Group Project: Commercial Building in Belize City

# Building efficiency and sustainability opportunities for a commercial building in Belize.

**OBJECTIVE:**

Complete an energy audit on a commercial building to determine a baseline energy consumption and create a Building Energy Audit Report Presentation that includes efficiency upgrades, energy monitoring to collect consumption data and renewable energy systems where appropriate.

**SCOPE:**

The audit must meet the following criteria:

* + Record of site information including all building systems and solar site analysis
  + Utilize existing data provided from available energy consumption records or benchmarking to determine a baseline energy model with recommendations for energy efficiency improvements to the existing building.
  + Assess the building’s requirements for data collection via current transformers. Is the Emporia data logger a good fit?

Examples of suitable scope for the term project include:

* + RETScreen Expert Filescreen clips and report of findings
  + Evaluation of efficiency measures – what is the improvement when [efficiency measure] is applied to [building component]?
  + Quantifying losses – how much energy is lost due to uninsulated building areas compared to the proposed upgrades.
  + List recommendations for improving/replacing existing systems based on the efficiency of the existing building and recommended upgrades.

**TASKS/ACTIVITIES:**

Identifying sources of existing data and information, and methodology for gathering any new data such as:

* + Possible quantitative sources include Environment Canada, NRCan, equipment manufacturers, RETScreen baseline data, facility owners, etc.
  + Analyzing data using appropriate software/tools – RETScreen Expert
  + Summarizing results and linking back to the original objective (report findings on energy efficiency improvements)
  + Developing a conclusion and compiling findings in the final report

**Activity 1: Building a baseline.**

Each building group will perform a site assessment with the following:

* Data Collection Form– An overview of the building, retrofits of late, and available information on building size, systems, R/RSI values
* Original Building Plans captured digitally for your file if available
* Retrofit building plans if available for past upgrades (note additions to the original structure and their design).
* Energy Use Spreadsheets (Belize Electric and other fuel billing data)
* Detailed photos and data on existing mechanicals (wide shot and close-updigital photo of nameplates and written model number on DCF).
* Detailed photos and data on existing lighting systems(wide shot and close-updigital photo of nameplates and written model number on DCF).
* Detailed photos and data on existing appliances (wide shot and close-up digital photo of nameplates and written model number on DCF)
* Photos of all exterior sides of the building. Make sure your photos capture the entire face of the building (stand back far enough to capture the entire side when able, always check your photos for clarity and capture). When this cannot be achieved, capture photographs of all wall areas with multiple photographs for each exterior wall noting direction the wall is facing.
* Photo of Solar Pathfinder analysis.
* Photo of adjacent shading structures such as trees and tall buildings.
* Measure insulation depth in the attic if there is access and photograph the tape measure buried in the full depth of insulation, along with a wide shot of the attic area. Record attic R values on DCF.
* Probe walls to determine any insulation present and depth of cavity.
* Take all necessary measurements so that the volume of the building can be calculated.
* Remember to identify any unheated areas and note them on your sketch.
* Draw a sketch of the building footprint and side view of wall height, including sloped ceiling profiles if present, noting any unheated spaces.
* Building type (single-storey or multi-storey)
* Construction system (wood frame, steel, concrete)
* Cooled floor area and uncooled floor area
* Windows and doors
* Wall height
* Site-buildingorientation north
* Building Envelope (typology, insulation type and RSI values)
* Space and domestic hot water heatingsystems
* Appliances
* Ventilationsystem
* Lighting, appliances (including energy efficiencyprovisions)
* Measure solar potential with the Solar Pathfinder.

**Activity 2: Recommendations**

This activity is focused on recommending the details of any efficiency retrofits.

1. Overviewof efficiency upgrades(includinganymodellingorassessmentsthatledtothedevelopmentofthe upgrade).
2. Increased RSI and airtightness upgrades with steps to achieve included target as appendices. (NRCan Keeping the Heat In will be a useful resource)
3. Mechanical/lighting additions and/or upgrades
4. Anysolarrecommendations(ThiswillbedeterminedusingtheSolarPathFinder andwillgivea description of suitability for solarPV).

**Activity 3: Energy Analysis and Modelling**

The following tasks should be completed under Activity 3:

1. Use the cooling load calculation in RETScreen Expert to:
   1. Estimate energycosts(fuelandassociatedelectricityforcooling, domestic hot water, lighting, refrigeration, and any other equipment)
2. Develop an energymodel using the RETScreen Expert energy modellingsoftware.

ii. Models will be used to identify energy consumption in baseline and post-retrofit conditions.

iii. Each group will add their data to the RETScreen baseline file in the following order:

1. Building Envelope Group for data input. Screenshot your building components and create a Word document with a table of contents (TOC). Create headings based on building components. Example:Wall as heading, screen clip of RETScreen Expert wall inputs). Send to Lighting and scheduling group.

2. Lighting and Scheduling Group for data input.Screenshot your lighting components and add them to the existing Word document.Example: Lighting as heading, screen clip of RETScreen Expert lighting inputs.Send the saved file to the mechanical group.

3. Mechanical Group for data input. Screenshot your lighting components and add them to the existing Word document.Example: Mechanical Systems as heading, screen clip of RETScreen Expert Mechanical inputs (domestic hot water, cooling systems, ventilation, etc.).

1. Analysis of recommended upgrades energy consumption and cost reduction.

# **Sub-Deliverables**

A discussion of the energy analysis results above includes any relevant graphs and comparison tables for pre- and post-retrofit results. A list of any assumptions made in the energy analysis and the development of the energy model should be provided in this section.

**Activity 4: Cost Benefit Analysis**

Calculation of Simple Payback and Long-term Return on Investment

1. Simplepaybackcalculation–Costofretrofitdivided byannualenergysavings.

A calculation of a simple payback period: Payback (years) = cost of retrofit / annualcostof energy savings.

1. ROI–Returnoninvestmentgiventhe anticipatedlifecycleofretrofittedenergyefficiencymeasures. This should be information available from your Engineering Economics class content. There is a function in the RETScreen software for this.

**FINAL DELIVERABLES:**

Ensure your final report shows the following:

* Background of building, who, what, where, when, why did the assessment take place
* Project Objective
* Project Scope
* A final report with the results from activities one to five. Any supporting documentation will be included as an attachment. Please provide references for any research or figures used to support this analysis.
* Methods & Analysis (data sources, tools/instrumentation, software)
* Results (RETScreen file, Executive Report and Presentation)
* Recommendations including upgrades with comparison energy consumption, and emissions and cost savings.
* Conclusion of building audit and findings.
* Summary of time spent on the audit process, including data collection, modelling, report, and presentation broken down into 30-minute increments.

\*Time tracking will be valuable when estimating the cost of human resources for future projects andestimating the time it will take you to complete future work.

* Use an hourly rate of $23.75/hour and a travel expense rate of $0.15/km to track and calculate your billing expenses and include them as a separate document.

RUBRIC

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|  | Needs Work | Developing | Professional | Innovative |
| Project background and objective – is it clear what your project is trying to address?  (20 Marks) | Objective and background are missing | Objective and background are partially complete | Objective and background are complete | Objective and background are entirely complete AND…? |
| Methods – are the methods well suited to the problem, and fully described?  (20 Marks) | Methods are missing or largely incomplete | Methods are partially complete | Methods are complete | Methods are entirely complete AND…? |
| Data collection/sourcing – were the data appropriately sourced, and checked for quality?  (20 Marks) | Data are missing or largely incomplete | Some data tools were used properly | Alldatatoolswereused properly | Alldatatoolswereused properly AND…? |
| Analysis – were the datasets analyzed using the methods as described?  (20 Marks) | Analysis is missing or largely incomplete | Analysis is partially complete | Analysis is complete | Analysis is entirely complete AND…? |
| Results – are the results linked back to the objective? (20 Marks) | Results are missing or largely incomplete | Results are partially complete | Results are complete | Results are entirely complete AND…? |