energy consumption is 16.95%. of our total energy use, renewable electricity is 13.95% and renewable thermal is an additional 3%.

3. Energy Intensity Reduction Pathway

The energy reduction pathway represents what can be achieved from a coordinated approach to reducing energy consumption across the enterprise. The reduction pathway relies on five broad strategies: behavior change programs, ~~BIS~~ building information system metering, retro-commissiong, deep renovations, and decommissioning. Table 4 shows these broad strategies, which levers they relate to and their corresponding modeled energy use reductions as of 2027. Figure ~~12~~ 8 is a graphical representation of the reduction pathway. As of 2018 the adjusted baseline for energy intensity showed 10% reduction of energy intensity. The sum of reductions from these strategies and the adjusted baseline is 30%, meeting the goal identified in Executive Order 19-27. A detailed methodology of the Energy Intensity Reduction Pathway is described in Appendix II.

3.1. Energy Intensity Reduction Pathway Results

The pathway demonstrates that a 30% energy intensity reduction can be achieved by 2027. Table 4 summerizes the strategies that may be used, which energy consuming assets they could be applied to, the expected energy intensity reductions in those assets, and the resulting enterprise energy intensity reductions.

Table 4. Energy Intensity Reduction Pathway Results

Strategy	Applied in the model to	Expected %kBTU reductions in Applicable	Implementation Year	Lever (Section 5)	% Enterprsie kBTU Reductions in 2027
Behavior Change	All buildings	3	2019	7	0.9
Building Information Systems	All buildings above 10,000 SqFt	6.6	2019	1	1.9
Retro-commissioning	All buildings	7	2019	6	1.8
Deep Renovations	All buildings above 10,000 SqFt	30	2019	6	8
Decommission & Rebuild	The 30 worst performing buildings in the enterprise		2019	9	7.2
Adjusted Baseline			2006-2018		10
Total % Energy Intensity Reduction					30

- Behavior programs are informational, social, and educational campaigns aimed at efficiency and conservation. An example of an informational strategy are monitors providing real-time feedback to employees about their building's energy use. Behavior programs are expected to reduce energy intensity in applicable buildings (all buildings, excluding those identified as "equipment, process, and Met Council" in table 3) by 3%. Resulting in an overall 0.9% reduction of total energy use across the enterprise by 2027.
- ~~BIS~~ Building information systems provide more accurate metering of individual buildings and buildings systems. They contribute to energy reductions by providing information for educational campaigns, identifying poorly operating equipment, and provide data for more accurate evaluations. Building information systems are expected to reduce energy intensity in

applicable buildings (all buildings, excluding those below 10,000 SqFt) by 6.6%. Resulting in a 1.9% reduction of total energy use across the enterprise by 2027.

- Retro-commissioning and subsequent re-commissioning (or appropriate evaluation) could reduce energy use in building and equipment by 7%. Resulting in a total of 1.8% reduction of total energy use across the enterprise by 2027. This program would require that every building be retro-commissioned by the end of 2028, and then re-commissioned every 5-7 years after that to maintain reductions.
- Deep renovations are estimated to reduce energy intensity of applicable buildings (all buildings above 10,000 SqFt) by 30%. Deep renovations result in 8% energy use reduction by 2027.
- Decommissioning buildings and replacing the lost square footage with buildings built to the SB2030 model could result in a total 7.2% energy reduction by 2027 across the enterprise. Estimated reductions result from an exercise that identified the 30 worst performing (relative to their B3 Benchmark) buildings in the enterprise, and estimated how replacement buildings built to SB2030 standards would perform.

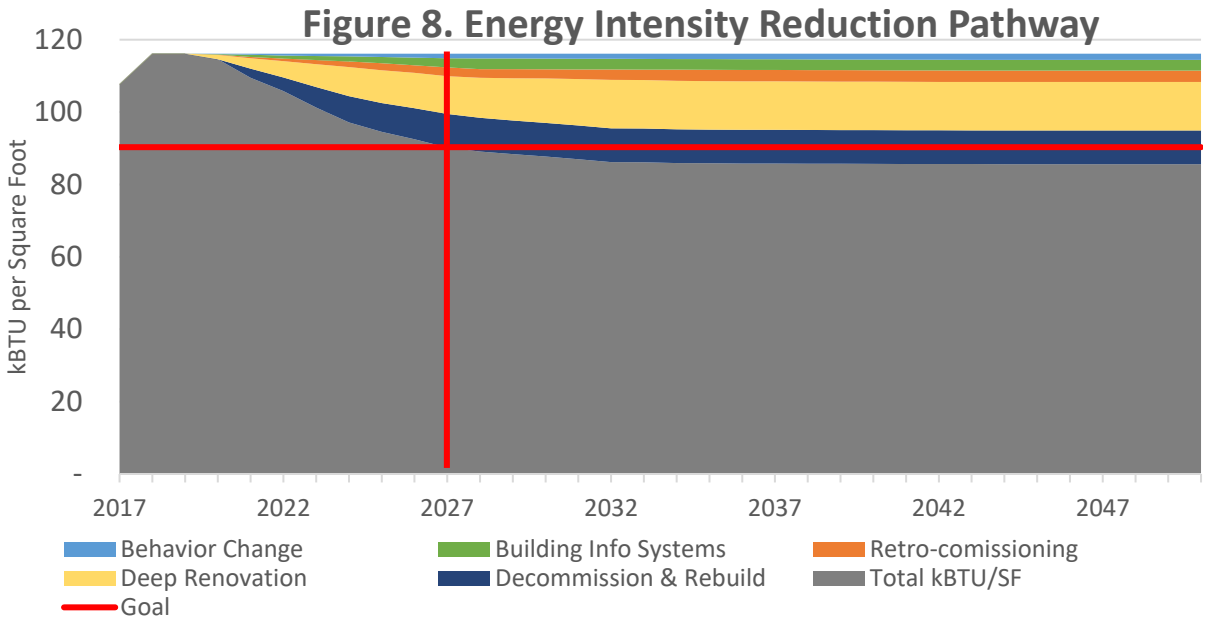


Figure 8. Energy Intensity Reduction Pathway

3.2. Energy Intensity Reduction Pathway Discussion

This pathway relies on aggressive implementation of behavior programs, BIS metering, retro-commissioning, and deep renovations. However, all of these strategies together achieve less reductions than those achieved through decommissioning buildings and replacing them with buildings built to the SB2030 standard. Not explored here are the anticipated costs of implementing these 5 broad strategies and the resulting avoided operating costs to the enterprise.

4. Implementation Guide

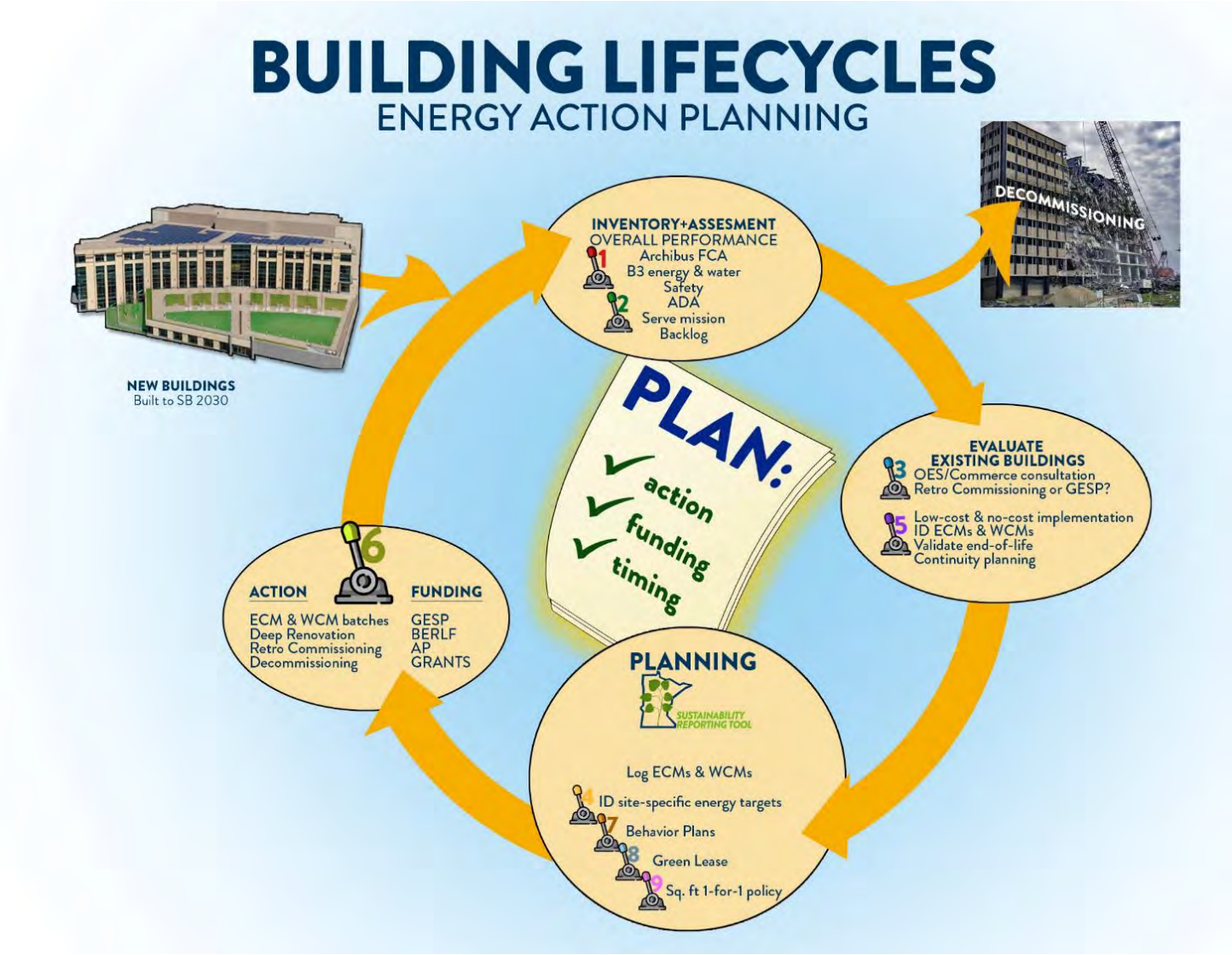


Figure 9. Building Lifecycles: Energy Action Planning

Figure 13 demonstrates how the levers apply to a building lifecycle.

- New Building – Built to SB2030 standards and commissioned to ensure they are performing as designed.
- Inventory and Assessment – On an ongoing basis, buildings should be assessed as it relates to the building's Facilities Condition Assessment, safety, ADA compliance, backlog of maintenance and repair, and its appropriateness for serving the agency's mission, and energy and water data should be entered into B3 Benchmarking (lever 1). To prioritize buildings, agencies may want to assess each of their buildings' performance as it relates to the B3 benchmark (lever 2)
- Evaluate Existing Buildings – Buildings should be evaluated using the information from the inventory and assessment work and additional information. Tools for accomplishing this evaluation include the Guaranteed Energy Savings Program (lever 3), retro-commissioning, or other energy audit approach (lever 5)

- Planning – The evaluation work should lead to identifying building specific energy reduction targets (lever 4). The energy conservation measures identified in the evaluation phase should be entered into the Sustainability Reporting Tool, along with implementation costs, and avoided operating costs. Agencies may also identify other approaches for reducing energy use, like behavior programs (lever 7), green leases (lever 8), and decommissioning and replacement (lever 9).
- Action –Agencies will identify the action to be taken, the cost of implementation, funding mechanism, and timing for activities like implementing ECMs, retro-commissioning schedules, deep renovation and decommissioning schedules.

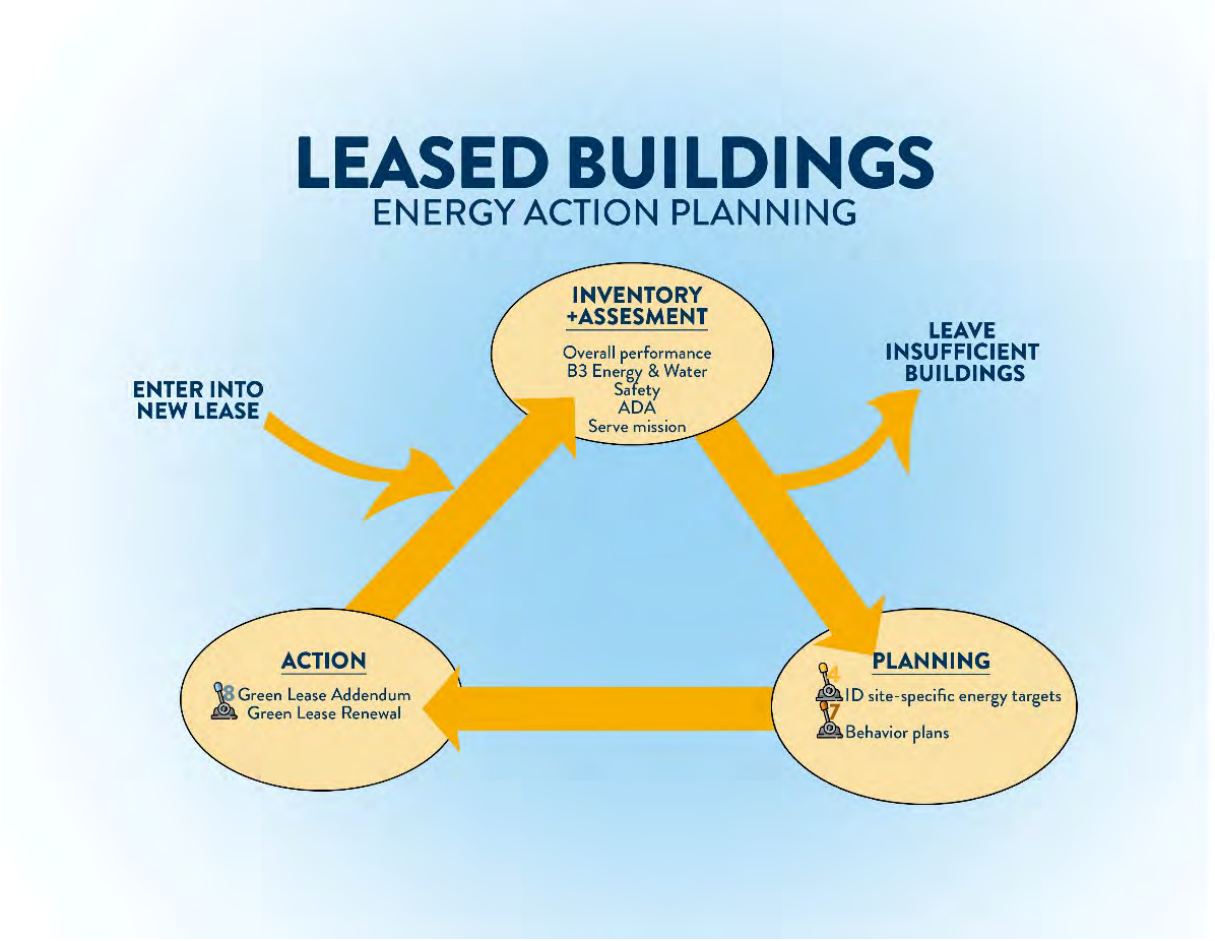


Figure 10. Leased Buildings: Energy Action Planning

Figured 14 demonstrates how agencies in leased buildings can apply these levers to their work.

- Inventory and Assessment – On an ongoing basis, agencies should be evaluating their leased spaces for their overall performance based on their utility data, whether it meets safety and ADA needs, and whether it serves the mission.
- Planning – Agencies can identify site specific targets (lever 4) as it relates to their leased spaces to understand how far their lease spaces are performing from what might be possible. They can also choose to implement behavior (lever 7) programs.
- Action – Agencies have limited options, they can choose to leave a lease and search out a better performing building, or they can work within the green lease (lever 8) program with Administration Real Estate and Construction Services.

5. Levers

Each agency will pursue levers identified in their agency sustainability action plan. There are 10 levers identified in this plan from which they may choose or they may identify additional levers. Figure 14 can be used to understand how each of these levers fits within the lifecycle of managing owned buildings. Figure 15 (section 4) can show how agencies with leased buildings could apply these levers. The ten levers described in this plan follow.

5.1. Lever 1 -Track Energy Use in B3 Benchmarking

Each agency will maintain in the B3 Energy Benchmarking website current utility data for state-owned buildings and/or leased buildings over 5,000 SqFt by 2017.

Anticipated Action: Agencies will continue to maintain current data in B3—energy current within 90 days and water within 120 days.

5.2. Lever 2 - Identify Buildings not Meeting B3 Benchmark

Using the B3 Energy Benchmarking website, each agency will identify state-owned buildings not meeting the B3 benchmark by 2018 for further evaluation.

Anticipated Actions: Rank buildings, sites and/or campuses based on their potential for energy use reduction. Use ranking as the basis of discussion with the Departments of Administration and Commerce.

5.3. Lever 3 - Identify Projects for GESP

Each agency with the assistance of Department of Administration, Office of Enterprise Sustainability, and Department of Commerce, Office of Guaranteed Energy Savings Programs, will determine which state-owned buildings not meeting the B3 Benchmark have the potential to utilize the Guaranteed Energy Savings Program, State Energy Improvement Financing Program by 2018, or the Productivity Loan Account (when/if funded) by 2019.

Anticipated Action: Potential energy efficiency improvements will be evaluated using a bundled approach, bundling multiple buildings, sites or campuses to obtain economies of scale for a viable project.

5.4. Lever 4 - Site-Specific Energy Reduction Targets

Each agency will establish site-specific goals for reducing energy usage in state-owned buildings not meeting the B3 benchmark by September 1, 2019.

Anticipated Action: Aggregate site-specific goals should include achieve 30% reduction in energy use per SqFt through energy efficiency strategies, to be identified in in the Sustainability Reporting Tool.

5.5. Lever 5 - Energy Audits

Each agency will conduct energy audits of state-owned buildings not meeting the B3 benchmark to identify cost effective energy efficiency and renewable energy strategies by 2020.

Anticipated Action: Retain energy auditor and/or utilize the Guaranteed Energy Savings Program or State Energy Improvement Financing Program to perform energy audits. Utilize available utility Conservation Improvement Programs to assist with the cost of the audit.

5.6. Lever 6 - Action

Each agency will develop a plan to implement best management practices and cost-effective energy efficiency and renewable energy improvements to achieve a 30% reduction in energy use per SqFt by 2027.

Anticipated Action: Best management practices (e.g. retro-commissioning, behavioral management, B3 Operations Manual, automated utility meters, etc.). Complete a retro-commissioning schedule by January 1, 2020.

Utilize available implementation and financing mechanisms that may be appropriate including agency funds, Office of Enterprise Sustainability Revolving Loan Program, Guaranteed Energy Savings Program or State Energy Improvement Financing Program.

5.7. Lever 7 - Behavior Programming

Each agency will implement a behavior program utilizing best management practices, such as with plug-loads, and leveraging data from building information systems.

Anticipated Action: Implement a behavior program at every site, with a specific energy reduction targeted through behavior.

5.8. Lever 8 - Green Lease

Agencies will compare leased building spaces to the B3 benchmark and identify a plan for implementing green lease initiatives to improve building performance or seek another suitable lease space.

Anticipated Action: Develop a timeline of building lease renewals and the green lease items to be strived for in each renewal negotiation, or lease amendments prior to renewal.

5.9. Lever 9 - One for One Square Foot Replacement Policy

Implement a 1 for 1 square foot replacement policy.

Anticipated action: Adopt an agency policy to limit the development of additional square footage, whereby every one square feet of decommissioned space will be replaced by 1 square foot of new space or consolidated space built to an SB 2030 standard with a reduced energy use intensity. Conversely, this policy means a no net gain of square footage.

5.10. Lever 10 - Plug-Load Audits

Conduct an audit of plug-loads and develop a plan with a targeted reduction goal.

Anticipated Action: Agencies will audit plug-loads of their facilities over 5,000 square feet by 2021 and develop a site-specific or agency wide plan with a specified energy use reduction target from plug-loads.

6. Policy, Market, and Technology Scan

The purpose of this sections is to provide a high-level view of the drivers affecting state agencies in policy, market, and technology. Included are some details about application of state policies, trends in energy prices and the grid, and applicable building technologies discussed in the energy reduction pathway.

6.1. State Policy

Several polices relate to the enterprise effort to reduce energy use. Important to this effort is the SB2030 program, Buildings Benchmark and Beyond (B3) which address the performance and tracking of newly constructed buildings and significant renovations. The Guaranteed Energy Savings Program (GESP) is a tool agencies can use to help them finance their energy efficiency work. Additional statutes provide guidance on renewable energy and building systems. Additionally, Executive Order 19-25 works in tandem with 19-27 to help reduce energy use.

6.1.1. SB2030

Minnesota Sustainable Building 2030 (SB 2030) is a progressive energy conservation program initiated by the Minnesota Legislature in the spring of 2008. Based on the national Architecture 2030 program, SB 2030 has been tailored to the needs of Minnesota buildings. Like Architecture 2030, SB 2030 sets specific performance targets (Energy Standards) for energy use in buildings compared to representative buildings in existence in 2003. Every five years, the total carbon emissions target from buildings is reduced so that in 2030 a 100% reduction (net zero carbon) is achieved. For new buildings compared to representative buildings in existence in 2003, the reduction in carbon producing fuel used for building energy is:

- 2010 – 60% reduction
- 2015 – 70% reduction
- 2020 – 80% reduction
- 2025 – 90% reduction
- 2030 – 100% reduction

SB 2030 Energy Standards are required for all state-bonded Minnesota buildings that have started Schematic Design after August 2009. It is anticipated in the near future, others owners and building projects will join the SB 2030 program on a voluntary basis and may qualify to receive utility incentives reserved for SB 2030. The Energy Standards along with other information about the program are available at https://www.b3mn.org/2030energystandard/.

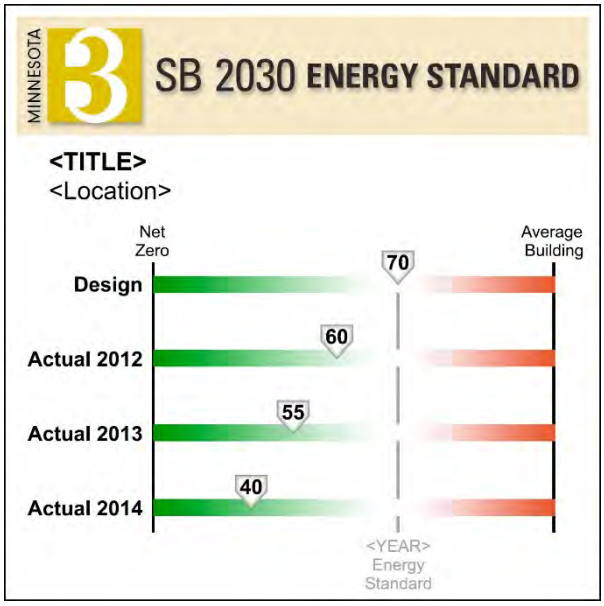


Figure 11: SB 2030 Standard Example

After the project construction is completed, actual energy data is collect in the B3 Benchmarking program. The B3 Benchmarking program normalizes the actual energy data for the year collected and returns it to SB 2030 Program tracking tool so that the proposed and actual building EUI can be compared. The tracking tool produces an SB Sustainable Building Energy Label shown to the [right]. [2]

6.1.2. Building Benchmark and Beyond

Buildings, Benchmark and Beyond (B3) is an online building energy and water performance tracking system.

- Funded through and administered by the Commerce and Administration departments.
- 2001 legislation required state bonded public buildings to benchmark for a period of 12 months.
- Developed and maintained by the Willdan Currently, B3 has over 7,500 public buildings with over 300 million square feet in its database.
- B3 is the primary database of record for the Enterprise Sustainability Program. Agencies are expected to have ~~data~~ energy data current to 90 days.
- More information at: Current Statistics Report.[3]

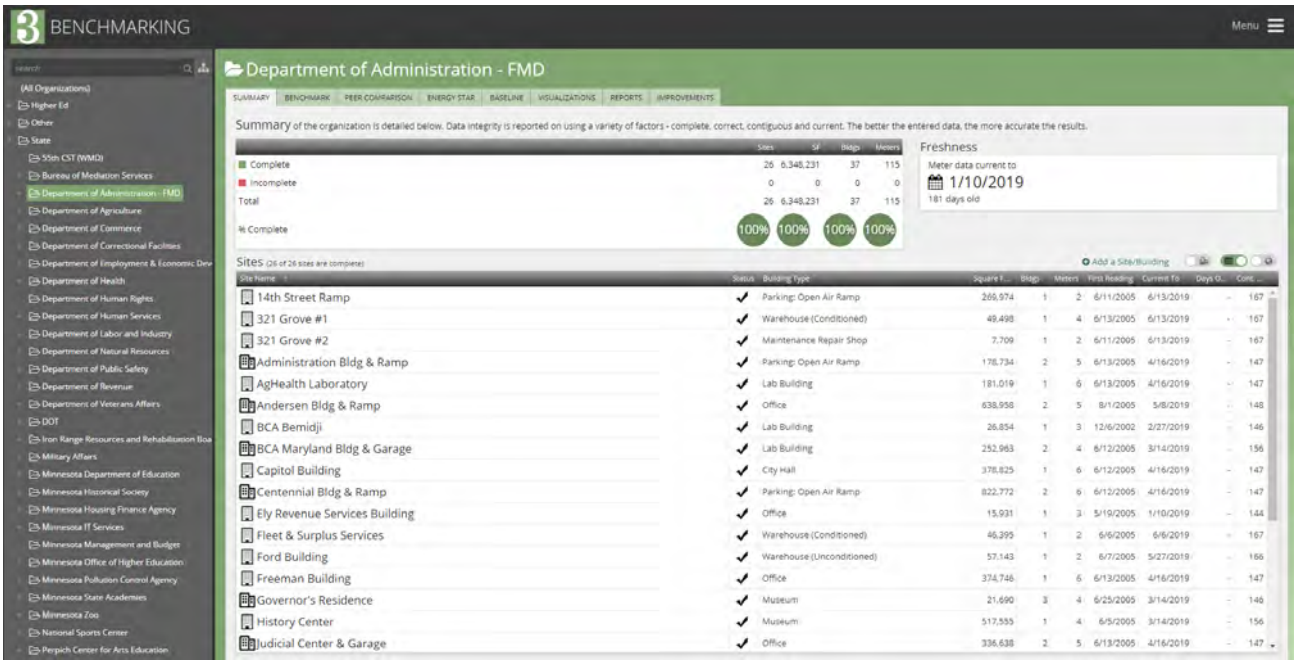


Figure 12. Example of B3 Benchmarking web application

[2] Graves, R., Smith, P., Baker, C., & Carter, R. (2009). Minnesota SB2030 Standard: Fact Sheet. Retrieved February 12, 2018, from https://www.b3mn.org/wp-content/uploads/2017/07/SustainableBuilding2030factsheet.pdf

[3] The Weidt Group. (n.d.). What is B3? Retrieved December 2, 2018, from https://mn.b3benchmarking.com/What-Is-B3

6.1.3. Guaranteed Energy Savings Program (GESP) – Minnesota Statute Section 16C.144

The GESP program provides technical assistance to state agencies, local government units, school districts and institutions of higher learning that elect to implement energy efficiency and renewable energy improvements through Guaranteed Energy Savings Contracts. GESP utilizes an energy performance contract (ESPC), which is a performance-based procurement and financing mechanism that leverages energy and operational savings achieved through the installation of energy efficient and renewable energy equipment and implementation of operational best practices, to finance the cost of the building retrofit and renewal project, with no net cost increase to the public entity. Typical energy conservation opportunities include in an ESPC include the following.

- Architectural/Structural – roofing, doors, insulation, weather-stripping, window treatments
- Electrical – lighting retrofits, emergency power, power and distribution, IT/communications networks, life safety systems
- Mechanical – HVAC systems, plumbing and drainage, energy management and building controls
- Property/Site – underground utilities, lighting improvements, swimming pools, ice arenas
- Renewable Energy – PV solar, solar thermal, wind, biomass, hydroelectric
- Water and Waste – water purification systems, water sewage facilities, landfill gas capturing, waste utilization
- Operational Best Practices – staff training and development programs associated with energy conservation

The Metropolitan Council may use GESP under 16C.144 through an interagency agreement with the Department of Commerce. They may alternatively procure GESP through Municipal Statute 471.345 Subd. 13.

6.1.4. Energy Use – Minnesota Statutes Section 16B.32

Subd. 1) Relating to energy efficiency and renewable energy, new construction or renovation of 50% of a building or its energy system requires that new designs must include active and passive solar, earth sheltered construction, and alternative energy sources where feasible. Subd. 1a) Agencies must consider meeting at least two percent of the energy needs of new buildings from wind and solar located on-site, where not suitable an analysis showing why wind and solar are not suitable must be recorded. Subd. 2) The Commissioner of Administration in consultation with the Commissioner of Commerce may conduct a shared-savings program involving energy conservation expenditures on state-owned and wholly state-leased buildings. Subd. 3) The commissioner may accept gifts of energy efficiency improvements in state-owned and wholly leased buildings.

6.1.5. State Energy Improvement Financing Program – Minnesota Statutes Section 16B.322

The State Public Building Enhanced Energy Efficiency Program (State PBEEEP) is currently in statute, but not available to state agencies. PBEEEP creates an energy improvement financing program, administered by the Commissioner of Administration. State agencies may elect to participate in the program. State PBEEEP provides technical services to state agencies with state buildings or facilities that the commissioner determines offer the greatest potential to improve energy efficiency or reduce use of fossil-fuel energy. The Commissioner may enter into agreement with private financing institutions on a project or line of credit bases.

6.1.6. Solar Energy in State Buildings – Minnesota Statute Section 16B.323

Photovoltaic systems installed in new buildings or during major renovations must be less than 300 kilowatts in capacity, or the cost of the system must not exceed 5% of the appropriations from bond proceeds for the construction or renovation of the building.

6.1.7. Sustainable Building Guidelines – Minnesota Statute Section 16B.325 and 216B.241 Subd.9

Directs the Departments of Administration and Commerce to develop the sustainable building design guidelines. These guidelines focus on the lowest lifetime cost for new buildings and major renovations. These guidelines are mandatory for all new buildings receiving funding from bond proceeds after January 1, 2004 and for all major renovations after January 1, 2009. These guidelines are the SB2030 standards.

6.1.8. Heating and Cooling Systems; State-Funded Buildings – Minnesota Statute Section 16B.326

Geothermal and solar thermal heating and cooling systems must be considered when designing, planning, or letting bids for necessary replacement or initial installation of cooling or heating system in new or existing buildings that are constructed or maintained with state funds.

6.1.9. Energy Efficiency Installment Purchases – Minnesota Statute Section 16C.14

The Commissioner of Administration may use avoided energy costs to pay for equipment or services intended to improve energy efficiency or reduce the energy costs of a state building or facility. The total number of installments may not exceed 15 years, the contract vendor provides or obtains financing without state assistance or guarantee, and the total contract must be less than the expected avoided costs.

6.1.10. Productivity Loan Account – Minnesota Statute Section 16B.85

The Productivity Loan Account (PLA) is a loan fund to finance agency projects that will result in either reduced operating costs or increased revenues. This loan fund is a potential mechanism for funding future energy efficiency work at state agencies.

6.1.11. Executive Order 19-25

Executive Order 19-25 advances energy efficiency and renewable energy programs for Minnesota's public buildings. It provide guidance to agencies to consult with the Departments of Commerce and Administration in establishing site specific goals for their owned buildings by September 1, 2019. This relates to EO 19-27 which directs agencies to create a retro-commissioning schedule for owned buildings by January 1, 2020. Executive Order 19-25 provides guidance for agencies to complete a series of additional energy reduction actions.

6.1.12. Funding

Retro-commissioning, building information systems, deep renovations, and rebuilding to SB2030 standards requires funding. While the cost of implementation is not discussed in this document, there are limited existing tools. Capitol bonding asset preservation, operating budgets, and GESP are available to agencies. Coordinating these funding sources to focus on energy efficiency is possible.

6.2. Markets

6.2.1. Energy Market

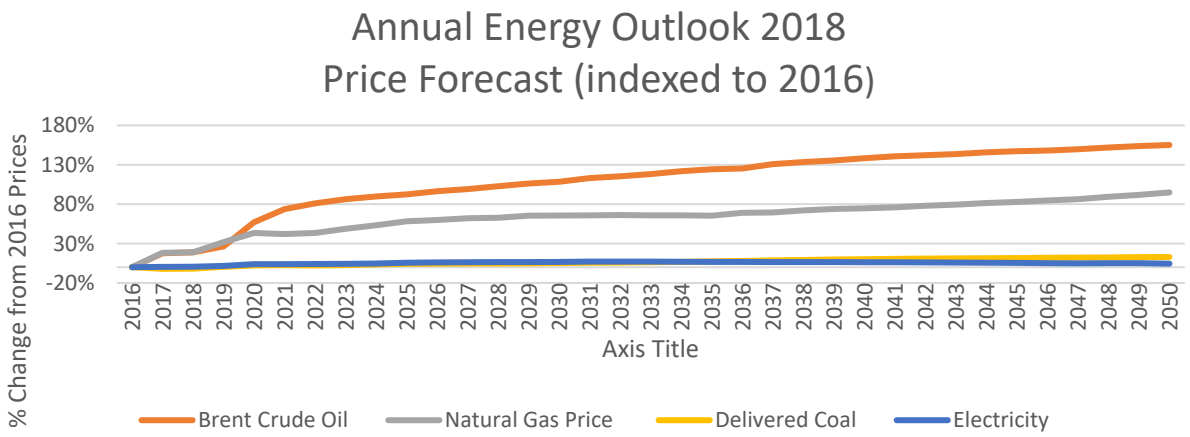


Figure 13. Energy Information Administration (EIA) Annual Energy Outlook 2018 price forecasts, reference scenario [4]

EIA's Annual Energy Outlook provides modeled projections of domestic energy markets through 2050. Strong domestic production of natural gas and oil coupled with relatively flat demand result in the US as a net exporter of natural gas. Natural gas consumption grows the most on a percentage basis, promoting upward pressure on price. Nonhydroelectric renewables grow the most on a percentage basis, promoting stable and declining electricity prices (EIA, 2018). This suggests that agencies should explore demand management practices and fuel switching to electric driven heating and cooling systems as a cost savings measure.

6.2.2. Decarbonization of the grid

The MISO (Midwest Independent System Operator) grid, under which Minnesota operates, is expected to become increasingly gas-fired and renewable based. As of 2017, the MISO grid is 16% non-hydroelectric renewable based. By 2032, MISO predicts scenarios ranging from 15% to 30%.

6.2.3. Microgrids and Islanding

A microgrid is defined within a specific geographical area and is comprised of interconnected and synchronized energy consumers (buildings, equipment) and distributed energy resources (solar PV, batteries). A microgrid can disconnect from the larger distribution grid and operate self-sufficiently for a certain amount of time. Microgrids are characterized by sophisticated controllers that balance supply and demand of electrical power, while prioritizing the microgrid's most critical operations.

Microgrids' greatest benefits are resiliency and efficient operation. With the Internet-of-Things (IoT), microgrids can capitalize on big data streams by employing advanced operational algorithms and predictive modelling. This type of coordinated operation can boost the overall efficiency of the energy consumers, thereby reducing costs.

[4] EIA. (2018). *Annual Energy Outlook 2018 with projections to 2050*. Washington D.C. Retrieved from www.eia.gov/aeo

6.3. Building Technology

Net Zero Energy Buildings (NZEB) are considered the next frontier in building technology. NZEB buildings consume an absolute minimum amount of energy per year. They are "net zero" by subtracting renewably produced energy either on-site or nearby. Some key components of NZEB are enumerated:

1) Digitalization, automation, and integration of building services
2) Energy flexibility in building services and coordination with grid
3) Passive ventilation, heating and cooling
4) Prefabricated construction
5) Energy generation and storage
6) Thermal energy recovery systems

*Figure 14. Net Zero Energy Building (*NZEB) Design Process[5]

6.3.1. Building Information System

Building information systems are systems of sub-meters intended to meter and log building or sub-building utility data. These systems serve several purposes.

- Reduce risk and mitigate losses. For example, a burst water pipe might set of an alert, leading to the water being shut off more quickly and reducing the resulting water damage to the building, finishings, and furnishings.
- Validate utility billing.
- Provide data to enhance behavioral focused conservation programs.
- Assist in maintenance.
- Provide data for existing building commissioning, including retro-commissioning and re-commissioning.
- Archive utility data for in-depth analysis.
- Identify opportunities to reduce peak electricity consumption.

6.3.2. Retro-Commissioning

Retro-Commissioning is a type of existing building commissioning. Retro-commissioning, performed to improve the performance of an existing building, sets a baseline from which re-commissioning can take place in subsequent years. Retro-commissioning can resolves problems that occurred during design and construction and were never addressed when the building was originally commissioned. Retro-

[5] Attia, S. (2018). *Chapter 2 – Evolution of Definitions and Approaches*. *Net Zero Energy Buildings (NZEB)*. https://doi.org/10.1016/B978-0-12-812461-1.00002-2

commissioning can also resolve problems and challenges that have developed over the course of the building's life as equipment has aged or as building usage has changed.

Figure 15 Retro-commissioning cycle

Similar work can be done through the Guaranteed Energy Savings Program. Or in smaller buildings, a less elaborate evaluation may be appropriate. Retro-commissioning and these other evaluation options provide a list of energy conservation measures (ECMs) to be implemented. Depending on the scope of the evaluation, they typically also include water conservation measure opportunities (WCMs).

Retro-commissioning and other evaluation tools can also provide important things like 1) end of life-cycle information for equipment, 2) provide further input into the Facility Condition Assessment, 3) provide training to facilities staff, and 4) develop materials for continuity of building operations.

7. Appendices

7.1. Appendix I: Performance of Enterprise Energy Cost (PEEC) Score

To prioritize buildings for either decommissioning or deep renovations, we create a score called the "Performance Enterprise Energy Cost Score." We employ B3's engineering modelled B3 Benchmark energy intensity, actual energy intensity, and the building's share of total enterprise dollar spend on energy.

Performance of Enterprise Energy Cost (PEEC) Score:

- SF = Square feet for building *i*
- s = spend per building, *i*
- *kBtu, actual* = the actual kBtu energy consumption recorded
- *kBtu, B* = the B3 benchmark estimated energy consumption

$$\text{PEEC Score} = \left(\frac{kBtu_{actual,i}}{SF_i} - \frac{kBtu_{B,i}}{SF_i}\right) \times \left(\frac{s_i}{\sum_{i=1}^{n} s_i}\right)$$

We identify the worst performing buildings among a final subset of 673 sites. To improve visibility, we plot square footage on a logarithmic scale. We dub this plot, a "geyser plot." The buildings plotted to the upper right quadrant of the chart are the worst performing.

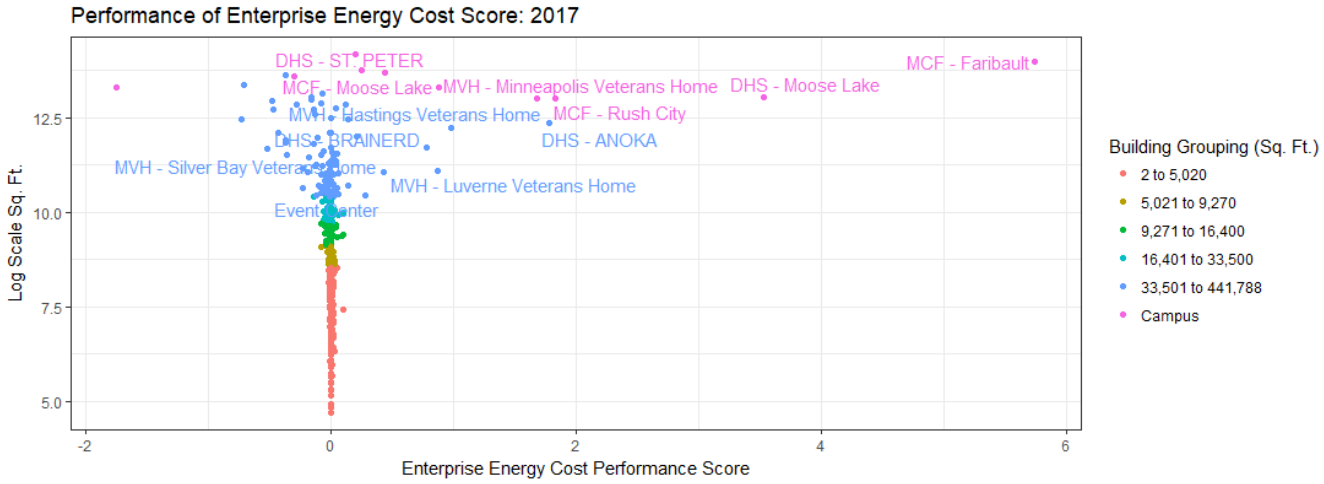


Figure 1. PEEC (Performance of Enterprise Cost Score: 2017

Table 1. PEEC Score: 2017, 12 Worst Performing Sites					
Site Name	Building Type	PEEC Score	Current SF	Actual kBTU/SF	Energy Spend/Year
MCF - Faribault	Corrections Facility	5.7490	1196653	173.0	$ 1,974,754
DHS - Moose Lake	Health Care Facility	3.5308	460554	172.7	$ 1,225,604
MCF - Rush City	Correctional Facility	1.8338	444381	169.1	$ 744,056
DHS - Anoka	Office	1.7786	233760	191.1	$ 536,424
MVH - Minneapolis Veterans Home	Nursing Home	1.6806	451008	184.3	$ 794,638
MVH - Hastings Veterans Home	Warehouse (Conditioned)	0.9816	205030	182.2	$ 365,646
MCF - Moose Lake	Corrections Facility	0.8787	595200	136.6	$ 962,079
MVH - Luverne Veterans Home	Nursing Home	0.8673	65418	277.7	$ 204,643
DHS - Brainerd	Dormitory	0.7810	121129	187.2	$ 247,200
DHS – St. Peter	Office	0.4413	886591	128.9	$ 1,599,949
MVH - Silver Bay Veterans Home	Nursing Home	0.4282	63513	216.7	$ 167,313
IRRRB - Event Center	Convention Center	0.2798	33858	176.4	$ 95,716

7.2. Appendix II: Energy Intensity Reduction Pathway Methods

The energy reduction pathway presented in Section 2.5 of the 2018 Energy Action Plan is a simple calculation using very conservative percentage-based reduction assumptions.

The most critical assumptions are 1) the assumed percent energy reduction from a given action and 2) the percent of square feet that the Enterprise targets for implementation in a given year. The reduction is calculated on a per square footage, per building group, and per fuel basis. All reductions are considered "one-time," meaning, they can be achieved for a building space only once. They must be maintained with continual retro-commissioning every 5-7 years.

Data Preparation:

We first separate our Enterprise energy database into two subsets: A) a "to-decommission list" and B) the remainder list of buildings. We use dataset B to calculate marginal reductions for the four action items using Equations 1:3. For dataset A, we calculate new estimated energy intensities as if the building were demolished in a given year and were re-built to the corresponding SB2030 standard. Throughout, we hold all process and equipment energy intensities constant (waste water treatment plants, pump houses etc…).

Calculations

Equation B.1: Marginal Reductions from Actions

The marginal reduction for a given action is calculated by the following formula:

$$\partial_{a,b,t}^{f} = \varepsilon_{b}^{f} * \rho_{a,b,t} * \theta_{b,t-1}^{f} * \beta_{b}$$

Where:

- ∂ is the marginal reduction [kBtu]
- ε is the expected percent reduction in the energy fuel [%]
- ρ is the percent of square footage targeted per action, per building, per year [%]
- θ is the energy intensity per building type, per fuel type, in the previous year [kBtu/square foot]
- β is the total square footage per building type [square footage]

And

- *t* denotes the year. The marginal reduction ∂ assumed that to have been achieved at year's end (i.e., the total reduction over the calendar year ending on 12/31).
- *b* denotes the building type
- *f* denotes the fuel type (electricity, natural gas, propane etc..).
- *a* denotes the action type (retro-commissioning, behavior, deep renovation etc..).

Equation B.2: Total Reductions from All Actions

Secondly, we then sum up all the marginal reductions from each action area, *a*.

$$\Delta_{b,t}^{f} = \sum_{a=1}^{a=n} \partial_{a,b,t}^{f}$$

Equation B.3: Total kBtu per Square Foot, per fuel and building type

Finally, we calculate the "current year" kBtu/SF energy intensity by reducing the total kBtu, as a result of last year's achieved reductions. In next year's reduction calculations, year t+1, this θ will serve as an input in the formula, Equation 1. This is simply because we assume all reductions are one time, and cannot double count reductions for the same square footage, fuel type, and building type.

$$\theta_{b,t}^{f} = \frac{\Upsilon_{b,t}^{f} - \Delta_{b,t}^{f}}{\beta_{b}}$$

Where, Υ is the total kBtu for a given building group, fuel type, and year.

The "pathway" graph is simply a stacked "wedge" graph, a sum of the running total kBtu/SF plus the running cumulative sum energy reductions per square foot for each reduction action. The stacked total is always equivalent to the original baseline kBtu/SF, 110 kBtu/SF.

Decommissioning Calculations: Dataset A

We identify our worst performing buildings weighted by age of original occupancy. We determine a list of 30 buildings to be decommissioned. We assume a 1:1 square footage replacement. We then employ an arbitrary schedule for decommissioning over the years 2020 to 2026. All buildings are decommissioned and rebuilt by end of year 2026. We employ the Weidt Group's SB 2030 demonstration "As-Designed Tool." We input parameters such as the type of building and use case and assumed square footage allocations. A web service runs an energy model based on the inputs and provides a target energy standard on a kBtu/square foot/year basis. We then calculate the percent reduction Ø in energy use intensity (EUI) for each building *i* and year of implementation *j,* using baseline year 2017*:*

Equation A.1: **Percent reduction Ø in EUI for the decommissioned and re-built building**

$$\emptyset_{i,j} = \frac{EUI_{i,SB\ 2030} - EUI_{t=2017}}{EUI_{i,t=2017}}$$

With this percent reduction, we calculate a running total of the gross kBtu for all decommissioned buildings, subtracting each years' reductions. Finally, we normalize the total decommissioned energy use to $EUI_{i,t,SF.A+SF.B}$, where the denominator square footage is the sum of all decommissioned buildings in dataset A and the square footage of the remaining buildings in dataset B. With the same denominator, we can then add this kBTU/SF value into the enterprise pathway.

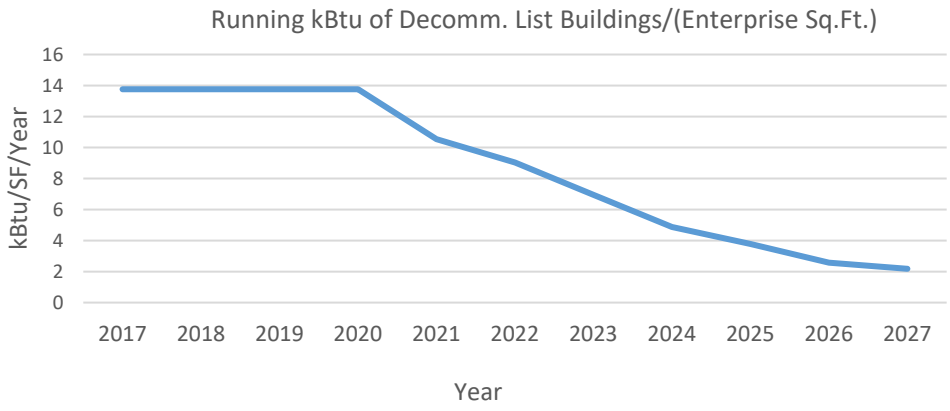


Figure 2: Running total energy use for the decommissioned building set, divided by total enterprise square footage

Parameters

Parameter ρ: percent of square footage targeted each year:

The percent of square footage targeted each year, ρ, is presented in the following figure. This is largely an arbitrary time series, implemented by trial-and-error as to meet the enterprise goal.

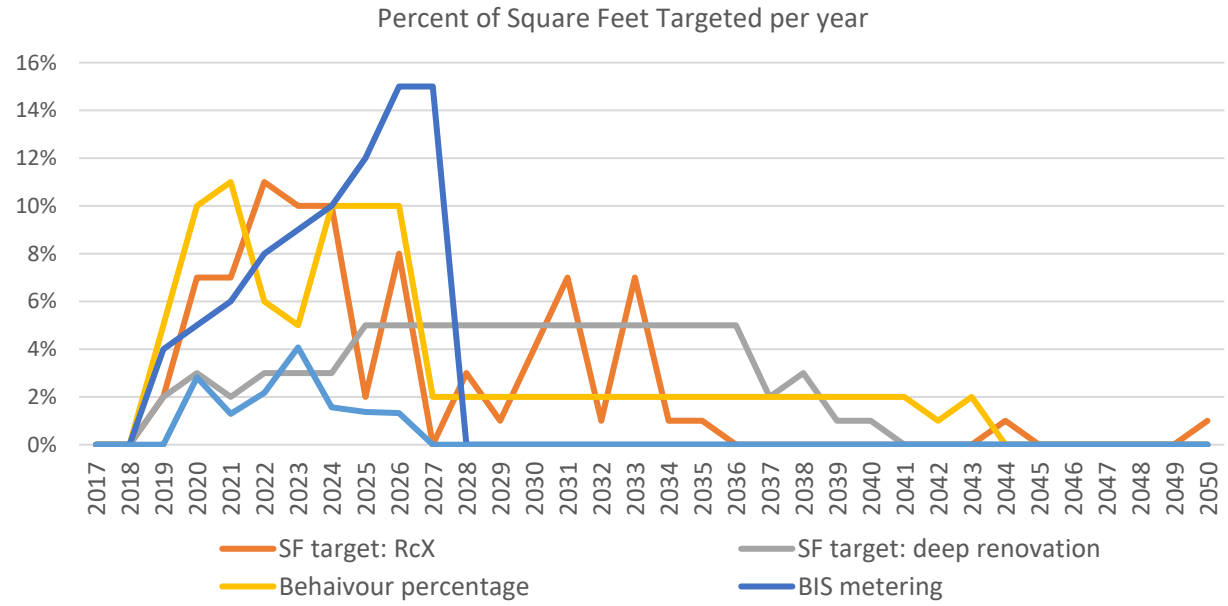


Figure 3: Percent of square footage targeted per year, per action area

Parameter ε: Anticipated percent reductions by fuel type

	% Reduction in Electricity	% Reduction in Natural Gas Consumption	% Reduction Propane
Retro-commissioning	7%	7%	7%
Deep renovation	30%	30%	
Behavior	3%	3%	
BIS metering and alerts	6.6%	6.6%	6.6%

BIS metering and Behavior:

We assume that the implementation of the Building Information System (BIS) will result in a 6.6% reduction in energy savings in electricity and heating. We obtain this 6.6% percent as a conservative, lower end estimate from (Parker et al., 2015). A wide literature study (Staddon, Cycil, Goulden, Leygue, & Spence, 2016) finds that 3.4% of a building's electricity can be reduced by routine changes in habit, informed by real-time access to consumption data. Examples of behavior changes would be removing space heaters, using smart power strips, and implementing automatic computer workstation sleep-modes. From the cited literature, we assume that the higher 6.6% reduction is achieved by operational changes in the building's controls, improved preventative maintenance, and mitigation of equipment failure.

Deep renovation:

We assume a 30% reduction in electricity and a 30% reduction in natural gas for deep renovations. We assessed a study and literature review, (Miller & Higgins, 2012), which only considered deep renovations that had achieved a 30% reduction in total energy. It is likely that the potential natural gas savings for our stock of buildings is in the realm of 30-35% percent. However, again, we choose the conservative end of this range.

Retro-commissioning

A 2009 study by the Lawrence Berkeley National Laboratory found that from a sample of 643 buildings, with over 10,000 building energy issues, the median energy savings was 16% (Mills, 2009). However, the electricity savings are much lower, ranging from 7% to 10%. Given the differences in the buildings' climates and use cases, we opt for a lower end, conservative estimate for total energy savings. We settle with 7% across all fuel areas. It is likely that natural gas savings could be much higher in our buildings with advanced HVAC controls. However, we must make this assumption agnostic to the currently existing controls and the degree to which HVAC systems can be optimized. 7%, as a rule of thumb, is defensible to the extent that it is highly achievable with our building stock.

Miller, A., & Higgins, C. (2012). Deep Energy Savings in Existing Buildings : Summit Summary. *ASHRAE Transactions*, *121*(February 2012).

Mills, E. (2009). *Building commissioning: A golden opportunity for reducing energy costs and greenhouse gas emissions in the United States*. *California Energy Commission Public Interest Energy Research*. https://doi.org/10.1007/s12053-011-9116-8

Parker, S. A., Boyd, B. K., Hunt, W. D., Stoughton, K. L. M., Fowler, K. M., Koehler, T. M., … Sullivan, G. P. (2015). Metering Best Practices: A Guide to Achieving Utility Resource Efficiency, Release 3.0, (March).

Staddon, S. C., Cycil, C., Goulden, M., Leygue, C., & Spence, A. (2016). Intervening to change behaviour and save energy in the workplace: A systematic review of available evidence. *Energy Research and Social Science*, *17*, 30–51. https://doi.org/10.1016/j.erss.2016.03.027