Belmont Secondary School:

Big Savings through Recommissioning

Barry Calhoun Photography

Belmont Secondary School's $50.8 million LEED Gold facility is an inspiration to faculty and students, with specialized classrooms, a wellness centre and daycare, three gymnasiums and a neighbourhood learning centre on site. While many building owners would have considered it a job well done once commissioning had been completed, facility staff at Sooke School District 62 were able to achieve a 50 per cent gain in energy efficiency through optimization of mechanical systems as part of a detailed recommissioning process. For other public sector organizations, recommissioning or retro-commissioning may be a relatively low-cost way to achieve significant energy and cost savings.

Project Summary

Modern facilities come with complex mechanical systems—and while these systems may "work," it is important to ensure all systems are functioning optimally in order to realize their full energy efficiency potential.

School District 62's new Belmont Secondary School opened in September 2015. Controls and commissioning sign-off were completed in the winter of 2015/16. The building appeared to be operating as intended, with most spaces achieving desired temperatures and minimal occupant complaints. However, a routine check of a few outstanding items related to mechanical systems uncovered several minor issues. Facing the choice of fixing those individual issues or doing a system-wide recommissioning, the school district opted to undertake a detailed investigation and performance trending of mechanical systems, heat recovery and air handling systems to take full advantage of the construction warranty period and minimize any additional costs to the district.

Modern, automated, building systems are very sensitive and interconnected. The operations team learned that seemingly small deficiencies in the school's automated system programming were triggering a cascade of interconnected mechanical systems to operate erratically. This was leading to surging, continuous operation of systems meant to run on an occupancy basis, and system oscillations and instabilities.

Through a detailed reassessment, the school district was able to optimize its control systems and lower its energy consumption by approximately 50 per cent. Sooke School District 62 is now using Belmont as a baseline for assessing the energy efficiency of its other buildings in the school district.

Buy-in/Business Case

School District 62 took advantage of their construction warranty period and used existing operational resources to optimize building systems. However, the district estimated that had they contracted out the services, the cost would have been about $20,000, with payback through energy cost savings achieved in under a year.

Energy Savings/GHG Reductions:

- 70% reduction in natural gas usage
- 24% reduction in electricity consumption

Benefits:

- Energy cost savings of approximately $30,000 per year
- Fewer system deficiencies
- Avoided equipment replacement costs and reduced maintenance costs
- Improved air quality and occupant comfort

Cost:

- Cost for a contractor to carry out recommissioning estimated at $20,000. Payback in cost savings would be achieved in under a year

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Results

Through a six-month recommissioning process, facilities staff were able to reduce natural gas consumption by 75 per cent and electricity consumption by 24 per cent—an overall energy reduction of about 50 per cent. This has translated into an estimated $30,000 savings in annual energy costs. Additional benefits include extended equipment life and reduced maintenance costs.

Yearly energy per building per area (e.g. ekWh/m^2/yr) gives the best representation of building energy performance and potential for improvement. Belmont Secondary's design target was 90 ekWh/m^2/year, which is approximately 30 per cent below the current average for secondary schools (as defined in the 4th Annual PUMA Benchmarking Summary for BC School Districts [Prism Engineering 2016]).

Other strategies yet to be implemented, which should further reduce energy consumption include: strategic pre-cooling of the building during night hours to reduce daytime mechanical cooling during summer months; linking heat pump circulation pump to heat pump operations to avoid running pumps when the heat pump is off; and utilizing the building's natural thermal mass by pre-heating the in-floor heating systems during daily peak temperatures to take advantage of efficiencies and reduce early morning demand. Future reductions in electrical demand from these actions could save an additional $5,000 per year or more.

Tell-tale signs a building may not be operating efficiently:

1. Excessive mechanical system noise or complaints of stuffiness
2. Periodic heating or cooling complaints
3. CO_2 levels in occupied areas consistently low throughout the day
4. CO_2 levels in one space (within a group) consistently higher than in other similar spaces, which may trigger unnecessary amounts of outdoor air being brought in from the air handling unit
5. Large systems such as pumps, air handlers and exhaust systems operating after hours with no specific purpose
6. Heat recovery units not operating (or not operating continuously when required)
7. Multiple levels of heating systems operating simultaneously instead of cascading (e.g. heat recovery, heat pump, boilers)
8. Free-cooling not utilized effectively and spaces too hot in the morning during summer months
9. Various systems operating intermittently (pumps, boiler, exhaust, air handlers, heat pumps, etc.)
10. Building pressure excessively positive or negative
11. Systems not properly responding to night setback temperatures
12. Over ventilation – improper CO_2 management
13. Faulty sensors – outdoor air temperature/CO_2/occupancy
14. Improperly set direct digital controls' (DDC) schedules
15. Excessive peak load

If several of the above items are discovered, combined with excessive yearly energy intensity, a detailed review of the overall building control system and strategy, combined with mechanical system review and recommissioning, may be warranted.

Lessons Learned

Building Commissioning is Just the Beginning

Building commissioning sign-off means, at a moment in time, the facility is functioning as designed by the building's architects and engineers. Energy consumption data should be checked the moment the building is occupied and tracked for at least a two-year period. Regular commissioning and energy monitoring can help a facility realize its full potential energy and cost savings—and identify problems before they cost money.

Use a Third-Party Commissioner

With today's complex and interconnected building systems, School District 62 recommends engaging a third party commissioner (independent of the building's architects and engineers) who is familiar with the complexities of building automation and trend review, and who knows how to optimize building systems for best energy use and equipment life.

Building Automation Systems are Subject to Human Error

Building automation systems are extremely sensitive to human error—and proper utilization and control of mechanical systems can take months to achieve. Ensuring building automation is capable of tracking systems at many control points and parameters is key to diagnosing issues during and after commissioning.

Building Automation Systems are Highly Interconnected

Building automation systems must be programmed to account for and respond appropriately to equipment failure and faulty sensors. For example, a failed occupancy sensor could cause an air handler to operate continuously, which could in turn trigger pumps, boilers and exhaust fans to run, causing unnecessary energy costs and wear and tear on equipment. It is critical to find people familiar with building systems and with programming expertise, who can take a global, holistic approach to building automation.

Analyzing Control System Likely Biggest Payback

In modern buildings with direct digital controls, occupancy sensors and CO_2 sensors, the first and likely greatest payback will come from analyzing the performance of the control system to determine if it is optimally utilizing mechanical systems to satisfy building demands. It is often possible to reprogram the building to run up to 50 per cent more efficiently while meeting all ventilation and temperature requirements.

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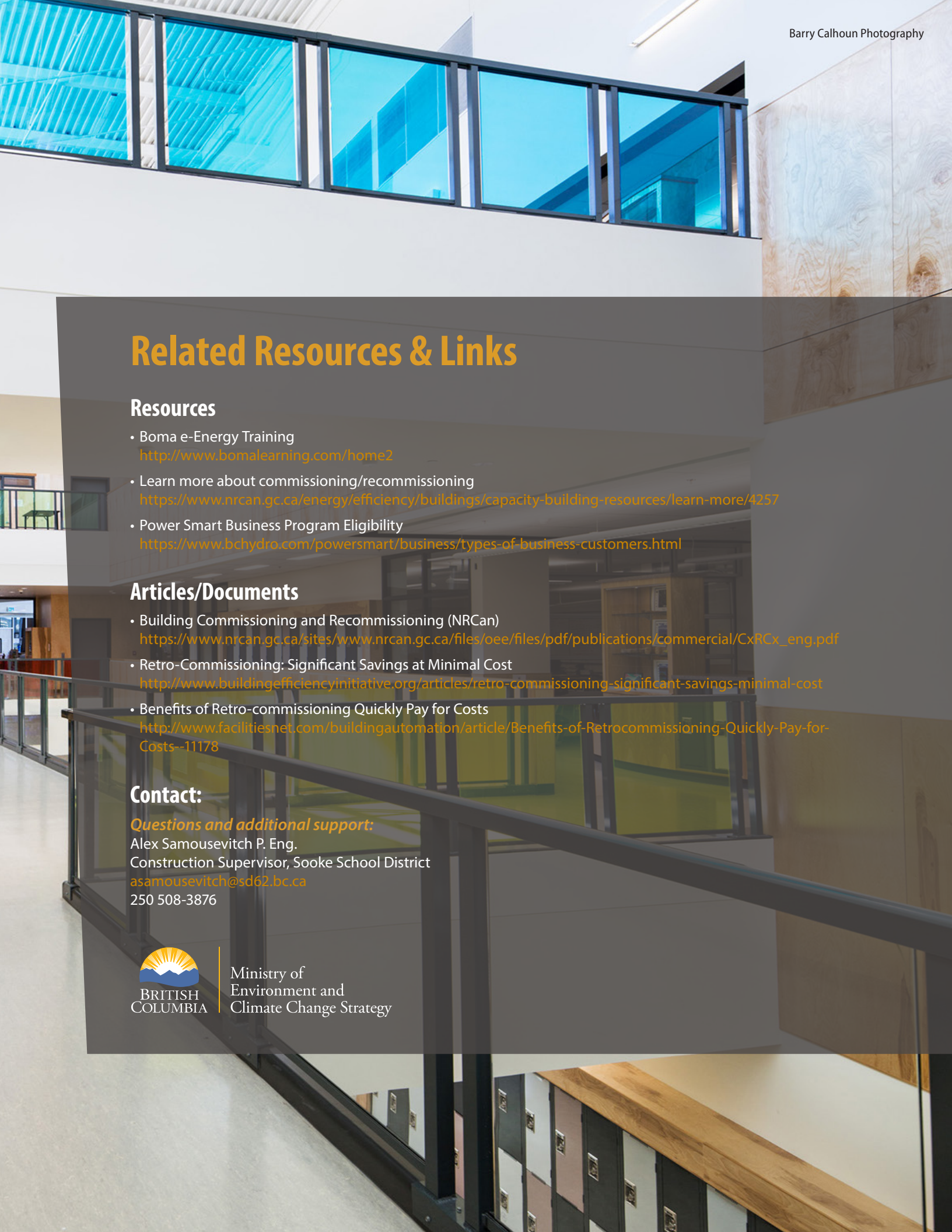

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Related Resources & Links

Resources

- Boma e-Energy Training
  http://www.bomalearning.com/home2
- Learn more about commissioning/recommissioning
  https://www.nrcan.gc.ca/energy/efficiency/buildings/capacity-building-resources/learn-more/4257
- Power Smart Business Program Eligibility
  https://www.bchydro.com/powersmart/business/types-of-business-customers.html

Articles/Documents

- Building Commissioning and Recommissioning (NRCan)
  https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/oee/files/pdf/publications/commercial/CxRCx_eng.pdf
- Retro-Commissioning: Significant Savings at Minimal Cost
  http://www.buildingefficiencyinitiative.org/articles/retro-commissioning-significant-savings-minimal-cost
- Benefits of Retro-commissioning Quickly Pay for Costs
  http://www.facilitiesnet.com/buildingautomation/article/Benefits-of-Retrocommissioning-Quickly-Pay-for-Costs--11178

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