

Abstract

The University of Calgary has experienced steady growth in its campus community and associated energy demands since its founding, over 50 years ago. To address this challenge, two strategic initiatives: the Utility Reduction Program (URPr) for existing buildings and the High Performance Green Building program for new buildings have been developed and implemented.

The projects implemented through the URPr include various energy retrofits in existing buildings. Additionally, UCalgary has 11 LEED certified buildings, two of them Platinum – making UCalgary one of the largest concentrations of green buildings on any post-secondary campus in Canada. Together, the High Performance Green Building and the Utility Reduction Programs provide a framework for greening up UCalgary's built environment and assist the University in the pursuit of its ambitious sustainability goals.

What is most innovative and creative about these programs is how they each hold campus engagement and student learning as instrumental to their success. They use participation of students and building occupants to minimize unexpected issues, quickly address occupant concerns and to ensure longevity of energy conservation measures. Additionally, the programs provide hands on learning opportunities for University of Calgary students on campus.

Innovativeness, Creativity and Originality

URPr

In the spring of 2015, the University of Calgary set out to achieve a \$200,000/year utility cost avoidance through a retro-commissioning program aimed at finding ways to optimize the efficiency of our existing buildings on campus. Eight buildings across campus received the performance improving retro-commissioning, and a period of measurement and verification of the program's progress was completed the following year. The energy conservation targets for this initial retro-commissioning program were exceeded by over 15%. This retro-commissioning program became the pilot for the much larger Utility Reduction Program which was launched in 2016.

The Utility Reduction Program helps reduce energy use and greenhouse gas emissions through energy efficiency retrofits on existing buildings. While this is the program's primary goal, it also has many additional unique benefits. The goal, beyond reduction of emissions, is to be an innovative program that over time funds itself and generates revenue that can be invested in other sustainability initiatives across campus. URPr demonstrates innovativeness, creativity and originality through:

i) *Engagement Strategy*: Most programs similar to URPr at other institutions are based purely on technical engineering analysis, but it was important for the University of Calgary to take an innovative approach and consider the impact the program may have on the campus community. To do so, an engagement strategy was established. The engagement component of the URPr aimed to facilitate implementation of the proposed energy conservation measures (ECMs) by inviting input from operations and occupant stakeholders to prioritize and refine recommendations based on their knowledge of their buildings.

The engagement strategy is two-tiered to ensure both Facilities and building occupants are given opportunities to provide input throughout the program. What is unique about this two-tiered approach is that they are involved across multiple stages of the program (Figure 1). Another unique aspect of this strategy is the enhanced feedback mechanism - designed to shorten the feedback loop between occupants and implementation so that ECM's can be refined quickly with minimum discomfort or disruption to users. This feedback mechanism is highly effective due to prior meetings with key building occupants who participated in occupant consultation. Their prior knowledge of the program and recommendations allows them to provide useful feedback to the program delivery team.

Overall, this engagement strategy contributed to high accuracy of ECMs, reducing unexpected issues during the implementation phase, improving operator and occupant ownership of recommendations, and increasing persistence of energy savings. Some of the stakeholders that were engaged with during this process included building occupants (staff and students), Campus Engineering, Facilities Management and Information Technologies, to name a few. By engaging both facilities staff and building occupants multiple times throughout the program a "one family" culture was developed ensuring all stakeholders felt included and considered.

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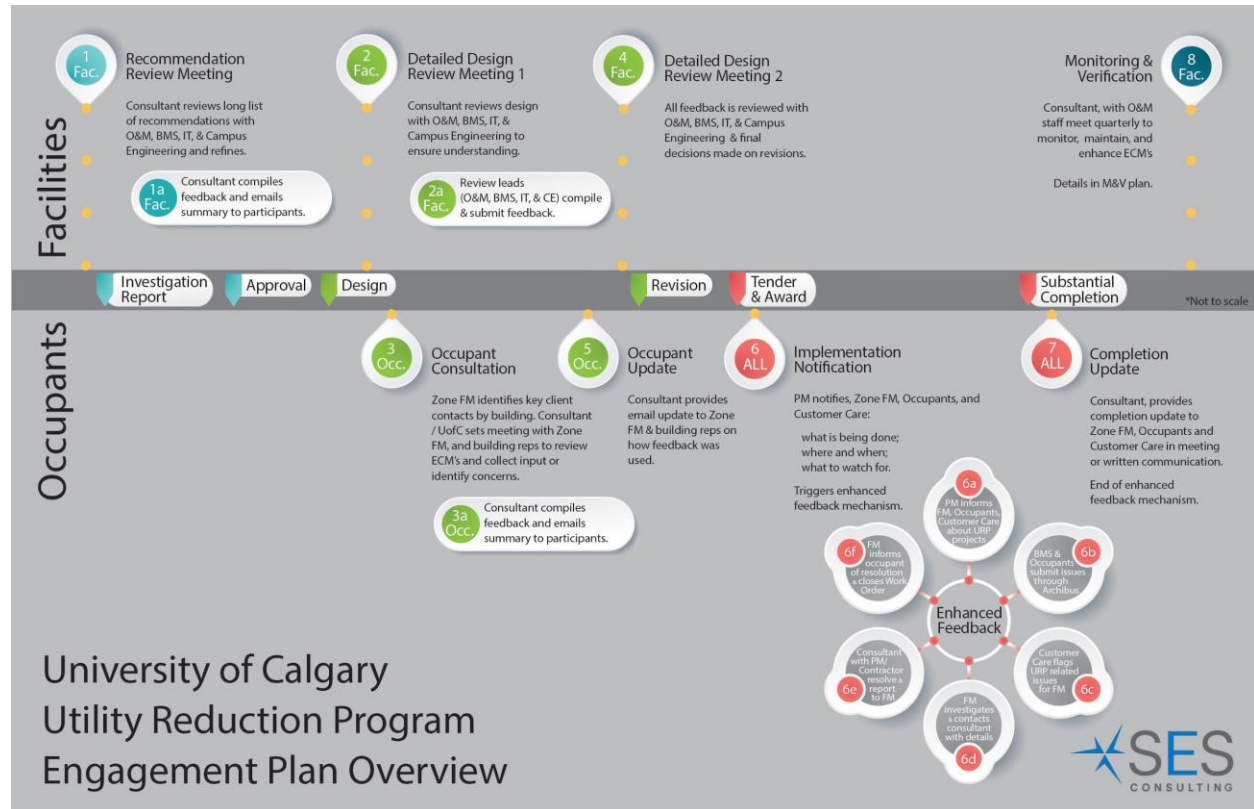


Figure 1: URPr Engagement Strategy overview (SES Consulting, 2017)

ii) *Funding Strategy*: The Utility Reduction Program was seed-funded through a loan from the province of Alberta through the Alberta Capital Finance Authority (ACFA). The University of Calgary took advantage of the low interest rates of the loans provided by the provincial government to start the URPr, then applied for grants. Money was matched through the Post-Secondary Institutions Strategic Investment Fund (SIF), provided by the Government of Canada.

The utility reduction program was designed so it will become self-funded. The annual payment on the provincial loan will be provided through the Utility Cost Avoidance (UCA), which is the money saved on utility costs through the energy efficient retrofits. However, no more than 75% of the predicted UCA will be used annually for provincial loan payments. The remaining 25%-30% of the UCA is surplus, and will be reinvested into the program or invested in sustainability initiatives on the UCalgary campus - something that makes the program unique.

iii) *Supporting Student Success Through Experiential and Applied Learning*: One of the creative and innovative components of the URPr is the use of experiential and applied learning to support student success and benefit the educational institution through the University of Calgary's Campus as a Learning Lab (CLL) program. CLL is a critical component of the University of Calgary's Integrated Practice Model for Sustainability (Figure 2). It knits together education and research on campus with operations by providing students, faculty and staff with the opportunity to work together on applied sustainability research projects that advance campus sustainability.



Figure 2: Integrated Practice Model for Sustainability

CLL projects completed during the past academic year tied to the URPr included a senior year capstone project focused on comparing heat recovery potential in the Olympic Oval to the incorporation of solar panels on the Kinesiology Building. Speaking about his experience working on a CLL project focused on URPr, Manuel Canelon (BSc. in Engineering 2017) shared:

“The capstone project was an incredible experience to put into practice the core concepts I learned throughout my degree in a practical way. Besides enhancing my technical skills acquired in school, the capstone project was a great way to learn to work with others, share and accept all ideas, while compromising on certain decisions for the greater good of the project. This was one of the most complete learning experiences throughout my Mechanical Engineering degree at the University of Calgary.”

CLL projects for URPr were also completed as a term project for an upper-level engineering course on life cycle assessment (LCA). These projects included an LCA analysis of 1) the URPr lighting retrofits and

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2) a heat recovery system for the swimming pool. The results of these projects provide important context in justifying energy efficiency efforts on campus.

There is an institutional commitment to continue using CLL as creative and innovative approach to improve URPr and other campus operations.

High Performance Green Buildings

University of Calgary High Performance Green Building program demonstrates innovativeness, creativity and originality through:

i) *Zero Carbon Building Pilot Program*: The University of Calgary is currently redeveloping the MacKimmie Library Complex; this project has been accepted as one of an elite group of 16 projects nationally, chosen to participate in a two-year pilot of the Canadian Green Building Council's Zero Carbon Building Standard. The MacKimmie Complex Redevelopment project is a multi-year, multi-phase project to address deferred maintenance and accommodate growth on the University of Calgary campus. The MacKimmie Complex will be redesigned to provide a re-energized central hub of classrooms, centralized undergraduate and graduate student services, student study space, and much needed academic space in the heart of the main campus. The MacKimmie Project is striving to be one of the most energy efficient buildings on a Canadian post-secondary campus; to holistically support and enable the health, wellbeing, and comfort of the campus community; and to be a showcase for a rich diversity of experiential learning and applied research opportunities on sustainability in the built environment.

ii) *Supporting Student Success Through Experiential and Applied Learning*: Similar to the URPr, high performance green buildings on campus provide a rich testbed for engaging students, faculty and staff in experiential and learning through Campus as a Living Lab. CLL projects for URPr were completed as a term project for an upper-level engineering course on life cycle assessment. These projects included an LCA analysis of: 1) LEED certified flooring materials; 2) MacKimmie Library Tower structure; and 3) MacKimmie Library Tower envelope. The results of these projects inform project team decision making and help to quantify and communicate the environmental benefits of the project design direction.

Speaking about his experience as a student working on one of these projects, Tanvir Alam (BSc. in Engineering 2017) shared the following:

“The opportunity to participate in experiential learning on campus exposed me to a real-world scenario and required me to learn new skills while applying knowledge from my other classes. In particular, our group completed a life cycle assessment on the structure of the MacKimmie Library Tower to determine the best course of action to achieve LEED certification of the tower through either a renovation of the existing structure or with the removal and subsequent replacement of an equivalent tower. These projects are important because students will be creating solutions to sustainability challenges on campus while learning about the importance of collaboration and teamwork.”

CLL projects with a focus on University of Calgary's high performance green buildings continue to be cultivated. For example, there is currently a PhD candidate who is completing thesis research on whole

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building life cycle assessment that will directly support the MacKimmie Complex Redevelopment project's green building certification under the LEED rating system for Building Design and Construction.

iii) *Supporting Environmental Stewardship Through Professional Development for Green Buildings:* The University of Calgary Office of Sustainability also operates a High Performance Green Building Professional Development program supporting staff across Facilities in growing their skills and knowledge in the field of sustainable buildings. Ranging from awareness campaigns to goal-oriented internal research and education workshops, the program spans to all corners of the University of Calgary's Facilities department, to encourage the professionalization of UCalgary staff. Topics addressed in the past include the design and operation of renewable energy systems, understanding and preparing for the application of the new provincial adoption of the National Energy Code for Buildings, green building rating system introductions (including LEED v4, WELL Building Standard, Sustainable Sites Program, and the Passive House Standard), and working sessions to understand the impact of the above concepts on university design standards, work processes, and standard operating procedures.

Economic Benefit

URPr

As the University of Calgary continues to grow, it is expected that total utility expenditures will increase in the coming years. The Utility Reduction Program (URPr) aims to respond to budget pressure imposed by these rising costs. The money saved by retrofitting existing buildings through energy efficient projects will be placed into a Sustainability Reserve Fund. The annual payment on the provincial loan that originally funded URPr will be provided through this fund. However, no more than 75% of the predicted Utility Cost Avoidance (UCA) will be used annually for provincial loan payments. The remaining 25%-30% of the UCA will be reinvested into the program or invested in sustainability initiatives on the UCalgary campus.

Another economic benefit that URPr creates is that, by completing the various retrofits in existing buildings on campus, it reduces deferred maintenance by updating and upgrading facilities that are aging. This lowers the cost of maintaining the buildings on campus.

High Performance Green Buildings

High Performance Green Buildings generate significant economic savings directly through lower operational and maintenance costs, but also indirectly through improved employee productivity and improvements in health and safety. The development of green buildings at the University of Calgary focuses on optimized operation of the buildings and seamless incorporation into the existing district energy systems on campus. A focus on the incorporation of an integrated process starting in the design phase and continuing through to the operational phase of a project, ensures that green building strategies are incorporated at lowest possible first cost, without compromising the ability of the University to operate them in a fiscally responsible manner.

Environmental Benefit

URPr

In 2015, the Government of Canada announced new targets for greenhouse gas (GHG) emissions reductions and intend to develop new regulations. To help stay within these targets, the University of Calgary's has the High Performance Green Building Program for new buildings, in combination with the Utility Reduction Program for existing buildings, will help reduce the GHG emissions on campus. To date, the URPr has reduced greenhouse gas emissions by 8,000 tonnes per year. The goal is for this program to reduce energy consumption on campus by 15% and reduce greenhouse gas emissions by 13% compared to 2014 baseline over the next five years.

High Performance Green Buildings

Similar to URPr, the High Performance Green Building Program has many sustainable achievements that contribute to a green environment:

- 10,000 tonnes in annual GHG emissions reductions - equivalent to having 2,100 less cars on the road.
- 24,500 tonnes of waste diversion from landfill
- 133,000 m³ of annual potable water savings - equivalent to 53 Olympic swimming pools
- 51 acres of natural greenspace with 80+ species of native/adaptive plants
- 75,000 m³ of stormwater annually managed to protect water quality and mitigate flooding

Together, both the Utility Reduction and High Performance Green Building Programs help reduce the University of Calgary's energy use and greenhouse gas emissions. Overall, this contributes to the worldwide efforts to reduce global greenhouse gases. In combination with the efforts of other post-secondary institutions globally, the University of Calgary is always striving to be a sustainability leader by modeling environmental stewardship and doing its part to work towards creating a better world for everyone.

Societal Benefit

URPr

The societal benefit from the URPr stems from improvements made to spaces that are accessed by external community members. These include the University of Calgary's swimming pool (an Olympic-sized pool accessed by those taking swimming lessons and swimming for fitness, or involved in numerous swim, synchro, water polo and triathlon clubs) and the Olympic Oval (a speed skating, ice sports and fitness venue where world-class athletes train and compete alongside members of the public). Whenever buildings are upgraded, occupant health and wellness are top considerations for design decisions.

High Performance Green Buildings

Through the High Performance Green Building Program, the University of Calgary has added more than 1.7 million ft² of space that holistically supports the health and wellbeing of the campus community. Green buildings at the University of Calgary focus on providing optimal ventilation and are built without toxic materials resulting in fewer air contaminants and a higher air quality. Our buildings also focus on the provision of natural lighting and views to the outdoors for all occupants; strategies that have been shown to enhance health, wellness, and improve learning outcomes for those using the spaces. Buildings are also developed with a priority on occupant comfort, paying special attention to the minimization of indoor noise pollution and delivery of superior thermal comfort through increased insulation and improved temperature control.

The University of Calgary has committed to striving for LEED Gold for every new build that occurs on campus. This will result in new, high-end work and study spaces for campus members as well as community members that visit the campus.

Adaptability and Transferability

With global atmospheric greenhouse gases constantly increasing, institutions are feeling the pressure to reduce energy use and emissions. To contribute their part, the University of Calgary is using a combination of the URPr and the High Performance Green Building Program. By adapting various components of these programs to fit their specific needs, other campuses in North America can reduce their emissions and energy use as well.

URPr

The retrofits that are completed through the URPr are ones that would ultimately be made by the campus as part of regular maintenance. This advantage, in combination with the various additional benefits the URPr has the potential to provide, can be used to create a strong business case for other institutions to apply for funding for similar programs. As well, the money saved in utility costs from the retrofits can be used to further fund the program, which lightens the financial pressure on campuses. There are many opportunities for institutions to apply for low interest loans and receive matching grants to kick-start their programs, making the funding model used for UCalgary's URPr easily transferable.

Replicating the engagement strategy is possible for institutions, and is an important aspect when transferring the energy and emission reduction programs to their campuses. This component is fundamental when designing a program that considers the "human layer" in the overall system.

High Performance Green Buildings

The Green Building Program is also easily transferable to other campuses as it involves LEED certified buildings, a green building certification program that is available across all of North America. As an academic institution, the University of Calgary's primary mission is education and research. Since the first green building opened its doors in 2007, the university has demonstrated a commitment to learning and research in green buildings through actively sharing its experiences with the campus community and beyond. On-campus outreach and educational activities include green building tours, educational signage (to make visible the link between building operations and occupant and environmental health), as well as hosting events on campus to support the development of young green building professionals in the region. In the past 10 years, the university has hosted more than 100 green building related events on campus involving thousands of students, staff, faculty and community members. University staff and faculty also actively shared knowledge by presenting at conferences in Canada and the United States and by publishing articles. Through these actions, the university is reaching out to the critically important members of industry to support their knowledge development in green building practices. Other institutions can use the University of Calgary's learnings from their experience with green buildings and adapt it to fit the needs of their own institution.

Both the URPr and the High Performance Green Building Program have incorporated campus as a learning lab projects. The campus as a learning lab approach is one that is transferable and adaptable. The CLL initiative at the University of Calgary was designed based upon existing approaches and best practices, and the University of Calgary is committed to sharing its approaches and best practices regarding experiential learning for sustainability through the "Campus as Lab Community of Practice" which is co-hosted by the University of Calgary and Princeton University. The Community of Practice has members from over 100 post-secondary institutions across North America. To-date, the Community of

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Practice has hosted monthly webinars to enable knowledge sharing. There are discussions underway regarding how to use the Community of Practice to enable members to advance sustainability more effectively on their respective campuses.

The internal education and engagement conducted through the High Performance Green Building Professional Development program is a model that could be easily adopted by other organizations. Additionally, much of the specific content developed for this program is easily transferable to other institutions. Inter-institutional partnerships of this nature are mutually beneficial allowing the post-secondary sector to further leverage specific expertise.

Institutional and Community Benefit

URPr

The University of Calgary's Sustainability Strategy lays out goals and objectives toward becoming one of the most energy efficient campuses in Canada through reductions in energy usage. Additionally, sustainability is one of the priorities in the university's Academic Plan which supports the integration of utility reduction programming to experiential learning for sustainability through the campus as a learning lab program. Annually, university administration reviews the Utility Reduction Program, prepares a business case for annual investment/borrowing and provides updates on the progress to the university's Board of Governors. The Utility Reduction Program was a natural fit for the University of Calgary's existing buildings, as it nicely complements UCalgary's approach to demonstrating high performance green buildings when constructing new projects.

High Performance Green Buildings

To date, we have 11 LEED certified projects, two of them Platinum – this makes the University of Calgary one of the largest concentrations of green buildings on any post-secondary campus in Canada. The High Performance Green Building program, in conjunction with the utility reduction program for existing buildings, lays a strong foundation in supporting the University of Calgary in becoming a carbon neutral campus.

The university has utilized the High Performance Green Building Program to inspire and educate the campus community and beyond. Internally, students have benefited from applied-practice experience through involvement in LEED projects. Faculty have published post-occupancy research papers and undertaken class projects related to green building practices. Examples include life cycle assessments, GHG emission inventories and post occupancy performance assessments. Within operations, lessons learned have been integrated into institutional design standards informing all campus projects. The university has fostered continuous improvement and recently completed buildings are demonstrating the highest levels of energy performance to date – at no additional construction cost.

Externally, the university has also inspired others and demonstrated positive impact. The university's pioneering work including a LEED Platinum project in 2007 paved the way for others in public and private sectors. The 2007 certification far exceeded the Province of Alberta's new (2006) requirement for all provincially funded buildings to attain LEED Silver certification thereby serving as a catalyst. Today, there are more than 40 green building projects across 10 post-secondary institutions in Alberta. Alberta has more certified building area per capita than any other province. Across Canada, the University of Calgary is recognized as a leader in green buildings.

Buildings that fall under the High Performance Green Buildings program have been designed to positively benefit teaching and learning at the institutional level. With the wide-open spaces and cutting-edge technology at the [Taylor Institute for Teaching and Learning](#) and the brand-new [Canadian Natural Resources Limited Engineering Complex](#), UCalgary is creating spaces that help advance how we teach and learn. Classrooms and buildings across campus are being transformed to provide more room for peer-to-peer learning and technologies. These optimized spaces are making it easier to create new, more engaging learning experiences for students, from 'speed dating' to pick teammates to taking time

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to sit quietly after discussing a difficult history. Better teaching and learning environments benefit both instructors and students.

Management Commitment & Employee/Student Involvement

Management Commitment

The work completed under the URPr and High Performance Green Building Program directly aligns with, and support, commitments made by senior leadership, managerial and support staff through two documents: the University of Calgary’s Eyes High Strategy, and the Institutional Sustainability Strategy.

i) *Eyes High Strategy*: The Eyes High Strategy is comprised of three pillars (sharpen focus on research and scholarship; enrich the quality and breadth of learning; and integrate the university with the community) woven together by student experience and campus culture (Figure 3).



Figure 3: Three foundational commitments of the Eyes High Strategy

By utilizing the URPr to retrofit existing spaces or the High Performance Building Program to create new spaces, the two programs enhance student experience and contribute to a campus culture that is integral to advancing the three foundational commitments of the university’s Eyes High Strategy.

ii) *Institutional Sustainability Strategy*: The Institutional Sustainability Strategy builds on the University of Calgary’s established foundation in education and research, community engagement, and operational practices, and created a roadmap to leadership innovation and the discovery of knowledge to create a

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more sustainable future. The strategy is supported by three interdependent frameworks (education and research; community engagement; and operations). The work undertaken through the URPr and High Performance Green Energy Program aligns with, and supports, the operations framework by improving sustainability performance, modeling social responsibility across administrative and operational endeavors and using the campus as a learning lab for applied practice in sustainability.

Employee/Student Involvement

i) *Supporting Student Success Through Experiential and Applied Learning:* The University of Calgary has a Campus as a Learning Lab (CLL) initiative. The “learning laboratory” is an innovative concept that coordinates research, teaching, and operations on campus in all areas of sustainability, with a focus on generating real world, innovative outcomes relevant to the campus community and beyond. Students gain real world, hands-on experience with research that enables them to apply their learnings to sustainability challenges on campus. Staff gain insight, information and support with projects are provided with an opportunity to work with students and faculty. CLL projects enable staff to work with students and faculty to engage in research that they may not have the capacity or resources to undertake on their own. Faculty can broaden their teaching practice and students’ learning opportunities through experiential learning and applied research on campus, offering real-world application. CLL projects provide faculty opportunity to expand their research, and to collaborate with students and staff on innovation and relevant studies into real sustainability challenges on campus.

ii) *Staff Involvement Through URPr Engagement:* The URPr and High Performance Green Building program on campus strive to include campus members, especially students, from start to finish in the various projects through the CLL program. The engagement component of the URPr aimed to facilitate implementation of the proposed energy conservation measures (ECMs) by inviting input from operations and occupant stakeholders to prioritize and refine recommendations based on their knowledge of their buildings. The engagement strategy is two-tiered to ensure both facilities management and building occupants are both given opportunities to provide input throughout the program. What is unique about this two-tiered approach is that they are involved in multiple stages of the program. Another unique piece of this engagement strategy, is the enhanced feedback mechanism. This process is designed to shorten the feedback loop between occupants and implementation so that ECM’s can be refined quickly with minimum discomfort or disruption to users. This feedback mechanism is highly effective due to prior meetings with key building occupants who participated in occupant consultation. Their prior knowledge of the program and recommendations allows them to provide useful feedback to the program team. Overall, this engagement strategy contributed to high accuracy of ECMs, reducing unexpected issues during the implementation phase, improving operator and occupant ownership of recommendations, and increasing persistence of energy savings. Stakeholders engaged with during this process included building occupants (staff and students), Campus Engineering, Facilities Management and Information Technologies, to name a few. By engaging both facilities staff and building occupants multiple times throughout the program a “one family” culture was developed ensuring all stakeholders felt included and considered.

iii) *Student Internship Program:* The Office of Sustainability has a long-standing student internship program. Student internships in the Office of Sustainability support both the URPr and High Performance Green Buildings program. Below are two testimonials by the current student interns speaking to how their internship experience has supported their student success.

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“I have been interning with the office of sustainability for almost two months. As a graduate student pursuing a Masters in Sustainable Energy Development, the position could not have been more relevant to my future career path. I am currently working on the University’s Utilities Reduction Program (URPr) and have gained useful skills in measuring energy use, water use, and greenhouse emissions. As a professional seeking to work for a more sustainable future, my position of the Office of Sustainability is furthering my ambitions by giving me valuable technical skills and insights into energy management, and sustainable development. It has been a pleasure to be part of the Facilities family!” - *Feras Obeid, Master of Sustainable Energy Development student and Office of Sustainability Intern*

“Being an intern working on both of these programs provides endless opportunities to my technical and my professional development which together directly support my success. The exposure I am receiving ranges from managing stakeholder and contractor relations, all the way to learning how to integrate emerging sustainable technologies and practices. These programs have also given me chances to tour mechanical rooms and construction sites allowing me to get that critical visual hands-on experience. With having previously studied, and lived on campus, plus knowing I will be returning to study in these exact buildings I am working on, allows me to offer valuable insight to ensure the effects of these programs are not only achieving environmental stewardship, but also helping maximize on future student success.” - *Victoria Page, Undergraduate student in Engineering and Office of Sustainability Intern*

Documentation and Analysis

- Stakeholder engagement is ongoing as part of the Utility Reduction Program to identify challenges faced by building occupants and how buildings are used. This process helps to determine which measures would be most beneficial and defines a timeline for making changes in a particular building.
- The first year of the Utility Reduction Program (five years total) included analysis and design, and implementation of the building upgrades.

List of associated documents and analysis

- Institutional Sustainability Strategy
- Eyes High Strategy
- Annual Institutional Sustainability Report
- URPr Engagement Strategy
- URPr Business case
- URPr Measurement and Verification Plan