

Re-Commissioning (RCx)

Case Study - Secondary School
St. Oscar Romero, Toronto ON



Project: Retro-Commissioning of St. Oscar Romero Catholic Secondary School to help promote TCDSB and Canada’s energy efficiency objectives and address its clean energy and climate change goals.

St. Oscar Romero was built in 1967, comprises 157,045 sq.ft of floor area on three floors. The school accommodates 753 students and up to 35 children in the daycare. The RCx started on October 2020 and completed in 2021. It focused mainly on the following electromechanical systems:

- Natural gas boilers with 3,857 kW capacity
- Cooling system with a capacity of 400 tons
- Ventilation system with a capacity of 68,653 L/s (145,467 CFM)

PROJECT SUMMARY

RCx Scope/Objectives

- To identify the faults, defects and issues causing lack of comfort and indoor air quality
- To improve the HVAC system behavior in terms of efficiency and operation by considering how to rectify issues related to equipment set up and performance

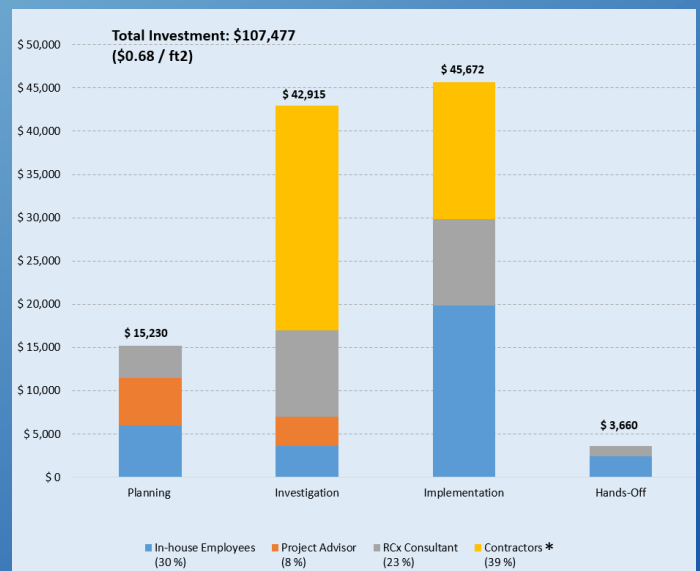
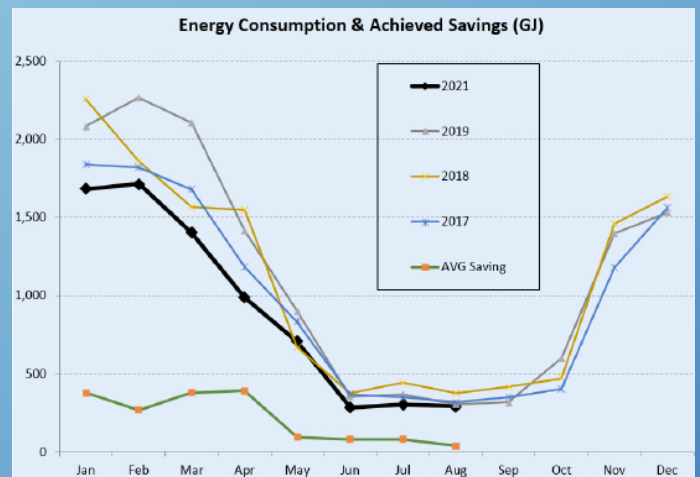
Size of commissioned area: 157,045 ft²

Total commissioning investment: \$ 107,477

	Initial 8-month Achievement *	Additional Potential Savings **
Energy Conservation Measures Implementation Costs	Less than \$7,000	\$113,000
Energy Costs Savings	\$37,900 within 8-month period	\$33,422 per year
Simple PayBack	Within the first month	3.4 years
Energy Savings	1,716 GJ (15%) within 8-month period	3,227 GJ (28.3%) per year
GHG Emission Reductions	214 tonnes (20.4%) within 8-month period	238 tonnes (22.7%) per year
Quantified annual non-energy benefits	Improvement in comfort, indoor air quality, operation, and maintenance costs.	

*:The outcomes of implementing low/no-cost measures within the first 8 months of 2021.

** : The potential benefits of additional \$113K investment to implement the rest of ECMs.



*Test and balancing contractor and Controls’ vendor were involved during investigation phase.

OVERVIEW & BACKGROUND

St. Oscar Romero Catholic Secondary School located in Toronto, Ontario, was built in 1967. The school consists of labs classrooms, offices, shops, a cafeteria, a library, and a gym. The Daycare was added in 1987, which shares natural gas, hydro, and water with the school. During the new addition project in 1993-1994, science rooms, classrooms, shops, library, and chapel were added to the school. The school is currently 157,045 ft² and serves 753 students. Daycare with an area of approximately 10,000 sq.ft currently serves 25 children with a capacity of 35. Re-commissioning is a process for best-in-class building energy performance. The project aims to uncover and correct variances due to operational and control deficiencies. This re-commissioning project was directed by the school's energy performance metrics. The savings were realized through the systematic evaluation of building systems and implementation of low-cost/no-cost measures targeted to improve system operation and, in many cases, improve indoor air quality, comfort, and operation costs.

PROJECT SCOPE OF WORK

The re-commissioning process for the school is performed based on the *Re-commissioning Guide by Natural Resources Canada, ASHRAE 36, 62.1 202 and Guideline 0*. The objective was to identify any faults, defects, issues decreasing comfort levels and indoor air quality. We targeted the issues related to equipment set-up and performance to reduce the gas & electricity consumption by improving the HVAC system efficiency and operation. A detailed on-site investigation of the HVAC equipment in the school was conducted with the RCx Consultant, the schools staff, controls' vendor, and test and balancing contractor.



PROJECT MANAGEMENT

Pact Engineering was retained as a commissioning specialist to perform the Re-Cx practice in this school.

In approaching this project, we first needed to consider the following items in preparation of our road map:

1. There was no record of commissioning and re-commissioning practice in the past for this school. Therefore, this project was to be a retro-commissioning project certain specific requirements which we needed to consider during planning phase.
2. The challenge was to collect school documents from the original construction through post occupancy additions and alteration projects. The majority of documents were unavailable. Thus, requiring an engineering re-calculation and design. Due to budget constraint, we decided to base our assessments on available information and our experience in similar building and similar mechanical systems.
3. As a retro-commissioning consultant, we also needed to involve the school operation staff in investigation and implementation phases. This would allow a mindful monitoring through their day-to-day operation.
4. The project was a strongly tied teamwork among the school board energy officials, Enerlife engineers and Pact Engineering team. Right after kick off we set up frequent meetings among the team members to establish the approach, objectives, budget and timelines.
5. One of the goals of this project was to use this project and its results as an example for all other schools in Canada. As a noble project, all team involved in this project put extra efforts in finding the most feasible measures with maximum results. The results of this project do show maximum savings with minimum investment.
6. There were implications due to COVID-19 that we needed to consider in our approach. From the investigation phase through the analysis, calculation and implementation phase, we needed to consider some limitations, the changes in occupancy load and changes made by the board maintenance staff to the school ventilation in order to abide by their COVID related requirement.

As the project was a collaboration with the school board officials, a real time coordination was always in place. Though vast measures with potential savings were identified, Pact Engineering directed the implementation phase to control the spending based on the available budget. A limited number of Energy Conservation Measures (ECMs) with the most saving and minimum costs were chosen in the implementation phase and the remaining measures reported as "potential savings" were saved for future upon securing the required budget.

RESULTS

At the end of the investigation phase, 47 ECMs were recommended and 89 deficiencies were identified to improve operation and performance of the HVAC systems. As a result, 18 low-cost/no-cost measures were implemented, and 52 deficiencies were rectified.

MAJOR MEASURES & ISSUES IDENTIFIED

1. Large AHUs were operating after hours when school was unoccupied
2. Some schedules were improperly set in the building's DDC
3. HRVs serving the science labs were controlled locally and kept working in unoccupied time
4. Large circulating pumps are not equipped with VFD
5. CO2 sensors and damper actuators required (re)calibration/renewal
6. Heating coils on major AHUs were clogged and caused a significant air pressure drop
7. Noticeable amount of air leak observed on supply air ducts of the major AHUs
8. Building pressure was excessively negative in gyms and the main common area.
9. In the Gym and the exercise room there was no occupancy sensor for the demand-based operation for the lighting and the air units.
10. Some of the VAV boxes dampers were stuck open or closed. Also, there were some other VAV boxes with incorrect airflow control.
11. The AHU serving the large common area supplies excessive cold air in the wintertime.
12. Periodic heating complaints in library and chapel area

PROJECT BENEFITS

Initial Achievements: (in the first 8 month of the year)

- \$37,900 in energy savings
- Payback within the first month
- 214 tonnes of GHG Emission Reductions
- Improved maintenance and operation
- Enhanced the BAS graphics
- Increased familiarity with building systems and controls for maintenance staff
- Low-cost down points were identified and fixed that increased productivity and occupants satisfaction
- Written document provides the information about the school's existing HVAC systems and controls.

Annual Additional Potential Savings:

- \$33,400 in energy savings, leads to an estimated 3.38 year payback.
- 238 tonnes of GHG Emission Reductions
- Improved occupant comfort and indoor air quality in library, gyms, change rooms and common area

IMPLEMENTATED RCx MEASURES		Annual Saving:
AHUs and Chiller plant schedules are adjusted properly based on occupancy. Cost: \$500 PayBack: 0 years	Electricity:	290,000 kWh
	Natural Gas:	24,700 m ³
Trim and Respond logic is applied to reset the air handling units' supply air temperature set-points. Cost: \$1,000 PayBack: 1.2 years	Natural Gas:	4,100 m ³
Café was cold because of VAVs maladjustment. Cost: \$1,000 PayBack: 2.3 years	Electricity:	2,700 kWh
	Natural Gas:	250 m ³
15 other RCx measures Cost: \$4,500 PayBack: 1.2 years	Electricity:	25,000 kWh
	Natural Gas:	1,800 m ³

Note: Costs and payback periods include only implamantation phase materials and labour

Missing design documents and updated design values

In this project, the majority of the building technical documents including the design drawings, specifications, and the main equipment shop drawings were unavailable. When TCDSB purchased the school, some of the above noted documents were not transferred to TCDSB. As a result, operating and maintaining the school have been more costly, as well as increasing the current RCx cost. We learned that a project like this school, an engineering service is required to provide the new design values based on the current building application and existing equipment.

Rebalancing the air and hydronic systems

To ensure the air and hydronic system serve the building properly, a periodic rebalancing of these systems is required. However, for a successful rebalancing a set of up-to-date drawings and design values were required, which were not available for this school.

Use a third-party commissioning authority for any capital projects

We observed a few major deficiencies in HVAC systems such as an excessively large pressure drop in some ductwork fittings due to improper installation due to previous projects. These major issues could have been prevented by a 3rd party commissioning authority retained at the time of the capital project.

Building Automation Systems are the source of the biggest paybacks

One of the first measures to consider (because of its very short payback) is to analyze 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 percent more efficiently while meeting all ventilation and temperature requirements.

An available budget issue usually exists

The lack of an available budget has always been a barrier in the implementation phase. By involving the owner in the planning and assessment phases, a mutual understanding between the RCx consultant and the owner will provide much more successful results in the implementation phase.

In this project, the available funds for implementing the ECMS were very limited. By knowing this we re-oriented the recommissioning planning. We spent more time in the assessment phase and we figured the optimized usage of the available fund. The results were remarkable.

PROJECT PARTNERS/TEAM:

Building Owner/Manager:	Toronto Catholic District School Board
Re-Commissioning Consultant:	Pact Engineering Inc
Project Advisor:	Enerlife Consulting
TAB contractor:	Air Balance Group Inc
BAS Contractor:	Pure Automation Controls

COMMISSIONING Vs RE-COMMISSIONING?

Commissioning for new or an addition/alteration building project.

Commissioning is a systematic and documented process of helping to ensure that building systems perform according to the design intent and the owner's operational needs.

Re-Commissioning for an existing building 5 years or more after the construction completion.

Existing Building Commissioning (EBCx):

- Provides a better environment for occupants
- Reduces indoor air quality problems
- Reduces occupant complaints
- Reduces contractor call-backs and warranty issues
- Reduces energy consumption and operational costs

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