



An approach to recommissioning

A retrospect on Yukon University's recommissioning experience

Sustainable Infrastructure Branch

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Introduction

This report is the Government of Yukon's summary of the Yukon University recommissioning project. In this report, we describe how we integrated multiple goals into the project to improve the building's performance and develop a replicable framework for other recommissioning projects.

Climate change is an issue that affects us all. We are already seeing its harmful impacts to our ecosystems, infrastructure, and much more. The Government of Yukon is doing our part; we are reducing our buildings' greenhouse gas emissions by 3 per cent compared to 2010 levels, by 2030 (Action H1, [Our Clean Future](#)). A key aspect of achieving this target is finding ways to improve the efficiency of our buildings.

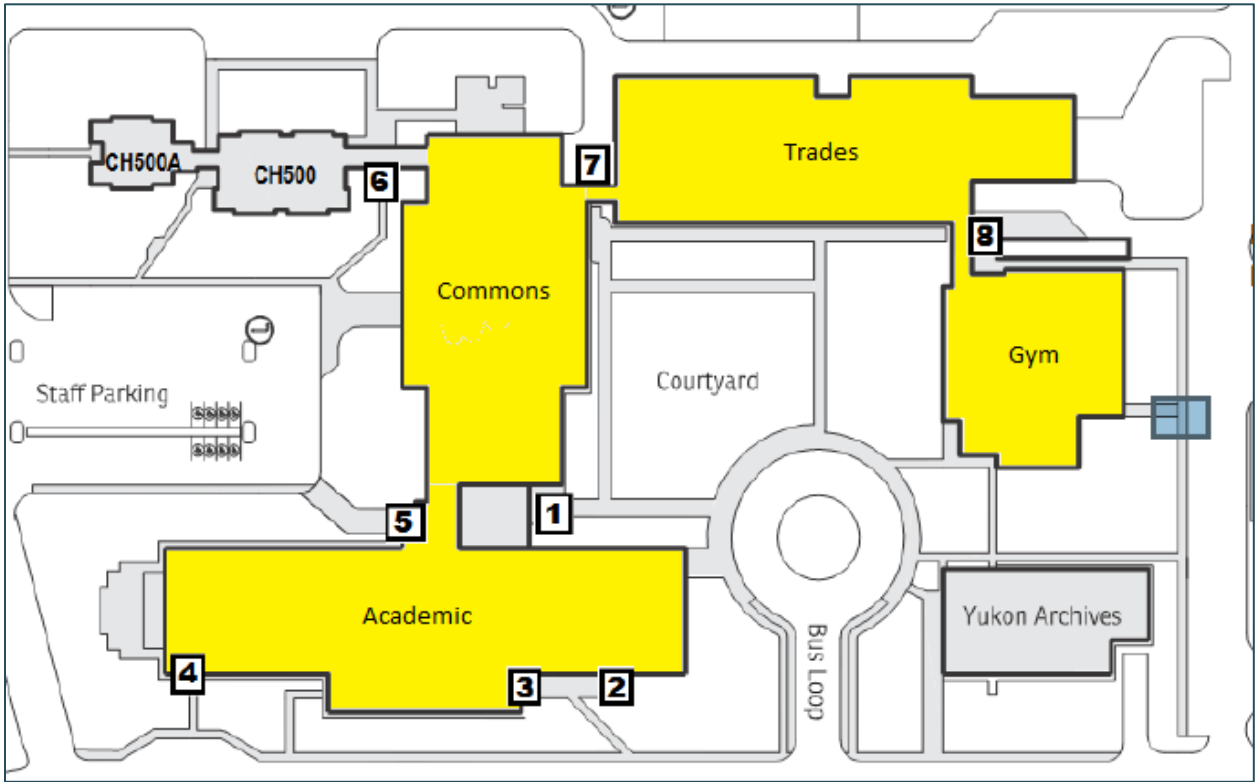
Improving the efficiency of a building will lower energy consumption, building maintenance efforts and costs needed to provide building occupants with a comfortable space suitable for their purposes.

Recommissioning is one of the most effective energy conservation measures to improve a building's operation and performance, thus leading to more efficient energy use. Most modern buildings rely on an automation system to provide their heating, ventilation, and air conditioning equipment with acceptable parameters within which to operate. The programming includes basic instructions of how the equipment should operate, schedules to turn on and off, and the ideal indoor temperature for the building.

Building automation system issues can cause increased energy use, equipment malfunctions, and occupant discomfort. Recommissioning projects are a comprehensive review done to evaluate the building's ability to perform as intended. Correcting deficiencies and realizing opportunities identified during this comprehensive review can save energy, resolve operational issues, improve occupant comfort, and extend the lifespan of existing equipment. Recommissioning projects are interventions to stop the building from operating in an ineffective or even harmful way.

The phrase “existing building commissioning” broadly refers to an investigative approach to improving building operations in a holistic way. Recommissioning is one type of existing building commissioning that applies to facilities that have previously been commissioned. Another common term, “retro commissioning”, is another type of existing building commissioning that applies to buildings that have never been commissioned before. We conducted a recommissioning project at Yukon University Ayamdigt campus because the facility has previously been commissioned.

Yukon University’s main campus is a large building located at 500 College Drive in Whitehorse, Yukon. The site is the largest greenhouse gas emitter in the Government of Yukon’s portfolio, representing approximately 10 per cent of its total annual emissions. This is mostly due to the size of the campus, which is over 33,000 square meters and includes the Yukon Commons, Yukon Trades and Tech, Yukon Academics, and gyms.



Map of Yukon University. Recommissioned sections of the campus are highlighted yellow.



An energy assessment completed at the campus in 2017 recommended a recommissioning project to improve the operational performance of the site's building automation system. This project had high greenhouse gas and energy use reduction potential due to its size, history, and condition. This work would require qualified professionals to conduct a thorough review of the building, including end-to-end testing, a detailed analysis of the building automation system, and interviews with the building maintenance staff.

A replicable scope of work

Yukon University's issues with its building automation system are not unique. Our building maintenance staff rely on building automation systems in many Government of Yukon buildings across the territory to ensure building occupants are comfortable. When these systems fail – such as a malfunctioning valve, an unresponsive controller, or programming errors – the building operators rarely have time to identify and fully resolve the root cause of the issue. Additionally, there are opportunities to reduce energy use by minimizing unnecessary equipment run times.

Proactively planning for seasonal recommissioning for applicable buildings can allow necessary resources to be dedicated for retuning the system. A more extensive and comprehensive recommissioning exercise can be undertaken every 5 years to address the bigger underlying issues or re-optimizing the control system based on new equipment that may have been installed. We wanted to strategically introduce these recurring practices to more Government of Yukon buildings without needing to reinvent the wheel every time.

The Government of Yukon, with support from Natural Resources Canada, simultaneously pursued two recommissioning projects for Yukon University and Alexander MacDonald Lodge. This presented a valuable opportunity to develop a replicable framework that could work for both buildings. The challenge was to standardize a scope of work that was adaptable to the unique circumstances of each building.

At its core, recommissioning is divided into two parts: investigation and implementation. Investigation includes document reviews and on-site assessments, while implementation refers to executing the recommended measures. The former phase lends itself better to standardization; we could develop all-encompassing checklists for qualified professionals to use in their assessments. These checklists would be similar, if not identical, to those found in commissioning packages for newly constructed buildings. The latter phase, however; is entirely dependent on the types of deficiencies found. Standardization is therefore impractical.

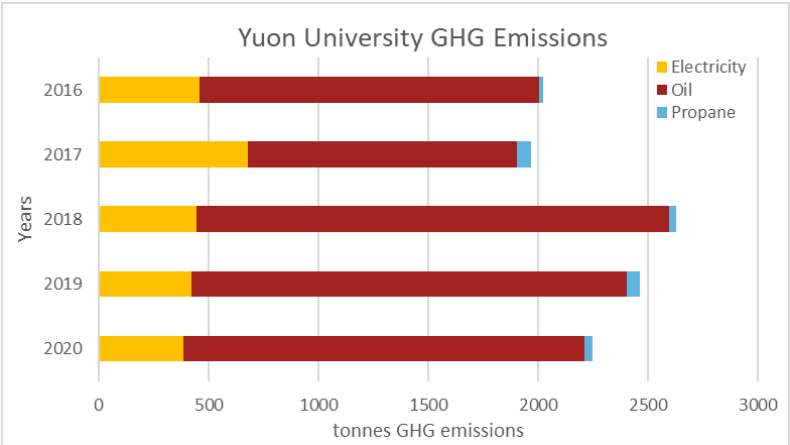
Setting our expectations and goals was critical to defining our vision for recommissioning projects. The next step was to find a pilot site for this framework.

Identifying building(s) for recommissioning

Because of its status as the largest greenhouse gas emitter of Yukon government buildings with known building automation system issues, Yukon University was in need of recommissioning.

The facility was built in 1986 and much of the original equipment remains in use. The building is equipped with an outdated pneumatic control system for which required parts have become difficult to replace. Pieces of the older system were partially converted to digital components, which reportedly resulted in communication issues and a decrease in responsiveness in some areas.

The campus represents approximately 10 per cent of emissions from Government of Yukon buildings over the last 5 years. The building's emissions have also been increasing, which is a sign that intervention is necessary.



Yukon University's Greenhouse Gas emissions for the last 5 years.



Once we decided to recommission Yukon University, we began gathering relevant documentation in preparation for the consultant's review. This process can be time consuming as records may be scattered across multiple teams in both paper and digital formats. We collected information on historical energy use, technical specifications and drawings for the building, sequence of operation, maintenance records, and other documentation relevant to the building's set up and performance.

We also requested vital information from Johnson Controls, who is both the manufacturer of the system and holder of the current service contract. Like most building automation systems in commercial buildings, Yukon University's system remain bound to its respective manufacturer for servicing. Despite the industry's push for more open platforms, the lingering proprietary nature of many building automation systems presents a barrier for locally available, independent businesses trying to break into the industry.

Securing qualified personnel

The Government of Yukon is committed to our procurement policy, which ensures fairness for all proponents. The policy places a large emphasis on involving local and First Nations businesses and Citizens. This is an important step in advancing reconciliation, as well as helping to build a strong economic future for the Yukon.

However, the proprietary nature of building automation requires manufacturers to support the installation, programming, and servicing of these systems. Being a small and remote jurisdiction, the Yukon's local industry for building automation systems is limited with only a handful of Yukon-based businesses. Few brands of building automation systems have dedicated service providers in the territory, while others rely on services based in other provinces like BC and Alberta. COVID-19 has further increased this strain as provinces and territories adopted travel restrictions to mitigate the spread of the pandemic.

Another challenge of recommissioning work is determining how to procure services without knowing the scope or costs of the subsequent implementation portion of the contract. For this project, we requested services for the investigation work, which we

standardized as part of our earlier planning work. Our expectations were prescriptive and understood by the bidders. After the investigation, proponents would provide a work plan with cost breakouts for each corrective action recommended. No measures could be implemented prior to the approval of the final work plan; undocumented changes not communicated to building maintenance staff would cause operational issues, especially if they are incorrect. Additionally a work plan allowed us to select the measures that fit within our budget, and that we would manage through contract change orders.

The Government of Yukon retained Johnson Controls Canada LP for the recommissioning project at Yukon University. As the existing contract holders, the company was well suited to the work. The recommissioning team consisted of experts located in BC and Alberta, including representatives who were already familiar with the campus's building automation system.

We worked closely with Johnson Controls to make sure they fully understood our vision for the project. They would conduct a thorough review of the building and automation system to evaluate its performance. The resulting recommendations should address the root causes of the issues and improve the efficiency of the building, both from an operational and energy use perspective.

Investigation phase

The investigation phases were further broken out into three sections: document review, on-site assessment and work plan development. Johnson Control's familiarity with the system and the provision of relevant documentation early in the project accelerated kickoff. The contract started on September 1 2019, and the team arrived on-site two months later in November. They returned on February 22 2020 to verify the building automation system's performance over the winter season. Fortunately both of these visits occurred before the appearance of COVID-19 and thus were not impacted by the pandemic.

These assessments included interviews with on-site staff and document reviews of mechanical drawings, points list, sequences of operations, trend logs, and graphic

screenshots. The building maintenance staff's input are invaluable for providing Johnson Controls with a clear understanding of the building's operation.

Johnson Controls confirmed some known issues and identified new ones. They verified that there were some existing original pneumatic controls not connected to the direct digital control (DDC) system, which prevented effective scheduling for energy conservation. Johnson Controls recommended 27 measures to improve the efficiency of the building, at a total cost of \$606,190. If implemented, these measures would achieve estimated annual savings of \$257,703 and result in a simple payback of 2.35 years. These recommendations were categorized based on priority: low cost and/or high priority, low cost and/or medium priority, and low priority. This was useful for determining which measures to implement.

Some examples of recommended measures include switching constant speed pumps to variable speed pumps. According to the maintenance staff at the building, these pumps have not been balanced since construction. Switching to variable speed pumps would rebalance the system, lower energy use, and reduce wear and tear. Another example of some recommended measures include implementing demand controlled or zone-based scheduling for ventilation systems. Allowing ventilation equipment to reduce its operations in accordance to demand will minimize energy use and unnecessary heating requirements for its space. Lastly, Johnson Controls also recommended recalibrations for sensors that were either giving no readings or faulty readings. Identifying and resolving these deficiencies would improve building operability and occupant comfort.

For the full list of recommendations and detailed work plan, [see the Johnson Control's Recommissioning Investigation report](#).

Implementation

Though implementation was not pursued for this recommissioning project, the Government of Yukon plans to pursue these recommended measures in the future. Once implemented, we would be able to evaluate the project's success and quantify its benefits. Then, the campus would be monitored closely over a one-year period by

tracking data points from the building automation system, energy use and feedback from building maintenance staff.

Conclusion

Recommissioning projects are widely considered to be low-cost projects with tremendous potential for resolving operational issues and realizing energy conservation. In fact, this is one of the most commonly recommended energy conservation measures in our energy assessments. There are many variations of recommissioning work, and our experiences have shown that there is tremendous value in articulating our requirements and visions for these projects. Standardizing the investigative portion of the work is straightforward, but the assessment results will vary for each building. Development of a work plan can help ensure the project remains on track while providing oversight for the recommended measures.

Perhaps the most crucial ingredient for a recommissioning project's success is the involvement of building maintenance staff; they know the building best. Having their input necessary to ensure accuracy, reliability, and effectiveness of a recommissioning assessment. It also speeds up the investigative process.

Additionally, our building staff have expressed interest in more recommissioning initiatives. They are supportive of additional attention to the performance of building automation system to alleviate operational issues, conserve energy, reduce greenhouse gas emissions, and improve occupant comfort. We look forward to developing an ongoing recommissioning program for the Government of Yukon's building portfolio.

This report was written by Tony Lam, Manager, Energy Management Unit, for the Sustainable Infrastructure Branch.

