2020-2025 ENERGY DEMAND MANAGEMENT PLAN

CONTENTS

1.0 EXECUTIVE SUMMARY

The University of Calgary's Energy Demand Management Plan (EDMP) is focused on improving existing building energy performance. A supporting document to the University of Calgary's 2019 Climate Action Plan, the EDMP identifies engagement, operational, reporting and technological advancement opportunities that will assist the institution in its pursuit of 50% (from 2008 base year) institutional greenhouse gas (GHG) emissions reduction target by 2030 in support of the larger goal to reach carbon neutrality by 2050.

The EDMP was developed by the Office of Sustainability under the strategic direction of the Energy and Emissions Steering Committee (EESC) and through consultation with representatives from various departments including Energy & Utilities, Operations & Maintenance, Campus Engineering, and the Project Management Office. Additionally, representatives from Information Technologies provided valuable input. Inspired by best practices in energy management, including the internationally recognized ISO 50001 standard, the EDMP offers impactful recommendations to unite people, technology, and processes, and to align them with the university's strategic vision for sustainability. Key actions include:

1. Prioritizing investments in energy retrofits and continuous energy performance monitoring to reduce energy consumption in the university's top energy consumers;
2. Implementing an Energy Management Information System (EMIS)
3. Cultivating an energy-centric operating culture through enhanced training, engagement and communications; and
4. Conducting ongoing energy performance assessments and reporting activities to monitor the effectiveness of our approaches and support continuous improvement.

Focusing on the university's top energy consumers on the main and Foothills campuses through investments in energy retrofits and continuous energy performance monitoring will make a significant impact on the university's overall energy consumption. Based on preliminary modelling and analysis, it is estimated that a 30,000 tonne GHG reduction in existing buildings is roughly equivalent to a 20% reduction in energy consumption at the building level. A reduction of this order of magnitude will not only put the University of Calgary on a solid path towards carbon neutrality by 2050, but will also put the institution in a leadership position for energy performance among the research intensive universities in Canada.

Implementing an EMIS as part of the EDMP is a foundational component that will provide co-benefits such as enhanced decision-making and efficiency in capital renewal planning and operations & maintenance planning, as well as key data for workforce and occupant engagement. Campus energy use assessments indicate that 20 buildings account for approximately 80% of the University of Calgary's total building energy consumption, with laboratory buildings being the largest energy users. To address this issue, the EDMP prioritizes efforts on energy intensive buildings by identifying energy improvement opportunities across the institution's top energy users. Proposed initiatives include the basic retrofits delivered through the Utility Reduction Program (URPr), deep energy retrofits, and operational improvements for energy optimization. These programs will use data-driven decision making processes to create an energy efficiency culture across Facilities, improve institutional energy performance, and reduce GHG emissions and utility costs.

Successfully implementing the EDMP will require ongoing assessments and reviews as well as building occupant behaviour change, collaboration, and teamwork across the institution. Conducting assessments and reporting progress will assist the university with continuous improvement and an evaluation of the effectiveness of our efforts towards institutional goals and targets. Additionally, given the number and diversity of campus building types, and the approximate 40,000 people that regularly engage with our buildings, occupant engagement and behavior will play an important role in reducing overall energy demand. Providing campus groups with the proper supports will build capacity and empower building occupants and operational staff to take ownership for improving existing building energy performance in their daily practices.

2.0 INTRODUCTION

2.1 Foreword

According to the United Nations Environment Programme (UNEP)[1], daily building operations account for approximately 28% of global carbon emissions annually. Experts across the globe have developed greater awareness for the interconnected relationships of climate change, greenhouse gas emissions and built environment, putting greater impetus on organizations to deploy innovative solutions to reduce energy demands from new and existing buildings. As a signatory to the 2015 Paris Agreement, Canada committed to reducing national GHG emissions by 30% by 2030 in an effort to reduce global carbon emissions. In 2018, the University of Calgary surpassed the 2030 national target by attaining a GHG reduction of 30% across the institution from the 2008 baseline. However, as the University of Calgary campus continues to grow in response to rising campus populations, so too does its built environment. Ensuring future sustainable development across the institution's campuses requires concerted efforts to reduce energy demands from existing buildings, as well as behaviour changes from the campus community.

2.2 Background

In 2016, the University of Calgary launched its Institutional Sustainability Strategy (ISS), which includes the aspirational goals of striving to attain carbon neutrality and becoming one of the most energy efficient research campuses in Canada. The ISS is supported by three interdependent frameworks: Framework for Advancing Sustainability Education and Research, Framework on Engagement for Sustainability, and the Framework on Sustainability in Administration and Operations. The University of Calgary's actions to date and the rapidly evolving regulation and policy trends subsequently called for the renewal of the university's Climate Action Plan. Published in 2019, the renewed University of Calgary's Climate Action Plan (CAP) is the institution's operational roadmap for the transition to a carbon neutral campus by 2050. The CAP focuses primarily on Scope 1 and 2 GHG emissions, of which over 99% are attributed to the built environment. The CAP outlines four key focus areas to drive GHG emissions reductions: green power, new building innovation, existing building energy retrofits, and decarbonization of the district energy system (DES) on main campus. The University of Calgary's 2019 CAP calls for the reduction of 73,000 tonnes of GHG emissions below the 2018/19 level by 2030 as an intermediate step on the institutional path towards carbon neutrality by 2050. Of these reductions, 30,000 tonnes need to come from existing building energy performance improvements.

In support of the University of Calgary's *Eyes High* and Institutional Sustainability Strategies, the Facilities team at the University of Calgary strives to create a campus environment that inspires research, learning and community, enriches student experience and advances sustainability. Since 2010, the university has made steady progress towards GHG emission reduction goals through a variety of sustainability initiatives, including the Green Building Program and the Utility Reduction Program (URPr). Achieving carbon neutrality necessitates further actions to reduce energy demand from existing buildings. The development and implementation of the EDMP will support operational, engagement and training initiatives to enable the university to achieve significant energy consumption and GHG reductions in its existing buildings, thus reducing operational costs. These reductions are critical steps towards the university's aspirational goal of carbon neutrality by 2050.

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[1] World Green Building Council (2017). *Global Status Report 2017*. Retrieved from https://www.worldgbc.org/sites/default/files/UNEP%20188_GABC_en%20%28web%29.pdf

3.0 PLANNING CONTEXT

The University of Calgary achieved a GHG emissions reduction of 30% below its 2008 baseline in 2018/19. Guided by the university's 2019 CAP, and the ISS and its Framework on Sustainability in Administration and Operations, the university aims for carbon neutrality by 2050, and has set intermediate GHG emission reduction targets of 35% by 2025, and 50% by 2030 below the 2008 baseline. The 2030 GHG reduction target of the CAP represents an absolute reduction of 73,000 tonnes of CO_2e from 2018 levels. Modelling carried out as part of the development of the 2019 CAP estimated that this target could be achieved through the combined effect of three major initiatives: new building innovations (10,000 tonnes), procurement of green power (33,000 tonnes), and existing building energy retrofits (30,000 tonnes). Further emissions reductions towards the 2050 goal will include additional GHG reductions in these three categories and through the decarbonization of the District Energy System (DES).

To address these institutional priorities, Facilities will develop, build and operate the campus in a manner that is aligned with best practices in energy efficiency and the aspirations of the CAP. The EDMP provides a pathway for improving the energy performance of existing buildings. Based on preliminary modelling and analysis, the Facilities department has estimated that a 30,000 GHG tonnes reduction in existing buildings is roughly equivalent to a 20% reduction in energy consumption at the building level. A reduction of energy consumption of this order of magnitude will not only put the University of Calgary on a solid path towards carbon neutrality by 2050, but will also put the institution in a leadership position in terms of energy performance among the research intensive universities across Canada.[2] A departmental Energy Policy was developed by Facilities in May 2020 as a supporting document to the EDMP to inform Facilities' efforts towards best practice in energy management and the aim to become one of the most energy efficient research campuses in Canada. Appendix C provides additional details on the Energy Policy and Facilities' commitment to manage its energy usage and improve its energy performance to minimize the environmental, economic and social impacts associated with the planning, design, construction, operation, and maintenance of its facilities.

Boundary and Exclusions

The EDMP includes all forms of energy purchased by the University of Calgary to operate all facilities under its control. The energy used by each building is accounted for through tracking building level energy use. Fuel used for mobile equipment and fleet is excluded. The list of buildings included in the EDMP analysis is provided in Appendix D.

4.0 PERFORMANCE ASSESSMENT & REPORTING

The ISO 50001 standard and other energy management guidelines require that organizations conduct periodic management reviews to assess performance of their energy management system and track progress towards their energy performance goals. At the University of Calgary, the management review will be conducted once a year by the Energy and Emissions Steering Committee (EESC). The Climate Action Plan Working Group (CAPWG) will work under the direction of the EESC and in collaboration with different business units across facilities to develop and implement concrete actions that aim to achieve the goals and targets of the CAP and EDMP.

[2] University of Calgary Office of Sustainability. (2019). Internal analysis carried out using publicly available data from the Sustainability Tracking and Reporting System (STARS). Retrieved from https://stars.aashe.org/

At the University of Calgary, the EESC is the main body responsible for the advancement of the 2019 Climate Action Plan and the 2020 Energy Demand Management Plan. Institutional and building-level energy performance will be reported once a year to the EESC by the Director, Energy Planning and Innovation (EPIT) and the Director, Energy & Utilities.

The CAPWG will work under the direction of the EESC and in collaboration with different business units across facilities to develop and implement concrete actions that aim to achieve the goals and targets of the EDMP. Energy performance data will be reviewed by the working group quarterly.

Recommended Actions

Short-Term Actions

- CAPWG to confirm scope and timelines of the management review with the EESC.
- CAPWG to update proposed RACI chart and obtain endorsement from EESC (Appendix I).

Mid-Term Actions

- Assess EWEW Group progress and membership. Adjust as needed.
- Develop an ISO 50001 internal audit process.

Long-Term Actions

- Consider implementation of ISO 50001 external audits towards full accreditation.

4.1 Management Review

According to the ISO 50001 standard, organizations should carry out a management review periodically of its energy management system (EnMS). Management reviews assist organizations to achieve continual improvement and to assess the suitability, adequacy and effectiveness of its EnMS. EnMS effectiveness is evaluated against the energy policy, objectives and targets. The management review should also address external factors relevant to institutional energy performance and identify opportunities for improvement and, where appropriate, changes of emphasis or direction.

The scope of the management review typically includes:[3]

- Evaluating overall progress towards energy performance goals;
- Reviewing and revising the energy policy, objectives, and targets;
- Reviewing findings of previous management reviews of the EnMS;
- Evaluating the effectiveness of the EnMS and Energy Performance Indicators;
- Reviewing changes in areas such as legislation, expectations and requirements of stakeholders, organizational structure, strategic priorities of the organization, and advances in technology;
- Projecting/forecasting energy performance for the next period;
- Reviewing resources allocation; and
- Identifying room for improvement.

Facilities will conduct a management review of the energy performance of the University of Calgary at least every two years with evaluations spread over an alternating two year window. The process of data gathering and analysis for the management review will be led by EPIT with support of Campus Engineering, Energy & Utilities, Operations & Maintenance, and the Project Management Office. The management review will be conducted by members of the Energy and Emissions Steering Committee (EESC).

[3] ISO 50001 Energy Management System (EnMS) - Implementation guide. (2014) TÜV UK Ltd Retrieved from https://www.tuv-nord.com/fileadmin/Content/TUV_NORD_COM/TUEV_NORD_UK/pdf/iso-50001-guide-and-check-list-uk.pdf

5.0 INSTITUTIONAL ENERGY USE

Most of the energy consumed by the University of Calgary is used for heating purposes on the main and Foothills campuses. Lab-type buildings are the largest energy users across the institution, with the buildings on the Foothills campus representing about 30% of the total energy consumption at the building level. Significant improvement on the institution's energy performance can be achieved by addressing energy consumption in the university's top energy users through investments in energy retrofits, operational improvements (e.g. energy centered maintenance), and continuous energy performance monitoring. Additional improvements could also be achieved by increasing efficiencies throughout the DES. The conversion and distribution losses of the DES are currently estimated to be in the order of 30%-40% of the total energy purchased by the university.

Appendix B provides additional details on energy performance targets and energy performance indicators.

Recommended Actions

Short-Term

- The Climate Action Plan Working Group (CAPWG) to identify key low/no cost energy reduction initiatives to start implementing in the year 2020/21 and develop a rolling three-year priority list. Appendix F presents a number of suggested initiatives.
- Establish three and five-year energy performance targets and key supporting strategies for buildings selected by the CAPWG across the institution, starting with the university's top energy users and the projects on capital planning priority list.
- Initiate conversations with ancillary services and the Olympic Oval with the goal of collaborating more strategically in future capital investment in unsupported buildings.
- Investigate ways to optimize efficiencies throughout the DES on main campus.

Mid-Term

- Develop a strategic framework to leverage synergies between funding streams to create energy retrofit projects and continuous energy performance monitoring in top energy users and laboratory spaces.
- Implement measures to optimize efficiencies throughout the DES on main campus.
- Confirm a renewed Utility Reduction Program (URPr) that blends short and medium payback periods and confirms a funding strategy to support continued broad-based energy conservation measures following completion of the current URPr.

Long-Term

- Increasingly focus on energy retrofit projects that reduce heating loads and thus reduce natural gas consumption. (Due to the current low cost of natural gas, these projects tend to have longer paybacks.)

Current Energy Use Profile

The University of Calgary used approximately 700,000 megawatt hour (MWh) of energy during the fiscal year 2018/19. About 400,000 MWh of the energy consumed by the institution was used in 52 buildings serving a population of approximately 36,000 students and staff. The difference between the institutional energy consumption and the building level total represents losses due to energy conversion and distribution processes, as well as the energy used for other purposes such as exterior lighting. Table 1 presents a summary of key figures related to the university's energy consumption in fiscal year 2018/19.

Table 1. Total Energy Use and Energy Intensities, Fiscal Year 2018/19

	Unit	Institutional Level Total	Building Level Total
Total Energy Use	Kilowatt-hour (kWh)	691,635,345[4]	437,963,317[5]
	Gigajoules (GJ)	2,489,889	1,576,668
Campus Population	Weighted Campus Users	36,380[6]	
Building Area	Gross square metre (GSM)	1,037,871[7]	
Energy Use Intensity (EUI)	GJ/FTE	68.4	43.3
Energy Use Intensity (EUI)	GJ/GSM	2.40	1.52

Natural gas represents almost 90% of the university's total energy consumption (Figure 1). Natural gas is used primarily for the generation of heating water and electricity (through the cogeneration unit) on main campus and for the generation of steam at the Foothills campus. Steam is generated at the Alberta Heath Services (AHS) power plant and purchased by the university. Grid electricity accounts for about 11% of the institutional energy consumption. Propane represents only 0.2% of the institutional energy consumption. The university's main campus is responsible for 70% of the total institutional energy consumption, followed by the Foothills campus, which accounts for an extra 27% (Figure 2). It should be noted, though, that the Foothills campus represents only about 20% of the institution's total building area.

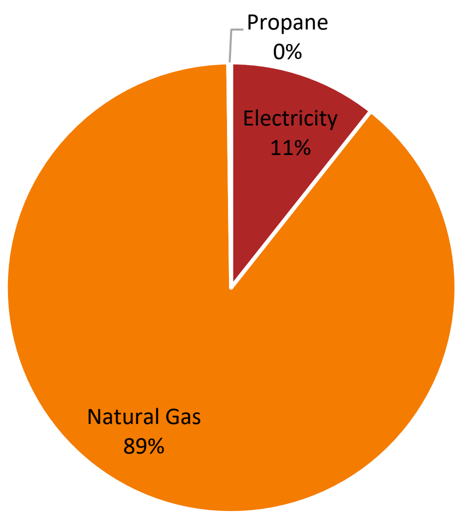


Figure 1 – Institutional Energy Use by Type, 2018-19

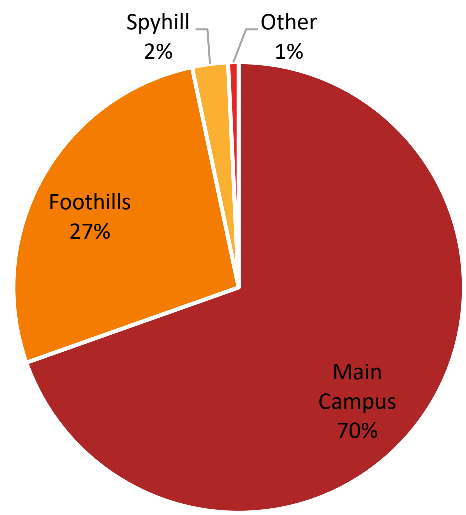


Figure 2 – Institutional Energy Use by Campus, 2018-19

[4] Source: 2018-19 OP5 – Calculator.xlsx
[5] Source: 2019 University of Calgary EUI.xlsx
[6] Source: Weighted Campus User Calculations for the 2018-19 Sustainability Report based on numbers provided by the OIA, Registrar's Office and Ancillary Services
[7] Source: 2021_FloorSpace_DisclApprov_June22 signed by Boris (002).pdf

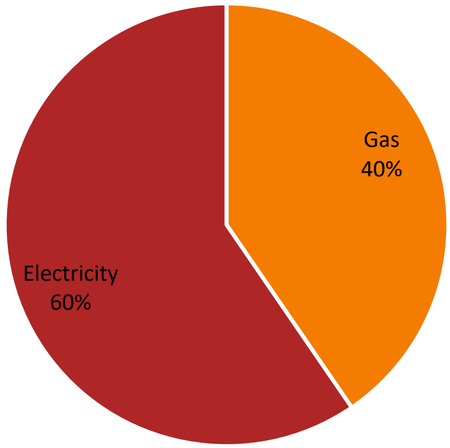


Figure 3 – Institutional Energy Cost by Type, 2018-19

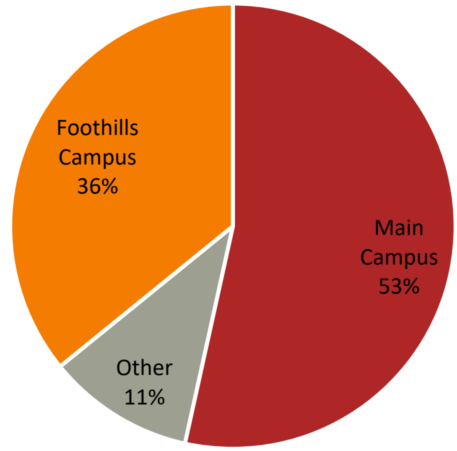


Figure 4 – Institutional Energy Cost by Campus, 2018-19

Figures 3 and 4 present the institutional energy costs by type of energy and by campus. Even though electricity represents only 11% of the institutional energy consumption, it accounts for about 60% of total energy costs. Main campus accounts for about half of the university's energy costs.

Historical Trend

Total institutional energy consumption has increased in similar proportion to area growth (Figure 5). In 2012/13, the university installed a cogeneration system in the central heating and cooling plant at main campus. This addition significantly reduced institutional reliance on grid electricity while concurrently increasing natural gas consumption. Institutional energy use intensity (EUI) increased slightly from 2.38 GJ/GSM in 2009/10 to 2.40 GJ/GSM in 2018/19. Figures presented in Figure 5 are based on absolute energy values and do not take into consideration the effect of weather on institutional energy consumption.

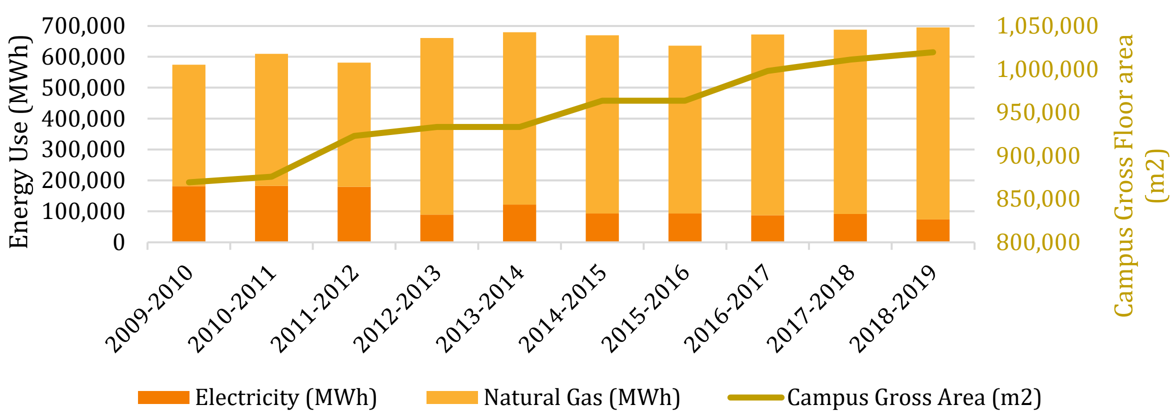
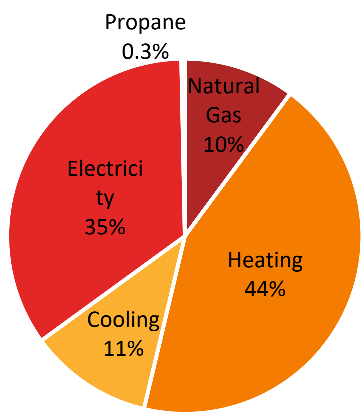


Figure 5. Institutional Energy Use by Year

Building Level Energy Uses

About 60% of the energy crossing the institutional boundary is directly used at the building level, for heating, cooling, lighting, and process loads. In a colder climate, the majority of the energy consumed at the building level is used for heating (44%), followed by electricity (35%), cooling (11%), natural gas (10%), and propane (0.3%) (Figure 6). Natural gas is used primarily for process loads and to heat buildings not connected to a central heating plant. Laboratory-type buildings are the largest energy users (59%), followed by classroom-type (13%), offices (10%) and student services-type (10%) (Figure 7). A list of buildings classified under each category is provided in Appendix D.



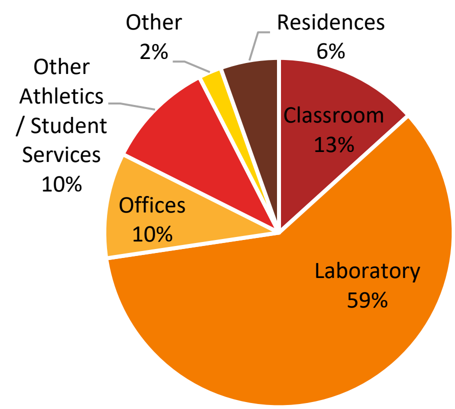


Figure 6. Building Level Energy Consumption by End Use (2018/19)

Figure 7. Building Level Energy Consumption by Building Type (2018/19)

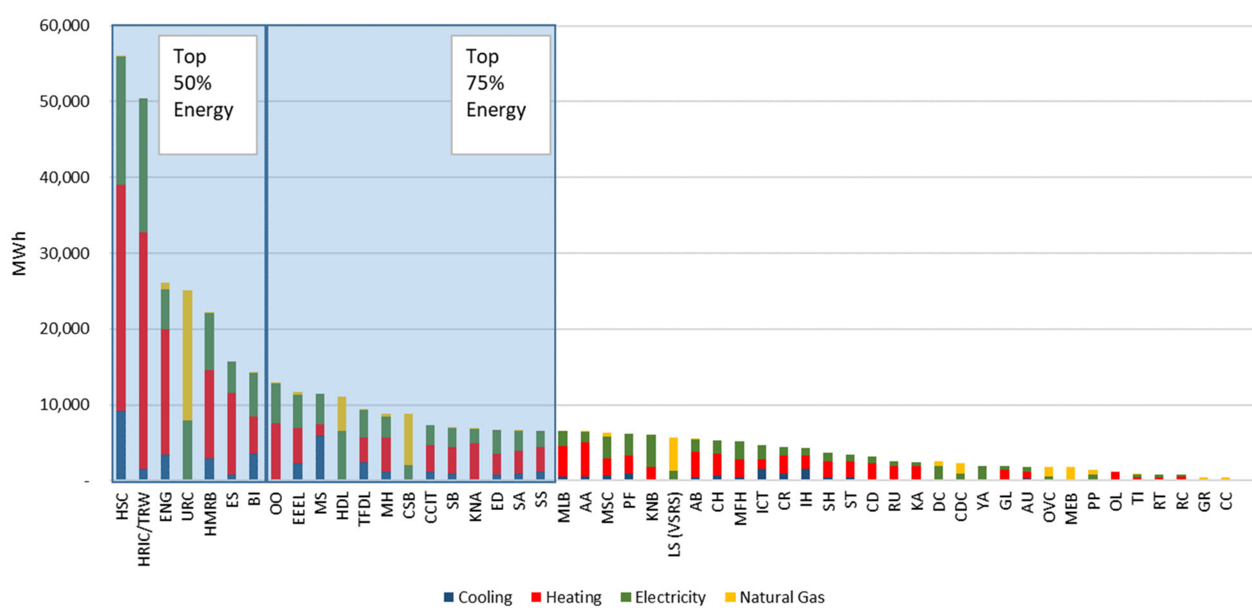


Figure 8. Significant Energy Users (2018-19)

Figure 8 presents a list of university buildings ranked by total energy use. The top three energy users account for about 30% of the total energy use at the building level. The top eight buildings account for about 50% of the building level energy consumption, and the top twenty energy users account for about 80%. This highlights the importance of addressing energy performance in the university's top energy users through investments in energy retrofits and continuous energy performance monitoring. Focusing on a relatively small number of buildings on the main and Foothills campuses will make a significant impact on the university's overall energy consumption. The Olympic Oval is an unsupported building, but is also ranked among the university's top energy users. Strategic energy-focused investments in the Oval can have a significant impact on the university's energy and GHG emissions performance.

6.0 ENERGY MANAGEMENT INFORMATION SYSTEM

The EMIS generates valuable information to support energy management activities and other business processes.[8] An advanced EMIS enables smart building automation bridging information and operational technologies (OT).

An EMIS enables an organization to improve energy performance and reduce operational costs. It provides timely and relevant information that enables the organization to enhance its performance and reduce utility costs. It also supports other functions, such as sustainability reporting and experiential learning. The University of Calgary has been making strategic investments over recent years to upgrade the EMIS and increase its resiliency. Critical items have been addressed, but continuous investment will be required.

As a foundational component of a comprehensive energy management program, an EMIS provides co-benefits such as enhanced decision-making, efficiency in capital renewal planning and operations & maintenance planning, and data for workforce and occupant engagement.

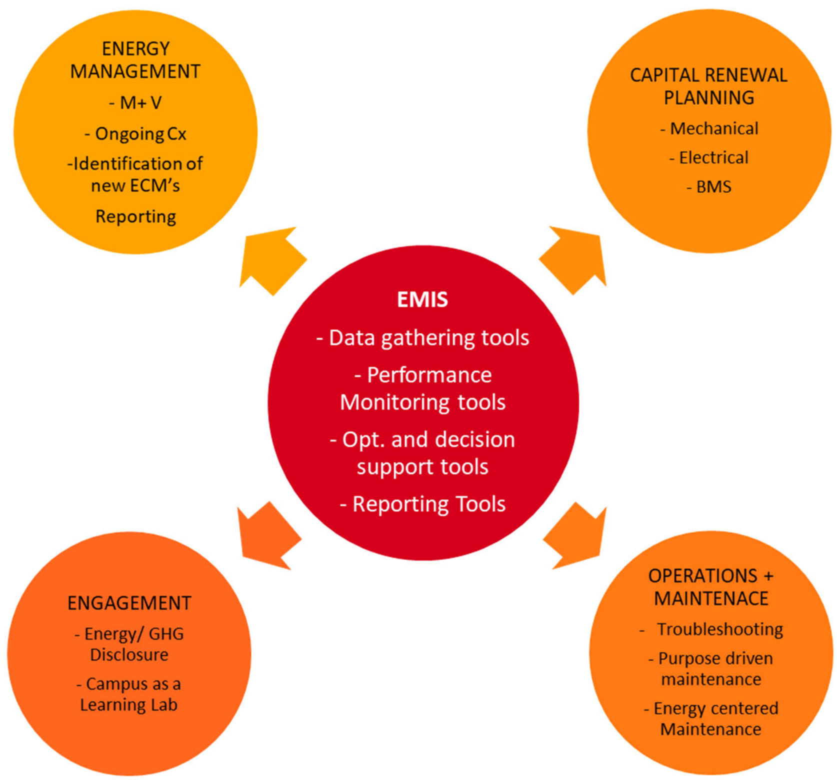


Figure 9. EMIS Supports Different Organizational Functions

A robust EMIS supports a number of important organizational processes as illustrated in Figure 9 and needs such as:

- Data-driven decision-making (strategic and operational)
- Early detection of poor energy performance in building systems
- Accurate internal and external energy performance reporting and validation of energy project performance
- Identification and justification of energy performance targets and energy efficiency projects
- Troubleshooting and diagnosing building operational problems

[8] Natural Resources Canada (2003). Energy Management Information Systems: Achieving Improved Energy Efficiency. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/oee/pdf/publications/industrial/EMIS/EMIS_eng.pdf

- Gathering empirical-operational data to support research, learning, and campus engagement activities
- Ensuring all systems and networks are following industry cyber threat protection practices

Recommended Actions

Short-Term Actions

- Continue Desigo migration across campus including BACnet conversion and Ethernet connectivity upgrades (Refer to Appendix G).
- CAPWG to continue implementation of pneumatic controls phase-out strategic plan (Refer to Appendix H).
- Implement deployment of Fault Detection and Diagnostics (FDD) Software tool (Skyspark) on top 10 energy users to optimize performance and URPr projects (Refer to Appendix H).
- Establish a building meter maintenance and calibration program.
- Leverage energy management software to generate energy data reports for operational teams to increase awareness and transparency.
- Engage a third party for threat risk assessment and aid in building the architecture and system standards required to ensure proper cyber security practices.
- Start the development of the OT governance (e.g. roles & responsibilities; support model, IoT/OT acquisition).

Mid-Term Actions

- Complete Desigo migration across campus (Refer to Appendix G).
- Complete pneumatic controls phase-out strategic plan (Refer to Appendix H).
- Complete deployment of FDD tool (Skyspark) on top 20 energy users (Refer to Appendix H).
- Develop jointly with IT a strategic technology roadmap (architecture, cybersecurity).
- Leverage FDD tool for predictive maintenance.

Long-Term Actions

- Build a secure and robust Networking Architecture focused on building operations.
- Develop a long-term upgrade plan for all digital technologies on campus.
- Leverage FDD tool for building self-tuning.
- Establish the ongoing governance and ensure the continuous cyber security monitoring of these networks and devices.

Deployment

The EMIS at the University of Calgary is composed of three functional layers: the building systems layer, the communications layer, and the processing and visualization layer. Each layer is required to enable the functionality of the other two. The lower layers provide the necessary foundation to support the activities happening at the top layer(s). The middle communications layer requires IT and Facilities to work together to ensure that new digital building technologies are deployed effectively, while minimizing cybersecurity risks. Figure 10 illustrates the relationship between these three functional layers.

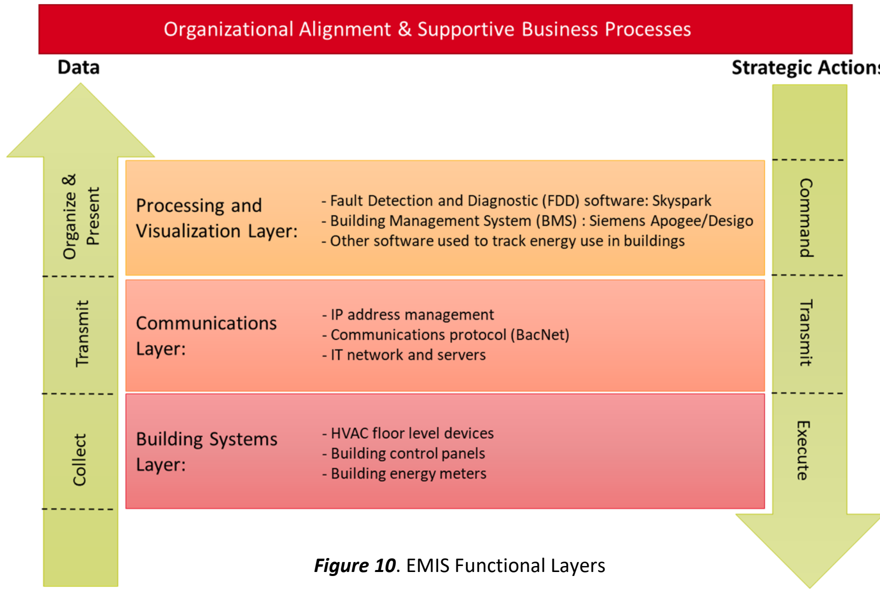


Figure 10. EMIS Functional Layers

Appendix B provides additional details on EMIS deployment.

7.0 PROJECT DEVELOPMENT & IMPLEMENTATION

To achieve the GHG emissions reduction goals of the 2019 CAP, the university must implement a number of initiatives that include deep energy retrofits, basic energy retrofits, and monitoring-base commissioning (MBCx). It is also critical to maintain energy performance targets as part of the goals of capital projects and develop action plans at the operational unit level to identify specific actions and track their implementation and success.

Appendix B provides additional details on institutional level targets and major initiatives.

Recommended Actions

Short-Term Actions

- Maintain an energy-sensitive approach for all capital and capital renewal projects through collaboration between the Energy Planning & Innovation (EPIT) team and Facilities Development.
- EPIT, Campus Engineering, and Operations & Maintenance (O&M) team to develop and pilot an energy-centered maintenance approach jointly with monitoring-based commissioning.
- Quality management system (QMS) specialist and energy manager to facilitate the development and implementation of action plans for key operational units within Facilities, in alignment with ISO 50001.

Mid-Term Actions

- CAPWG to develop an institutional basic energy retrofit program.
- CAPWG to initiate the conceptual development of an institutional deep energy retrofits program for energy-intensive spaces.
- EPIT to begin implementation of an energy-centered maintenance approach jointly with MBCx with a focus on top energy users.
- CAPWG to review design standards to ensure it is up to date with energy efficient equipment.
- Develop and approve a green building policy.

Long-Term Actions

- CAPWG to consolidate all energy projects documentation in one central location and automate energy performance reporting.

8.0 ENGAGEMENT, TRAINING & COMMUNICATIONS

Engagement, communications, and training must be part of any energy management program. All forms of training should follow the training cycle, as the steps are critically important in the delivery of an effective program. Several studies have documented the financial and organizational benefits of these efforts. In consultation with stakeholders across Facilities, the basic components for a comprehensive energy management training and awareness program have been identified. Further work will be undertaken in collaboration with stakeholders to address their specific needs.

Recommended Actions

Short-Term Actions

- EPIT to follow-up with Facilities groups to better understand energy scorecard results and help inform communications key messages and training needs.
- CAPWG to confirm training needs for Facility Managers, HVAC mechanics, Zones trades, Campus Engineering and Building Management System Technician staff.
- CAPWG to develop an energy management training program based on the training cycle and the five energy management training components.
- CAPWG to determine engagement strategies for key Facilities groups identified above.
- CAPWG to develop a launching and communication plan to create awareness of the Energy Policy, the EDMP, and energy efficiency in general across Facilities.

Mid-Term Actions

- Design and deliver 1-3 behaviour change campaigns per year.
- Design and deliver training programs for staff identified above based on the principles presented in this section.
- Develop and implement a communications plan with regular communications to staff ensuring energy management remains top of mind for staff.

Long-Term Actions

- Assess training needs for remaining Facilities staff. Design and deliver training to address gaps.
- Deliver follow-up training for O&M staff as needed.
- Re-fresh communications plan.

8.1 Engagement

Building Occupant Engagement

Studies have shown that occupant behaviour plays a significant role in affecting actual versus modelled building energy performance.[9] Research also shows that the degree to which occupant behaviour affects performance varies greatly by methodology, location and building use. Additionally, given both the number and diversity of building types and functions on the University of Calgary campuses, and that there are regularly approximately 40,000 people engaging with its buildings, occupant behaviour and engagement will play an important role in reducing the university's overall energy demand.

Engagement programming is most effective in environments where participants see the impact of their own behaviour change. This can be challenging in large buildings and particularly where occupants are more transient in nature. With regard to building energy use and demand, real-time data sharing through means such as visual dashboards, serve as an effective way to engage occupants to consider their role in the energy use of the buildings they occupy. Dashboards can be displayed on desktops and other university supported IT equipment as well as in public spaces so that information is also accessible to passing/short-term occupants. This in combination with engagement programming encompassing an annual campus-wide campaign and ongoing tailored building and audience specific communications and training, will most robustly support the advancement of the CAP and EDMP.

Additionally, the university is uniquely positioned to integrate co-curricular, course based and research opportunities for students with a view to reducing and analysing energy demands and the relationship with occupant behaviour. An annual campus-wide energy campaign and ongoing communications provide ample opportunity for student volunteers to participate and support occupant engagement. Before and after assessments could be led by academic partners with support from Facilities. Historically, building occupants respond most positively to engagement initiatives on campus that include students.

Operational Staff Engagement

Operational staff play a crucial role in determining if a building is operated sustainably and studies have demonstrated the potential for energy savings through staff training initiatives. For instance, a study commissioned by Natural Resources Canada found that the total energy savings achieved in buildings of the commercial, institutional and government sector as a result of the "Dollars to $ense" training program is estimated at about 666 terajoules per year.[10] Three studies on the U.S. Building Operator Certification Program have also demonstrated significant energy reductions as a direct result of a building operations training program. Most participants and supervisors reported increased occupant comfort in their buildings as well as energy and cost savings.[11]

8.2 Communications

Providing information that is timely, accurate, relevant, and actionable to stakeholders is critical. The EMIS will be leveraged to provide appropriate and frequent reports and dashboards to Facilities management and operational staff. These reports will highlight building energy usage, energy performance indicators, and another relevant building performance parameters. The level of detail in these reports will be tailored to the intended audience.

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[9] Delzendeh, Elham, et al. "The Impact of Occupants' Behaviours on Building Energy Analysis: A Research Review." Renewable and Sustainable Energy Reviews, vol. 80, 2017, doi:10.1016/j.rser.2017.05.264.
[10] Habart and Associates Consulting Ltd. (2003). Impact Attribution for Dollars to $ense Workshops.
[11] RLW Analytics. (2005). Impact and process evaluation: Building Operator Training and Certification (BOC) Program. Retrieved from www.theboc.info/pdf/Eval-BOC_NEEP_2005.pdf.
Opinion Dynamics Corporation. (2009). Evaluation of Kansas City Power and Light's Building Operator Certification Program. Retrieved from www.theboc.info/pdf/Eval-KCPL_BOC_Eval_Report_2010.pdf.
Navigant Consulting. (2011). Evaluation of MN BOC training. Retrieved from www.theboc.info/pdf/Eval-MEEA-MN-BOC-Training-Evaluation_%20FINAL.pdf.

Stakeholder engagement can be promoted through staff recognition, storytelling (e.g. UToday, Facilities communications), and internal campaigns. Best practices suggest an energy management campaign at least once a year. The Sustainability Reporting and Engagement (SRE) unit will provide support to some of these initiatives, subject to their internal capacity.

8.3 Energy Management Training

Energy management training is the process of improving the performance and increasing the awareness of the individuals responsible for energy use in buildings.[12] It is an integral component of any effective energy management strategy and a best practice recommended by Natural Resources Canada.[13] The ISO 50001 standard identifies training as an important method for developing energy management competencies in the organization.[14] Proper energy management training promotes a culture of energy efficiency and good resource stewardship. It ensures that energy savings achieved are sustained over time and new energy saving opportunities are identified, thus maximizing the benefits of the organization's energy management efforts. Training and awareness is a continuous improvement process that, over time, builds capacity and adaptivity within the organization. The training cycle in figure 11 consists of the following steps: assess needs, set objectives, design training, implement, and evaluate.

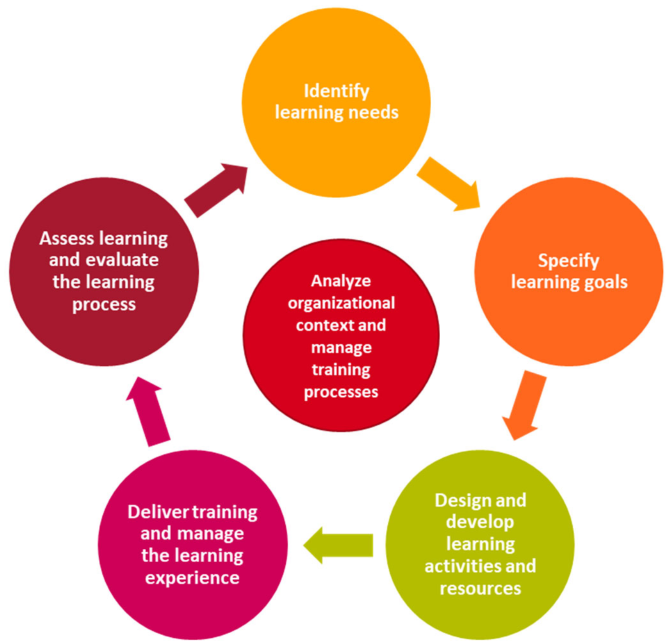

Figure 11. The Training Cycle

[12] Energy Management Training Primer, NRCan
[13] Energy Management Best Practices Guide, NRCan
[14] ISO 50001, section 7.2

9.0 GLOSSARY

Building Management System (BMS) Software – BMS software is the front-end application used to monitor buildings systems, set operational schedules, adjust set points, program control sequences, manage system alarms, and send direct instructions to the building control panels.

Energy Conservation Measure (ECM) – Any type of project conducted, or technology implemented, to reduce the consumption of energy in a building.

Energy Management Information System (EMIS) – "An Energy Management Information System (EMIS) is a performance management system that enables individuals and organizations to plan, make decisions and take effective actions to manage energy use and costs."[15] An EMIS consists of a number of different hardware and software tools that work together to create an integrated performance management system.

Deep energy efficiency retrofits – Significant energy efficiency retrofits addressing base building systems, building envelope and heat recovery. These types of projects can generate energy savings of 30% to 60%.

Desigo – An integrated building management platform for managing high-performance buildings.

District Energy System (DES) – A distributed energy system for thermal energy. Typically served by a central plant.

Fault Detection and Diagnostics (FDD) Software – FDD software monitors building systems in real time and optimizes building's performance by relaying information into relevant, actionable information.

Institutional energy use intensity (EUI) – Measurement of a building's annual energy consumption relative to its gross square footage.

[15] Natural Resources Canada. Retrieved from https://www.nrcan.gc.ca/energy/efficiency/energy-efficiency-industry/energy-management-industry/energy-management-information-systems/20403

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Appendices

APPENDIX A: ACKNOWLEDGEMENT AND ENGAGEMENT

The University of Calgary would like to thank the following groups and individuals for their support and contributions with development of the EDMP.

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Adam Stoker	*Sustainability Consultant*
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Tom Humphries	*Senior Bldg Management System Technician*
Caitlin Campbell	*Energy Data Analyst*

Department Engagement

Campus Architecture	**Life Safety**
Campus Engineering	**Project Management Office**
Customer Care	**Operations and Maintenance**
Energy and Utilities	**Sustainability Reporting & Engagement**

APPENDIX B: SUPPORTING CONTEXT

B.1 Energy Performance Targets and Energy Performance Indicators

Energy Baseline (EnB)

The university has made significant investments in recent years to install and upgrade energy meters in the majority of its buildings. Fiscal year 2018/19 has been selected as the energy baseline (EnB) year due to the enhanced reliability of building energy data obtained from these recently upgraded meters.

Energy Performance Indicators (EnPI)

Proposed energy performance indicators (EnPI) are outlined in Table 2. This set of indicators will allow effective tracking of energy performance at various levels throughout the university and is in alignment with the Framework for Sustainability in Administration and Operations and its associated implementation plan. These EnPI monitor progress at the institutional level for reporting purposes, but will also enable Facilities to track energy performance at a more operational level.

Energy Performance Targets

Preliminary, ten-year energy reduction targets have been established for all buildings across the institution. These targets are listed in Appendix E. The primary goal of these targets is to enable the university to achieve the deep energy consumption reductions required to meet the 2030 GHG emission reduction target set in the university's 2019 CAP. In assigning targets to each building, the following factors were taken into consideration: building age, total energy use, mechanical and electrical system types, building controls, and level of readiness for deployment of advanced energy optimization software. Intermediate, short-term targets for each building are still to be determined, based on more detailed study and analysis of the buildings.

Table 2. Energy Performance Indicators at the Institutional and Building Level

Name	Unit	Review Frequency	Operational Definition	Energy Baseline 2018-19	Ten-year (2030) Target
Institutional Energy Consumption	GJ	Annually	Total energy purchased by the university to operate its buildings minus electricity sold back to the grid	2,489,887	1,991,908

Institutional Level EUI	GJ/GSM	Annually	Institutional Energy Consumption divided by total built area	2.40	1.82
Normalized Total Institutional Energy Use	GJ/HDD	Annually	Institutional Energy Consumption divided by annual heating degree days (HDD)	456.4	398.4
Institutional Level EUI per Campus User	GJ/[FTE+FLE]*	Annually	Institutional Energy Consumption divided by total equivalent campus user	68.4	53.5
Weather Normalized Institutional EUI	MJ/GSM/HDD	Annually	Institutional Level EUI divided by annual degree days	0.45	0.36
Total Building Level Energy Consumption	GJ	Annually	The sum of energy consumption measured by all building-level energy meters across the institution	1,576,667	1,261,333
Institutional-to-Building Level (IB) Ratio	%	Annually	Total Building Level Energy Consumption divided by Institutional Energy Consumption	63%	63%
Building Level EUI	GJ/GSM	Quarterly	Total Building Level Energy Consumption divided by total built area	1.55	1.15
Individual Building EUI	GJ/GSM	Monthly	Total energy consumed by a single building divided by its gross area	See Appendix E	
System Level or Operational Unit EnPI	TBD	As required	Energy Performance Indicator used to track performance of a specific system or energy conservation measure implemented by an operational unit.	TBD	

*Staff and faculty population is measured in FTE. Student population is measured in full-load equivalents (FLE).

B.2 Energy Management Information System Deployment

The Building Systems Layer

The building systems layer includes the physical components and systems required to operate the building. It is also in this layer where building data is collected for analytical purposes. The components within this layer can be further classified into building heating, ventilation and air conditioning (HVAC) floor level devices, building control panels, and energy meters as detailed below.

- HVAC Floor Level Devices – Many buildings on campus were built in the 1960s when the predominant building control technology was pneumatic, which is only locally adjustable. With the advent of Direct Digital Controls (DDC) in the 1980s, pneumatic controls have become largely obsolete. Facilities has been phasing out existing pneumatic controls technology for DDC to provide greater visibility and control over buildings, increase operational efficiencies, reduce the potential risks associated with faulty building operations, and optimize energy performance. As this is an expensive and intrusive process, this work is being undertaken gradually and strategically over the years. Appendix H provides an overview of the amount of pneumatic controls remaining in campus buildings and the recommended order of priority for completion of the remainder of DDC conversions.
- Building Control Panels – The emergence of new control and analytical software has greatly increased building performance optimization as well as the demands on the building control systems. Building panels can be an entry point for cybercrime with lagging building panel technology leading to serious vulnerabilities. Upgrading building control panels will allow the institution to take advantage of emerging analytical software tools and build cybercrime resiliency. A program for maintaining and replacing building control panels will also reduce operational costs by improving building energy performance.
- Metering – Building level metering is critical for diagnosing faulty building operations, identifying energy saving opportunities, and validating performance of energy saving initiates. The university has made significant investments over recent years to install, upgrade and repair building-level energy meters on heating water meters. Over the coming years, the university will need to repair and upgrade some chilled water, electrical, and steam meters. It is critical for the university to have a strategic metering maintenance and calibration program to protect the valuable investment made in this area, address metering needs in the coming years, and provide the university with reliable energy performance data.
- Various Other Systems – With the emergence of smart building technologies also comes a multitude of new building system devices and components. Fume hood controllers, window blind controllers, operable window controllers, and lighting controllers will increasingly be deployed throughout buildings. Many of these systems use proprietary software to operate. Integration of these systems to achieve optimum building performance will pose an ongoing challenge in the coming years. A strong relationship with the Information Technologies (IT) department and engagement with a highly skilled workforce, along with clear processes to vet new digital building technologies are required to manage this challenge.

The Communications Layer

Recent advances and current trends in building digital technologies require Facilities and IT divisions to work collaboratively on integrated workplace technology solutions to optimize the full life cycle of building assets. A coordinated approach is needed to ensure the communications layer remains operational and secure in the face of ever-new technological opportunities and cyber threats. The communications layer as detailed below includes IT networks and servers that transmit building operational data across the University of Calgary's campuses, the networks' architecture, and the communications protocols required to enable the traffic and exchange of building operational data.

- IT Network and Servers – Developing a building technology roadmap that addresses current trends in building digital technologies, cybersecurity, systems resiliency, network architecture, and the Internet of Things (IoT) is required. Digital building systems generate large amounts of data that improve operational performance, optimize resource allocation, and reduce costs, which enables organizations to remain competitive in a fast changing environment. Building control panels with Ethernet manage data volume and traffic through the network to maintain a functional EMIS. Ethernet infrastructure significantly increases the speed at which data can be transmitted and processed. Ethernet connections are currently being installed in control panels in existing buildings and are required in control panels of all new buildings. Appendix G shows the progress of panel conversions to Ethernet, along with a prioritization schedule for conversions.

- Communication Protocols – Currently, a proprietary protocol is being used to communicate with devices in university buildings. This proprietary protocol makes it difficult to share information across different software platforms, which results in a fragmented EMIS, unnecessary operational inefficiencies, and higher utility costs. Migrating device communication from the proprietary protocol to a universal communications protocol is required to achieve a higher degree of integration throughout the EMIS and optimizing building and operational performance. BACnet is the most commonly used platform integrator across the Americas.[16] BACnet communication protocol increases the amount of data transmitted through the network, which requires building panels to have Ethernet connectivity. The university is currently converting control panels to the BACnet protocol in existing buildings. BACnet capability is a requirement for control systems in all new buildings. Appendix G shows the progress of BACnet panel conversions along with a prioritization schedule for conversions.
- Internet Protocol (IP) Addresses Management – With the advent of more sophisticated building technologies, the number of IP addresses required in university buildings is significantly increasing. An effective IP address management program is recommended to support the functionality of newer and more technologically advanced buildings. This program would be jointly implemented by Facilities and IT staff. As the number of devices requiring IP addresses increases, this is a critical time to re-assess the BMS/IT network needs in order to find a balance between cybersecurity and ease of operation requirements.

The Processing and Visualization Layer

The processing and visualization layer provides the graphic interface and the analytical capabilities of the EMIS for visualization of data, prioritization of actions, and direct interaction with Facilities staff (and other members of the campus community). It consists of a number of software tools with specialized functions and a range of different capabilities as detailed below.

- Building Management System (BMS) Software – The university's BMS software needs to migrate to Desigo, a state-of-the-art product to ensure the reliable operation of buildings in the coming years. Desigo is compatible with the existing HVAC floor level devices and building control panels, which allows for a certain degree of continuity with existing technology. Migrating to Desigo ensures a smooth transition to a new BMS platform while minimizing operational risks and costs for the university. Migrating to Desigo is planned in several phases, based on operational considerations and availability of funds.
- Fault Detection and Diagnostics (FDD) Software – FDD requires standardized communication protocols and a robust network infrastructure that is capable of handling heavy building performance data traffic. The recommended FDD platform for the University of Calgary, Skyspark, is powerful, flexible, and broadly supported by different vendors across North America. Additionally, Skyspark was successfully deployed as part of the MacKimmie Tower redevelopment project to monitor performance as a net zero carbon building. It is recommended to continue deploying Skyspark across campus, targeting large energy users. Appendix F shows the recommended deployment plan for this FDD tool on campus, based on level of readiness, operational needs, and building energy use.
- Various Other Software Tools – The university has a number of additional tools that are currently used to track energy usage in buildings. Schneider's *Power Monitoring Enterprise* (PME) is used to monitor electrical

[16] BACnet protocol has been an American National Standards Institute (ANSI) standard since 1995 and an ISO standard since 2003.

power provided to all buildings on campus. *Encilium,* the main centralized lighting system, has been used for many years by zone electricians to manage lighting systems in buildings and as the central data repository for lighting energy data. The energy module of this tool allows electricians to optimize lighting schedules based on occupancy and identify areas of high energy use intensity. Other tools are currently in use to gather and report energy performance data, such as monitoring power provided by photovoltaic arrays on campus and support energy-use visualization dashboards. It is recommended to minimize the number of these additional monitoring tools and focus institutional resources on the most critical components of the EMIS.

B.3 Institutional Level Targets and Major Initiatives

Preliminary modelling carried out by Facilities across the university's portfolio of existing buildings has provided rough estimates of the GHG emission and energy consumption reductions that could be achieved through the implementation of different energy saving initiatives. The proposed major initiatives, and the estimated GHG emission and energy use reductions associated with each of them, are presented in Table 3. Depending on scope and delivery model, each initiative can be assigned to one of two broad categories: capital projects or operational practices improvement.

Table 3. Proposed energy and GHG emission reduction initiatives for existing buildings to achieve 2030 CAP targets

Initiative (Energy Projects)	GHG Reduction Target (tonnes CO_2eq)	Energy Reduction from Base Year 2018	Comments
URPr Grant Program (Basic Energy Retrofits) (Capital Projects)	13,000	9%	Currently in progress. Partially funded through the Government of Canada's Low Carbon Economy Fund (LCEF).
Deep Energy Retrofits (Capital Projects)	10,000	7%	Deep energy retrofits in about 3 significant energy users, achieving overall reductions in energy consumption of 25% - 30% in these buildings.
Energy Optimization and Operational Improvements (Operational Practices Improvement)	7,000	4%	Use of FDD software for energy performance optimization, energy centered maintenance, and ongoing commissioning; enhanced business processes.
Total	**30,000**	**20%**	

Energy Improvement Projects

The process of identifying, evaluating, prioritizing, implementing, and assessing the performance of an energy conservation measure (ECM) is labelled as an energy improvement project.[17] Depending on scope, an energy project can be delivered either as a capital project or simply as an update and improvement of operational practices. The university's 2019 CAP uses two broad categories for energy retrofits in existing buildings: basic retrofits and deep retrofits. While an energy project can be proposed by any individual across the university, projects selected for implementation will depend on feasibility, impact relative to investment and available funding among other considerations. The process for the identification, screening and implementation of an

[17] US Department of Energy. Retrieved from https://www.energy.gov/eere/amo/50001-ready-program.

energy improvement project is presented in Figure 12.

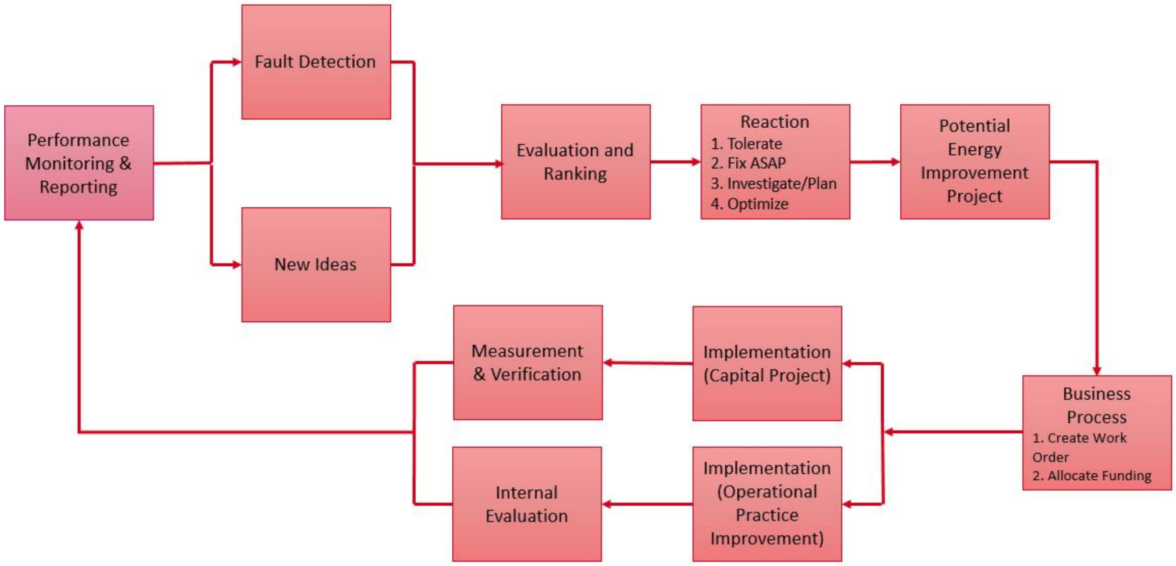

Figure 12. General Process Flow for Energy Improvement Projects

Capital Projects

- <u>Institutional Priorities for Capital Investment</u> – The university's 2019 Comprehensive Institutional Plan (CIP) identified a number of priorities for capital investment in new and existing buildings. Although these priorities are not necessarily driven by energy performance targets, major upgrades and building renovations typically offer an opportunity to significantly improve the energy performance of existing buildings. Some of the buildings targeted for future investment in the 2019 CIP are significant energy users (e.g. Health Sciences Centre, Kinesiology Complex, and Science A) that can achieve deep reductions in energy consumption through strategic actions implemented during renovations. Implementing major renovations in an existing building without considering current and future energy performance would be a missed opportunity for the institution, and therefore an energy-sensitive approach for all capital projects is recommended.
- <u>Basic Energy Retrofits</u> – Basic retrofits include retro-commissioning projects, lighting retrofits, select HVAC retrofits, and controls upgrades. The primary vehicle for the delivery of basic retrofits across the university is the URPr. The current URPr Grant Program is expected to run until 2022. It is recommended that the university start the conceptual development of an institutional basic energy retrofit program that would be implemented beyond the 2023 to provide the university a strategic advantage when applying for future government funding programs focused on energy efficiency and GHG emissions reduction.
- <u>Deep Energy Retrofits</u> – The 2019 CAP calls for deep retrofits in existing buildings, especially in energy-intensive spaces such as laboratory and healthcare facilities. These retrofits are critical to achieving significant improvements in energy performance, reducing GHG emissions and realizing utility cost avoidance (UCA), while also supporting the much-needed renewal of these spaces. Deep retrofits are more intrusive and holistic, addressing major systemic issues throughout the building and achieving significant reductions in energy consumption. Deep energy retrofits also tend to have much longer

paybacks than basic energy retrofits.

- Capital Renewal Program – The capital renewal program is focused on addressing deferred maintenance in buildings and therefore is not necessarily driven to enhance energy performance. However, the program has featured an energy-sensitive approach over the last few years, which has enabled the university to address its deferred maintenance liability and also advance its energy performance goals through certain projects. Ongoing coordination is required to maintain and strengthen the alignment between the capital renewal program and the IMP and other energy-focused initiatives, in order to maximize the benefits for the institution.

Operational Practices Improvement

- Energy-Centered Maintenance – Energy-centered maintenance (E-CM) is a strategic approach to maintenance that leverages the information provided by EMIS to identify and prioritize specific maintenance or repair needs.[18] Advanced EMIS tools have the capability to identify building systems and components that are performing outside expected parameters due to abnormal or erratic behaviour and excessive energy use. E-CM maintenance uses this data to inform and guide repair and maintenance decisions with an approach that reduces costs, optimizes the use of organizational resources, improves energy performance, and increases building systems reliability. Deploying FDD software as a component of the EMIS on a number of university buildings will enable Facilities to implement E-CM in these buildings. It is recommended to implement E-CM in some of the largest energy users across campus as a pilot project, and depending on the results, EC-M could be deployed at a larger scale across the portfolio of existing buildings in the future.
- Development of Action Plans – The ISO 50001 calls for development of clear and detailed action plans that can be implemented and reported on at the operational level. These action plans must be developed in alignment with the institutional energy performance goals and must specify actions, roles and responsibilities, resources required, timelines for implementation and completion, and criteria for evaluation of success (e.g. Key Performance Indicators). Consideration must be given specifically to how the proposed actions enable the organization to achieve its energy performance goals. Information related to action plans must be documented and retained by the organization.[19] The Government of Canada has demonstrated keen interest in the adoption of ISO 50001 across the country and has launched supporting funding programs.[20] Alignment with ISO 50001 promotes the professionalization of the organization through the adoption and standardization of best practices, enhances the university's reputation in the area of sustainability and energy performance, and gives the institution a strategic advantage when applying for funding programs focused on energy efficiency and GHG emissions reduction. It is recommended for a gradual approach in the development of action plans at the work-unit level. These plans would be developed by the operational units and endorsed by the appropriate directors.

B.3.3 Sustaining Improved Performance

Measurement and Verification (M&V)

All energy retrofits implemented as part of URPr go through a twelve-month measurement and verification (M&V) process that is in alignment with the International Performance Measurement and Verification Protocol

[18] Howell, M.T., Alshakhshir, F. (2017). Energy Centered Maintenance: A Green Maintenance System. Fairmont Press
[19] ISO. (2018). *ISO 50001 energy management systems standard,* (Section 6.2.3).
[20] Natural Resources Canada. (2019, October 1). *ISO 50001 energy management systems standard*. Retrieved from www.nrcan.gc.ca/energy-efficiency/energy-efficiency-industry/energy-management-industry/iso-50001-energy-management-systems-standard/20405.

(IPMVP®). Quarterly performance reviews are carried out with the participation of stakeholders across Facilities during this twelve-month period. Actions are identified and implemented to course-correct as needed. It is recommended that this practice should continue for all energy retrofits implemented in the future.

Monitoring Based Commissioning (MBCx) and Continuous Optimization

Monitoring-based commissioning (MBCx) is defined as the implementation of an ongoing commissioning process with focus on monitoring and analyzing large amounts of data on a continuous basis.[21] MBCx combines building energy system monitoring with standard retro-commissioning (RCx) practices with the aim of providing substantial, persistent, energy savings. MBCx is particularly powerful when supported by a robust EMIS. A study by Mills & Matthew (2014) of 24 buildings across the University of California and California State University campuses found median energy savings of 11% with a median simple payback of 2.5 years for MBCx projects. [22] In response to these findings, the Lawrence Berkeley National Laboratory recently developed and published a template to guide the development of an MBCx Plan that uses EMIS for ongoing monitoring and analytics.[23] The template is freely available online to encourage organizations to implement an EMIS/FDD-supported MBCx process across their facilities. Deploying an EMIS with advanced FDD tools provides an excellent opportunity for the university to implement MBCx jointly with energy-centered maintenance (E-CM) in a small cohort of buildings that include its significant energy users.

Energy Efficient Procurement

In alignment with the ISO 50001 standard, Facilities is committed to developing and maintaining Design Standards, a Project Delivery Manual and Standard Operating Procedures that aim to maximize energy and water efficiencies for all new equipment, new construction, major renovations and operations and maintenance practices. In addition to that, Facilities will work with Supply Chain Management (SCM) to develop energy efficiency standards for equipment purchasing.

B.4 Energy Management Training Components

Development and implementation of an energy management training program requires consideration and the proper alignment of the following five components:

- Stakeholders
- Learning goals
- Type of training required
- Learning content
- Delivery method

In consultation with different groups across Facilities, a preliminary analysis and inventory of training needs was carried out taking into consideration the five components mentioned above. Results are summarized in Table 4.

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[21] Brown, K. and M. Anderson. (2006). Monitoring-Based Commissioning: Early Results from a Portfolio of University Campus Projects. In *Proceedings of the 13th National Conference on Building Commissioning,* Portland, OR: Energy Conservation Inc.
[22] Mills. E. and Mathew, P.A. (2014). Monitoring-based commissioning: Benchmarking analysis of 24 university buildings in California. *Energy Engineering*, *111*(4), 7-24. DOI: 10.1080/01998595.2014.10844605
[23] Kramer, H., Crowe, E., Granderson, J. (2017, June). Monitoring-based commissioning (MBCx) plan template, Berkley, CA: Lawrence Berkley National Laboratory. Retrieved from https://buildings.lbl.gov/sites/default/files/MBCx%20Plan%20Template_June%202017_Final.pdf

Table 4. Basic components of energy management training program

Stakeholder category	Stakeholders Group	Learning Goals	Type of Training	Learning Content	Delivery Method
Leadership & management staff (Facilities)	Facilities directors and managers	Create general awareness & promote energy efficiency culture Develop and improve energy management systems and processes	Organizational (energy management systems)	Energy Management Basics ISO 50001, Energy Management Systems Administration	Classroom workshop Online training
Technical & operational staff (Facilities)	Facility managers HVAC mechanics and preventative maintenance staff Zone technicians and reactive maintenance staff BMS technicians Campus engineering (eng. & Cx)	Create general awareness & promote energy efficiency culture Sustain improved energy performance Identify new opportunities and optimize energy performance Maintain and upgrade staff's technical & professional skills Change specific behaviours	Technical (building systems) Behavioural (people's actions)	Energy Management Basics Building Systems Optimization Building Energy Data & Energy Reports Analytics & Energy Performance Monitoring Tools Energy Project Identification and Routing Building Operations Post-Energy Project Implementation Specific technologies and building systems components	Classroom workshop Online training On-the-job training & coaching
Other staff (Facilities)	Project managers Campus engineering (capital renewal)	Create general awareness & promote energy efficiency culture Identify new opportunities and optimize energy performance	Technical (building systems) Behavioural (people's actions)	Energy Management Basics Energy Project Identification and Routing	Classroom workshop Online training
Campus community	Building occupants Students	Create general awareness & promote energy efficiency culture Change specific behaviours	Behavioural (people's actions)	Energy Awareness	Classroom workshop Online training

The following is a brief description on the results of the preliminary analysis for the development and implementation of an energy management training program:

- Stakeholders – Stakeholders have been defined as those who have a significant impact on the energy consumption of buildings on campus. Each stakeholder group will have different training and engagement needs.
- Learning Goals – Based on specific training needs, learning goals (or desired outcomes) are established. Directors and managers may need to gain a general understanding of energy management concepts and energy management systems administration to provide effective support. Facility managers may need training in order to better interpret building energy data and building energy performance reports.
- Type of Training – Natural Resources Canada (NRCan)[24] classifies energy management in three major categories: technical training (building systems), organizational training (energy management systems), and behavioural change training (people's actions). NRCan stresses the need to take a balanced approach and address all three areas in order to ensure success of energy management initiatives, especially in large and complex organizations.
- Learning Content - The needs assessment and the stakeholders, learning goals and type of training components dictate the specific content of training needed. Technicians for example, will likely require very technical content focused on specific building technologies[25] (e.g. control systems, pumps, air-handling units), whereas facility managers will benefit better with content focused on the basics of energy management.
- Delivery Method - Delivery methods include classroom training, online training and on-the-job training. Decisions will also need to be made about whether it is best to deliver the training using internal resources or external vendors. Additionally, the training can be a formal program that, for example, leads to a professional or technical certification or can be a more informal form of learning.

[24] Natural Resources Canada. (2016). Energy Management Training Primer (pg.3). Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/oee/files/pdf/publications/commercial/EMT_Primer_en.pdf.
[25] Natural Resources Canada. Energy Management Best Practices Guide. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/oee/buildings/pdf/best_pratices_e(1).pdf .

APPENDIX C: FACILITIES ENERGY POLICY

Departmental Policy
Departmental Procedure
Instructions/Forms

Facilities
Energy Policy

Classification: Facilities	Table of Contents
Approval Authority: Vice-President, Facilities	
Implementation Authority: Associate Vice President, Sustainability, Associate Vice President Facilities Development, Associate Vice President Facilities Management	
Effective Date: May 20, 2020	
Latest Revision	

Introduction

1 The University of Calgary's Sustainability Policy (ISS) confirms the institutional commitment to excellence and leadership in sustainability. The university aims to be a Canadian post-secondary leader in sustainability, in our academic and engagement programs, administrative and operational practices, and through supporting community and industry in their aims for leadership in sustainability.

The Framework for Sustainability in Administration and Operations, which forms part of the Institutional Sustainability Strategy (ISS), confirms an institutional roadmap for sustainability practices across our administrative and operational endeavours. To fulfill these institutional priorities, Facilities will develop, build and operate the campus in a manner that is aligned with best practices in energy efficiency and the aspirations of our Climate Action Plan.

Purpose

2 The purpose of this policy is to inform and support the university's efforts towards the achievement of the following two objectives stated in the Framework for Sustainability in Administration and Operations:

- The University of Calgary strives to attain net carbon neutrality.
- The University of Calgary aims to be one of the most energy efficient research campuses in Canada.

Scope

3 The policy applies to all activities associated with the planning, design, construction, operation, and maintenance of facilities under the governance of the University of Calgary.

Definitions

4 In this policy:

a) "University" means the University of Calgary.

b) "University Community" means persons associated with the University.

c) "CAP" is the University's 2019 Climate Action Plan.

d) "ISS" means Institutional Sustainability Strategy.

e) "Design Standards" refers to the document developed by Facilities that serves as design guidelines for construction projects in the University of Calgary.

f) "ISO 50001" is an international standard that establishes systems and processes to improve energy performance.

Policy Statement

5 The University of Calgary is committed to manage its energy usage and improve its energy performance to minimize the environmental, economic and social impacts associated with the planning, design, construction, operation, and maintenance of its facilities.

Facilities will operationalize this commitment by:

a) Employing energy management practices that are generally informed by ISO 50001 and its principles of continuous improvement.

b) Ensuring compliance with relevant legal and other requirements related to energy efficiency, energy use and energy consumption.

c) Developing, and from time to time renewing, a Climate Action Plan (CAP) to inform near and long range planning for energy efficiency and the reduction of institutional greenhouse gas emissions.

d) Developing and maintaining an Energy Demand Management Plan (EDMP) that is generally informed by ISO 50001 and provides a roadmap to achieve the near and long range aims of the CAP.

e) Setting and periodically reviewing existing building energy performance targets in alignment with the strategic goals outlined in the ISS and CAP and with other institutional strategic priorities.

f) Considering energy performance as appropriate in the development and execution of key planning documents including but not limited to Long Range Development Plans, Campus Landscape Plans, etc.

g) Setting energy performance requirements for new buildings and significant building renewals that are in alignment with the near and long range aims of the CAP, and selecting site orientation and building form to optimize energy performance.

h) Developing and maintaining Facilities' Design Standards, a Project Delivery Manual and Standard Operating Procedures that aim to maximize energy and water efficiencies for all new equipment, new construction, major renovations and in operations and maintenance practices.

i) Continuously working to provide information and necessary resources to support the achievement of energy performance targets.

j) Promoting energy efficiency and energy performance awareness among Facilities staff and members of the University Community.

Responsibilities

6 **Approval Authority**

The Vice-President (Facilities) will monitor compliance with this policy and ensure appropriate rigour and due diligence in the development or revision of this policy.

Implementation Authority

The Associate Vice President, Sustainability, the Associate Vice President, Facilities Development and the Associate Vice President, Facilities Management will:

- ensure that Facilities staff are aware of and understand the implications of this policy and related procedures;
- monitor compliance with this policy; and
- regularly review this policy and related procedures to ensure consistency in practice.

The Associate Vice President, Sustainability will:

- sponsor the revision of this policy and related procedures when necessary.

Related Information

7

- Institutional Sustainability Strategy
- Framework for Sustainability in Administration and Operations
- University of Calgary 2019 Climate Action Plan
- Facilities Design Standards
- Facilities Project Delivery Manual

History

8 *Approved: May 20, 2020*

Effective: May 20, 2020

APPENDIX D: BUILDING LIST & 2018/19 EUI

Building Name	Building Type	kWh/m2
Craigie Hall	Classrooms	296
Education Complex	Classrooms	284
Information & Communications Technology	Classrooms	264
Murray Fraser Hall	Classrooms	381
Math Science Building	Classrooms	642
Rozsa Centre	Classrooms	211
Reeve Theater	Classrooms	301
Scurfield Hall	Classrooms	248
Social Sciences Building	Classrooms	291
Science Theatres	Classrooms	325
Taylor Family Digital Library	Classrooms	363
Biological Science Building	Laboratory	428
Calgary Centre for Innovative Technology	Laboratory	768
Clinical Skills Building	Laboratory	900
Energy Environment Experiential Learning	Laboratory	459
Engineering Complex	Laboratory	464
Earth Science Building	Laboratory	607
Heritage Medical Research Building	Laboratory	1053
Health Research Innovation Centre/Teaching Research & Wellness	Laboratory	615
Health Science Centre	Laboratory	794
Life Science Research Station	Laboratory	1400
Mechanical Engineering Building	Laboratory	285
Science A	Laboratory	465
Science B	Laboratory	403
University Research Centre	Laboratory	816
Administration Building	Offices	543
Arts Building & Parkade	Offices	469
Child Development Centre	Offices	149
High Density Library	Offices	1303
MacKimmie Library Block	Offices	512
MacKimmie Library Tower	Offices	0
Olympic Volunteer Centre	Offices	393
Professional Faculties Building	Offices	348
Physical Plant	Offices	251
Taylor Institute	Offices	203
Child Care Centre	Other Athletic/Student Services	396
Dining Centre	Other Athletic/Student Services	326
Grounds	Other Athletic/Student Services	322
Kinesiology A	Other Athletic/Student Services	386
Kinesiology B	Other Athletic/Student Services	226
MacEwan Hall	Other Athletic/Student Services	568
MacEwan Student Centre	Other Athletic/Student Services	269
Olympic Oval	Other Athletic/Student Services	519
Aurora Hall	Residences	156
Cascade Hall	Residences	198
Crowsnest Hall	Residences	238
Glacier Hall	Residences	254
International House	Residences	411
Kananaskis Hall	Residences	226
Olympus Hall	Residences	178
Rundle Hall	Residences	234
Yamnuska	Residences	176

APPENDIX E: BUILDING ENERGY REDUCTION TARGETS

Building Name	Total Energy Usage 2018-19 (kWh)	5-year Building Energy Reduction (%)	5-year Building Energy Reduction (kWh)	10-year Building Energy Reduction (%)	10-year Building Energy Reduction (kWh)	Suggested Actions
Health Sciences Centre	56,052,239	9%	5,044,702	39.0%	21,860,373	DR, FDD, OI
Health Research Innovation Centre / Teaching Research and Wellness	50,405,332	9%	4,536,480	9.0%	4,536,480	FDD, OI
Engineering Complex	26,177,294	9%	2,355,956	39.0%	10,209,145	DR recommended, OI, FDD
University Research Centre	25,115,209	0%		0.0%		DR recommended
Heritage Medical Research Building	22,189,915	9%	1,997,092	9.0%	1,997,092	FDD, OI
Earth Sciences Building	15,739,330	9%	1,416,540	39.0%	6,138,339	DR, OI, FDD
Biological Science Building	14,250,335	9%	1,282,530	39.0%	5,557,631	DR, FDD, OI
Olympic Oval	12,977,013	0%		0.0%		FDD recommended
Energy Environment Experiential Learning	11,639,006	9%	1,047,511	9.0%	1,047,511	FDD, OI
Math Sciences Building	11,424,615	9%	1,028,215	9.0%	1,028,215	FDD, OI
High Density Library	11,100,167	3%	329,127	3.0%	329,127	FDD, OI
Taylor Family Digital Library	9,326,567	9%	839,391	9.0%	839,391	FDD, OI
MacEwan Hall	8,870,113	2%	177,402	2.0%	177,402	FDD, OI
Clinical Skills Building	8,821,046	9%	793,894	9.0%	793,894	FDD, OI
Calgary Centre for Innovative Technology	7,320,344	9%	658,831	9.0%	658,831	FDD, OI
Science B	6,961,313	9%	626,518	9.0%	626,518	FDD, OI
Kinesiology A	6,896,234	2%	137,925	32.0%	2,206,795	Pool retrofit, FDD, OI
Education Complex	6,735,863	2%	134,717	32.0%	2,155,476	DR
Science A	6,667,515	2%	133,350	32.0%	2,133,605	DR
Social Sciences Building	6,610,553	2%	132,211	32.0%	2,115,377	DR/Solar panels
MacKimmie Library Block	6,586,926			100.0%	6,586,926	To be demolished
Administration Building	6,461,183	9%	581,506	9.0%	581,506	FDD, OI

Building Name	Total Energy Usage 2018-19 (kWh)	5-year Building Energy Reduction (%)	5-year Building Energy Reduction (kWh)	10-year Building Energy Reduction (%)	10-year Building Energy Reduction (kWh)	Suggested Actions
MacEwan Student Centre	6,297,134	2%	125,943	2.0%	125,943	FDD, OI
Professional Faculties Building	6,142,767	9%	552,849	9.0%	552,849	FDD, OI
Kinesiology B	6,115,077	2%	122,302	32.0%	1,956,825	DR, OI, FDD
Life Science Research Station	5,700,531	2%	114,011	32.0%	1,824,170	DR recommended
Arts Building & Parkade	5,415,941	2%	108,319	2.0%	108,319	FDD, OI
Craigie Hall	5,307,647	9%	477,688	9.0%	477,688	OI, FDD
Murray Fraser Hall	5,138,775	9%	462,490	9.0%	462,490	FDD, OI
Information & Communications Technology	4,707,892	9%	423,710	9.0%	423,710	FDD, OI
Crowsnest Hall	4,428,321	2%	88,566	2.0%	88,566	OI, FDD recommended
International House	4,293,682	9%	386,431	9.0%	386,431	FDD recommended
Yamnuska	3,835,963	2%	76,719	2.0%	76,719	OI, FDD recommended
Scurfield Hall	3,656,963	9%	329,127	9.0%	329,127	FDD, OI
Science Theatres	3,482,195	2%	69,644	2.0%	69,644	FDD, OI
Cascade Hall	3,158,908	2%	63,178	2.0%	63,178	OI, FDD recommended
Rundle Hall	2,508,064	2%	50,161	2.0%	50,161	OI, FDD recommended
Kananaskis Hall	2,403,013	2%	48,060	2.0%	48,060	OI, FDD recommended
Dining Centre	2,321,380	9%	208,924	9.0%	208,924	FDD, OI
Child Development Centre	2,319,853	9%	208,787	9.0%	208,787	FDD, OI
Glacier Hall	1,940,480			100.0%	1,940,480	OI, Demolition
Aurora Hall	1,813,204	2%	36,264	2.0%	36,264	OI, FDD recommended
Olympic Volunteer Centre	1,781,967	2%	35,639	0	35,639	OI
Mechanical Engineering Building	1,766,880	9%	159,019	9.0%	159,019	FDD, OI
Physical Plant	1,367,346	2%	27,347	2.0%	27,347	FDD, OI
Olympus Hall	1,170,749			100.0%	1,170,749	OI, Demolition
Taylor Institute	960,597	9%	86,454	9.0%	86,454	FDD, OI
Reeve Theater	788,204	2%	15,764	2.0%	15,764	FDD, OI
Rozsa Centre	786,142	2%	15,723	2.0%	15,723	FDD, OI

Building Name	Total Energy Usage 2018-19 (kWh)	5-year Building Energy Reduction (%)	5-year Building Energy Reduction (kWh)	10-year Building Energy Reduction (%)	10-year Building Energy Reduction (kWh)	Suggested Actions
Grounds Building	428,296	2%	8,566	0	8,566	
Child Care Centre	400,787	2%	8,016	2.0%	8,016	No DDC
MacKimmie Library Tower						No current data
Total	428,766,875	6.4%	27,563,600	19.3%	82,545,247	
Other*	9,196,441					
Total	437,963,317	6.3%		18.8%		

* Note:

DR - Deep retrofit (assume reduction of 30%)

FDD - Fault Detection and Diagnostics (assume reduction of 7%)

OI - Operational Improvements (assume reduction of 2%)

**Other buildings include Student Family Housing, Kananaskis, Turner Valley, Priddis, Bow River Pumping Station, Wildlife Research Centre, Downtown Campus

APPENDIX F: SUGGESTED ENERGY REDUCTION INITIATIVES

Suggested Energy Reduction Initiatives	Category	Estimated cost	Description
Conversion from pneumatic to digital control (DDC)	Project (Retrofit)	$$$	Where deep retrofits are not possible, DDC can replace pneumatic controls in locations that will have the most impact.
Ethernet drops to building panels	Program (DDC)	$$	Ethernet to panels allow data to flow to our FDD and energy dashboards in real time. Ethernet connection makes infrastructure future ready.
Conversion of Panels to BACnet	Program (DDC)	$$	The BACnet communication protocol is the HVAC universal protocol for North America allowing for building devices to talk to any FDD or front end.
Update panel firmware	Program (DDC)	$	Keeping panel firmware up to date is the best way to prevent vulnerabilities to our system.
Develop PMs for the Control system (ongoing commissioning)	Program (O&M)	$	Control systems (like other systems on campus) need to be maintained. From simple dusting to testing connections and ensuring critical backup power supplies are functional, preventive maintenance will have an impact on our system resiliency.
Run operator reports	Program (O&M)	$	When working to implement energy saving algorithms, sequences of operation are optimized such that the programming controls the HVAC system. When operators manually control equipment, they bypass the optimization sequences. Our BMS technicians run reports regularly to investigate if a piece of equipment has been running in OPER for an extended period of time, inquire why, and fix the issue in the programming if required. Running OPER reports must be done at least monthly.
OAT temperature Lockout	DDC Control Strategy	$	Where it makes sense, heating water temperatures can be set based on outdoor air temperature.
Implement Bias	DDC Control Strategy	$	Bias is where an additional buffer is used when reaching a temperature to keep a system from cycling. Biases can be used on air or water system. A plan and agreement on how bias should be implemented
Scheduling optimization	DDC Control Strategy	$	Monitoring occupancy and optimizing schedules based on occupancy is an easy way to attain energy savings. Unoccupied spaces temperature and airflows are reduced and any request to increase operating hours must be approved at a director level.

Suggested Energy Reduction Initiatives	Category	Estimated cost	Description
Install VFD motors on Elevators	Project (Retrofit)	$$$	Elevator motors have been identified as a significant electrical load in buildings. It should be investigated further where it may make sense to implement VFDs on elevator motors
Valve replacement	Program (O&M) or Project (Retrofit)	$$	Passing valves can cause systems to heat and cool simultaneously. FDD can help identify these locations where energy is wasted and valves must be replaced.
Motor maintenance	Program (O&M)	$$	FDD can help identify motors needing maintenance. In areas where it makes sense installing non-slip straps can generate some savings.
Air balancing	Program (O&M)	$$	Proper air balancing ensures we are delivering the right amount of air to meet ASHRAE standards. A building where air systems have been properly balanced will keep occupants comfortable and avoid overventilation. Diffuser and air duct cleaning can also optimize air distribution and reduce fan energy usage.
Hydronic System balancing	Program (O&M)	$$	Proper balancing of hydronic systems ensures we are delivering the right water temperatures and pressures to make occupants comfortable while optimizing energy usage.
Coil maintenance	Program (O&M)	$$	Coils can accumulate deposits internally that can reduce their heat transfer efficiency. In some instances where we notice very high temperatures in are required in AHU coils, it may be worth cleaning the coils.
Windows and doors insulation	Program (O&M) or Project (Retrofit)	$$	Full window replacement may not make economic sense in many instances. However, where obvious drafts can be noticed, insulation/caulking or weather strips can be used.
Hydronic system maintenance	Program (O&M)	$$	Glycol concentration levels and water cleanliness can ensure potential debris don't damage our equipment.
Air system maintenance/AHU air leakage	Program (O&M)	$$	Holes and gaps allowing air out of AHUs and duct work should be fixed. Diffusers should be cleaned to reduce unnecessary pressure drops. As a result, fan power should be reduced.
Pump insulation	Project (Retrofit)	$$	Heating pumps, valves and pipes must be insulated. Jackets are available to cover heating pumps and valves.
Roof insulation	Project (Retrofit)	$$	In a building envelope, roof insulation has demonstrated to be the most effective when it comes to reducing energy usage. Roofs should continue to be routinely maintained with special attention to fix any visible holes.
Suggested Energy Reduction Initiatives	**Category**	**Estimated cost**	**Description**

Separating heating water loop and domestic water loop	Project (Retrofit)	$$$	In some buildings where heating water is used to heat domestic water, there should be a separate loop for the domestic water such that the heating water does not need to re-circulate in the entire buildings.
Air changes per hour optimization	Project (Retrofit)	$$	LEAP where laboratory air supply is optimized should be pursued at larger scale when success is demonstrated in MEB. Optimized air delivery to areas that typically require the largest amount of air changes per hour (ACH).
Energy data sharing	Program (Engagement)	$	Using systems already in place, identify key stakeholders and key energy data information to share to have an impact.
Training	Program (Engagement)	$	Identify requirements and needs for both technical and skills development.
PMO playbook	Program (Engagement)	$	Work with PMO office to embed sustainability practices in the PMP playbook.
Design standards	Program (Engagement)	$	Work with Engineering to update equipment and practices specified in the design standards to be the latest/most efficient options within financial reason.
Fault Detection	Program (DDC)	$	Implement FDD rules in buildings.
Communication	Program (Engagement)	$	Develop communication skills, deploying project connect learnings.
Recognition	Program (Engagement)	$	Develop a team/employee recognition program to encourage working together towards energy reduction.
DES to building heat transfer optimization	Project/Program (O&M)	$$	Implement improvement projects such as system insulation and heat exchanger digital controls, and maintenance programs coil maintenance valve tuning.
Filter optimization	Program (O&M)	$$	Reviewing the filter selection and optimizing filter replacement schedules can generate economies by reducing the number of filters to replace and save energy by selecting the right filter for the task. Fault detection can be used to detect the optimal filter change time.

APPENDIX G: ETHERNET, BACNET AND DESIGO UPGRADE PLAN

		Phase 1	Phase 2	Phase 3	Phase 4
	Scope Description (building types)	Sciences/ Laboratories	Laboratories/ Humanities/ Classrooms	Healthcare	Other
Hardware	Ethernet Drops	60%	90%	100%	
	Panel upgrade (IMP)	95%	100%		
Networking	BACnet Flashes	25%	50%	95%	100%
Software	Graphics Conversion	15%	45%	80%	100%
Costs	Budgeting Amount	Funded	Funded	$850,000	$800,000

Notes:

1. Each phase will last approximately 12 months and some phases may overlap.
2. Phase 1 completed in Fall 2020.

APPENDIX H: FAULT DETECTION AND DIAGNOSTIC DEPLOYMENT PLAN

FDD Deployment Priority	Building Name	Total Energy Usage Rank	Readiness for FDD Deployment	Estimated DDC Installed (%)
	MacKimmie Tower		5	100
1	Social Sciences Building	20	5	50
2	Mechanical Engineering Building	41	5	80
3	Health Sciences Centre	1	5	40
4	Teaching, Research, and Wellness	2	5	75
5	Health Research Innovation Centre	3	5	50
6	Heritage Medical Research Building	5	5	50
7	Earth Sciences Building	7	5	25
8	Engineering Complex	6	4	50
9	Biological Sciences Building	8	3	75
10	Energy Environment Experiential Learning	10	3	100
11	Math Sciences Building	11	4	75
12	Clinical Skills Building	14	4	100
13	Administration Building	22	3	75
14	Taylor Family Digital Library	12	3	100
15	Science B	16	3	70
16	High Density Library	32	2	100
17	Craigie Hall	27	3	50
18	Calgary Centre for Innovative Technology	15	2	100
19	MacEwan Hall	13	2	50
20	Science A	19	2	70
21	MacEwan Student Centre	23	2	50
22	Education Complex	18	2	50
23	Kinesiology B	46	2	50
24	Professional Faculties Building	24	3	75
25	Murray Fraser Hall	28	4	50
26	Arts Building & Parkade	26	2	75
27	Information & Communications Technology	29	2	100
28	Scurfield Hall	33	2	70
29	Dining Centre	37	2	50
30	Taylor Institute	43	3	100
31	Kinesiology A	17	2	50

Note:

The level of readiness of the building depends on the status of the building and the operational needs (e.g. the High Density Library is currently partly BACnet and partly proprietary. It would be operationally beneficial to upgrade this building and add FDD since it has a new expansion where sequences of operation can be optimized.

The level of readiness is assessed as follows:

1. Building will not benefit from FDD as there is limited or no floor level DDC in the building
2. Building panels are not Ethernet, network outlets must be installed
3. All building panels are Ethernet, panels must be upgraded to BACnet
4. Building has been upgraded to BACnet and is ready to be added to FDD
5. Building has FDD or is scheduled to have it shortly

APPENDIX I: PROPOSED ROLES AND RESPONSIBILITIES

Task	AVP	EESC	CAPWG	EPIT	CE	O&M	E&U	QMS	IT	PMO	CA
Identify key energy reduction initiatives (2020-2021)	I	C	A	R	R	R	R				I
Establish short-term building level energy reduction targets to reach	I	C	A	R	I	I	R				
Develop synergies between funding streams	R	I	A	R	R	R	R	R	R	R	R
Complete Desigo migration	I	I	I	A	C	C	I		R	R	
Complete FDD deployment	I	I	I	A	C	C	I		R	R	
Meter maintenance and calibration program	I	I	A	R	I	R	R				
Review scorecard periodically and report on EDMP progress regularly	I	I	A	R	C	C	C	C	C	C	C
Develop energy-centered maintenance program	I	I	A	R	C	C	C				
Apply ISO50001 principles by leveraging the existing Quality Management System	I	I	A	R	C	C	C	R			
Develop basic and deep retrofit programs	I	C	A	R	R	R	R				
Update Design Standards with energy efficiency in mind	I	I	A	C	R	C	C				
Develop a training program	I	C	A	R	R	R	R	C			
Develop a communication plan around the Energy Policy	I	C	A	R	I	I	I	I	I	I	I
Operationalize the EDMP across Facilities	I	C	A	R	R	R	R				
Develop a joint IT/OT technology roadmap	I	C	A	R	I	I	I		R		

Note:

R - Responsible
A - Accountable
C - Consulted
I - Informed

AVP - Associate Vice-President
EESC - Energy and Emissions Steering Committee
CAPWG – Climate Action Plan Working Group
EPIT - Energy Planning & Innovation
CE - Campus Engineering
O&M - Operations & Maintenance
E&U - Energy & Utilities
QMS - Quality Management Systems Specialist
IT - Information Technology
PMO - Project Management Office
CA - Campus Architecture

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