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**MEETING:** Regular Council  
**DATE:** February 26, 2024  
**TIME:** 6:00 PM  
**LOCATION:** Town Council Chambers

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## AGENDA

1. **Call to Order**
2. **Approval of Agenda**
3. **Approval of Minutes**
  - Regular and In Camera meeting Minutes of January 15<sup>th</sup>, Epoll meeting Minutes of January 23<sup>rd</sup> and February 14<sup>th</sup>, and Emergency meeting Minutes of January 30<sup>th</sup>, 2024
4. **Proclamations/Presentations/Flag Raising**
  - Deep Energy Retrofit Feasibility Study Results/Capital Pre-application (L. Roy)
  - Maritime Municipal Electric Utility Alliance MOU (L. Roy)
5. **Business from Minutes**
  - Sidewalk/Snow Removal Policies
6. **New Business**
  - Solid Waste Management Committee – New Committee Member Required (D. Roberts)
  - Land Acknowledgement
7. **Correspondence**
  - RK MacDonald Nursing Home – By-law Amendments
8. **Staff Reports**
  - CAO Report
9. **Committee Reports**

**Regular Town Council Meeting  
January 15, 2024  
Town Council Chambers**

**Present**

Mayor L. Boucher  
Deputy Mayor W. Cormier  
Councillor M. Farrell  
Councillor A. Murray  
Councillor S. Cameron  
Councillor D. MacInnis  
Councillor D. Roberts

**Call to Order**

Mayor L. Boucher called the meeting to order at 6:00 PM

**Approval of Agenda**

“It was Moved and Seconded to approve the agenda as presented.” Motion carried.

**Approval of Minutes**

- December 18, 2023, Regular and In Camera and January 12, 2024 Emergency In Camera and Emergency Meetings

“It was Moved and Seconded to approve the meetings of December 18, 2023, Regular and In Camera and January 12, 2024, Emergency In Camera and Emergency Meetings.” Motion carried.

**Proclamations/Presentations/Flag Raising**

- St. Ninian’s Pioneer Cemetery Committee – Paving Proposal (M. MacDonald, Fr. D. MacLennan, F. Dunn)

At 6:01 PM Councillor M. Farrell declared a conflict of interest and left the meeting.

M. MacDonald took to the podium and provided Council with a PowerPoint presentation outlining the start and finish of the project and thanked Council for their support.

Details were provided on the parking lot and sidewalk (busy area/pooling of water in parking lot) and an agreement in principle from neighbors on proceeding with parking lot improvements.

F. Dunn took to the podium noting it is the hope of the group that the site will become a historical site including a park and noted that in order to do that improvements are required.

Council was advised that one of the adjoining property owners is agreeable to providing a required easement subject to improvements to the installation of new sidewalk and curb & gutter and outlined proposed improvements.

K. Proctor, P. Eng., spoke to issues that may make it difficult to provide what is being asked and suggested that a number of items be reviewed.

CAO J. Lawrence noted the project could be given consideration during budget deliberations, subject to identified constraints being resolved.

Mayor L. Boucher thanked the delegates for their presentation and they left the meeting.

At 6:14 PM Councillor M. Farrell re-joined the meeting.

- Proclamation – African Heritage Month

Mayor L. Boucher provided comment on African Heritage Month and acknowledged and thanked L. Reddick for her for her efforts over the years in promoting African Heritage Month.

Mayor L. Boucher read aloud and signed the 2024 African Heritage Month Proclamation.

“It was Moved and Seconded to approve a flag raising request (January 31<sup>st</sup>) as requested.”  
Motion carried

## **Business from Minutes**

### **New Business**

- Temporary Borrowing Resolution (TBR) Extension - Antigonish Community Solar Garden (M. Barkhouse)

M. Barkhouse took to the podium and provided details on the temporary borrowing resolution, noting that the solar garden project needs to be operational while the TBR is in effect – however, as the current temporary borrowing resolution will end prior to it becoming operational, the Town would be required to pay the outstanding balance. M. Barkhouse stated that she is requesting Council extend the TBR at the same amount, and noted that the borrowing would be rolled into the Fall debenture issue.

“It was Moved and Seconded to extend the Temporary Borrowing Resolution as detailed by staff.” Motion carried.

Discussion took place on delays in getting the solar garden up and running, with CAO J. Lawrence providing comment on issues identified by NSPI and advised that AREA is working on the matter.

- Solid Waste Management Committee

On behalf of Councillor D. Roberts, Mayor L. Boucher noted that a new community member is required for the Solid Waste Management Committee.

### **Correspondence**

- RK MacDonald Nursing Home – By-law Amendments

CAO J. Lawrence provided details on the amended RK MacDonald Bylaws, including when a conflict of interest is to be declared. It was noted that to make a single amendment the entire lot of Bylaws had to be included for the amendment.

“It was Moved and Seconded to accept the amended Bylaws of the RK MacDonald Nursing Home as presented.” Motion carried.

## Staff Reports

- CAO Report

Councillor S. Cameron stated that he and other Councillors feel that the snow (ice banks) should be removed.

CAO J. Lawrence stated he believes that staff have arranged for the removal of the snow/ice later this week.

CAO J. Lawrence noted that for the period leading up to Christmas the Town offers enhanced snow removal in an effort to ensure downtown businesses are not unduly impacted during the busy shopping season.

It was suggested that a workshop be held to consider any changes/amendments that may need to be made, with CAO J. Lawrence noting that Council needs to be mindful of staff requirements for such activities.

K. Proctor noted that in coordinating such activities a number of factors need to be considered.

It was noted that subject to traffic control availability and weather, the snow/ice is scheduled to be removed from the downtown later this week.

“It was Moved and Seconded to approve the CAO Report as presented.” Motion carried.

## Committee Reports

- Eastern District Planning Commission (EDPC)

Councillor M. Farrell read aloud the four (4) motions arising from a recent EDPC meeting and for which discussion took place on various points:

“It was Moved and Seconded that that the Municipal Planning Strategy for the Town of Antigonish be amended by Inserting the following wording in bold text in Policy UDH12 as follows: Council shall consider by development agreement, subject to the conditions of Policy ADM16, any development or change in use otherwise **not** permitted by the land use designation and zone for any additional building, or part of a building, on a lot on which a historic or registered heritage building is situated subject to the following consideration...” Motion carried.

“It was Moved and Seconded that the Land Use By-law for the Town of Antigonish be amended by inserting the following wording in bold text to the “Hard Surface” definition in Part 3: Definitions of the Land Use By-law to read as Hard Surface means any surface on a lot that is impervious to water and shall include buildings, asphalt, and monolithic concrete surfaces including any area intended for parking.” Motion carried.

“It was Moved and Seconded that the Land Use By-law for the Town of Antigonish be amended to read as follows: 8.4.2 Design requirements for the Downtown Mixed Use (MU-1) Zone Part 8: Mixed Use Zones of the Land Use By-law: (i) Building Materials and Colours: (ii) Building materials shall be of high quality and shall include one or more of the following: a. Clapboard, shingles, board and batten siding or wood or composite materials; b. Brick, stone, tile, and like products; c. Parge Coat; d. Metal, ceramic, or composite material tiles.” Motion carried.

“It was Moved and Seconded that the Land Use By-law for the Town of Antigonish be amended to permit transitional homes in the RN-1 zones, RN-2 zones, and MH zones.” Motion carried.

- Accessibility Committee

Councillor D. MacInnis noted that Accessibility and Emergency Measures (EMO) committee meetings are both upcoming.

- Community Enhancement Committee (CEC)

Councillor A. Murray noted that a CEC meeting was cancelled due to illness. He further noted that the Museum Board will be seeking two (2) new members.

- People's Place Library

Councillor S. Cameron noted that the library will be hosting Leslie Crew from CBC who will be doing a reading in January and that Zoom links will be available.

Council was advised that an updated General Equivalency Diploma (GED) program to be offered and details on the new program were provided today on 989xfm.

- Deputy Mayor W. Cormier stated he had nothing to report.
- Mayor L. Boucher acknowledged that CAO J. Lawrence would soon be leaving his position with the Town and provided comment on his mentorship with staff, and Council's priorities.

A token of appreciation was presented to CAO J. Lawrence and a photo opportunity took place.

Mayor L. Boucher noted that Council was successful in hiring interim CAO Mr. Marvin MacDonald. She noted he has worked with the province for 18 years as well as being CAO for the District of St. Mary's.

The meeting was adjourned.

**Epoll Meeting**  
**January 23, 2024**  
**Via Email**

**Present**

Mayor L. Boucher  
Deputy Mayor W. Cormier  
Councillor S. Cameron  
Councillor M. Farrell  
Councillor A. Murray  
Councillor D. MacInnis

CAO J. Lawrence

CAO J. Lawrence called the meeting to order noting that it was a duly called epoll meeting and provided background information relevant to the following motion:

“That the Town of Antigonish CAO direct staff to submit a Smart Renewables and Electrification Pathways (SREP) Capacity Building Stream Grant Application to a maximum of \$2.67 million dollars (cost-shared 75 % federal/25%Town of Antigonish) prior to the deadline application date of January 31, 2024.” Motion carried.

**Emergency Town Council Meeting  
January 30, 2024 – 6:00 PM  
Via Zoom**

**Present**

Mayor L. Boucher  
Deputy Mayor W. Cormier  
Councillor S. Cameron  
Councillor M. Farrell  
Councillor A. Murray  
Councillor D. MacInnis  
Councillor D. Roberts

Interim CAO M. MacDonald  
D. Wilson, Deputy Clerk

Mayor L. Boucher called the meeting to order at 6:00 PM.

“It was Moved and Seconded to approve the agenda as presented.” Motion carried.

Mayor L. Boucher noted that this was a one item agenda to reconfirm the original motion on consolidation.

“It was Moved and Seconded that Town Council confirms its October 20, 2022, request that the provincial government consolidate the Town of Antigonish and the Municipality of the County of Antigonish into one municipal unit through special legislation.”

Discussion took place with each Councillor providing comment on the matter of consolidation, and Mayor L. Boucher responding to questions from Council.

For the motion: Councillors M. Farrell and A. Murray, Deputy Mayor W. Cormier and Mayor L. Boucher - Against the motion: Councillors D. MacInnis, D. Roberts and S. Cameron. Motion carried.”

At 6:12 PM the meeting was adjourned.

**In Camera Council Meeting**  
**January 15, 2024**  
**Town Council Chambers**

An In Camera Town Council meeting was held to discuss personnel matters, contract negotiations, and/or the sale, acquisition, or lease of municipal lands, and /or information subject to solicitor-client privilege.

**Epoll Meeting  
February 14, 2024  
Via Email**

**Present**

Mayor L. Boucher  
Deputy Mayor W. Cormier  
Councillor S. Cameron  
Councillor M. Farrell  
Councillor A. Murray  
Councillor D. MacInnis

D. Wilson, Acting CAO

Acting CAO D. Wilson called the meeting to order noting that it was a duly called epoll meeting and provided background information relevant to the following motion:

Motion: "That the Town of Antigonish write a letter of support for the Antigonish Arena for a funding application to the province for upgrades totalling \$265,000, and subject to funding approval from the province, would financially support the upgrades to a maximum of \$57,500." Motion carried.



# Eastern District Planning Commission

606 Reeves Street, Unit #3, Port Hawkesbury NS B9A 2R7  
Ph.: 902-625-5364  
Fx.: 902-625-1559  
1-888-625-5361

**John D. Bain**  
Director  
jdbain@edpc.ca

February 13, 2024

Mr. Marvin MacDonald, CAO  
Town of Antigonish  
274 Main Street  
Antigonish, Nova Scotia B2G 2C4

## Reference: Revised Appointments

Dear Mr. MacDonald,

As in years past we would ask that the Town of Antigonish Council make the following appointments at your next regular session of Council replacing all previous appointments of District Planning staff to various Municipal positions effective **April 1, 2024**:

- Building Inspection:  
Building Inspectors: **Sean Donovan** and **Jonathan Martin**  
Alternates: **David MacKenzie, Harry Martell, André Samson** and **Luke Ross**
- Development Officer: **John Bain**  
Alternates: Andrew Jones; Wanda Ryan; Kristen Knudskov and Mikayla Tait.
- Fire Inspector: **Sean Donovan**  
Alternates: A. Samson, L. Ross, H. Martell; D. MacKenzie; and J. Martin.
- Dangerous or Unsightly Premises  
Administrators: **Sean Donovan** and **John Bain**  
Alternate: Jonathan Martin and André Samson
- Special Constables: Building/Fire Codes, Dangerous or Unsightly Premises, Land Use By-laws  
**Sean Donovan** and **Jonathan Martin**

If you have any questions or concerns about these appointments, please do not hesitate to contact me.

Yours truly,

John Bain  
Director

/jb

**Subject:** CAO Report  
**To:** Antigonish Town Council  
**Date Prepared:** 24-02-26  
**Prepared by:** Dianne Wilson, Acting Chief Administrative Officer

**Administration**

This report compiles monthly updates and progress reports from the Town of Antigonish’s Administration, AREA Community Development, and Public Works departments.

The Utility and Review Board held the Town’s water rate application in Town Council Chambers on February 20<sup>th</sup> with a decision expected in late March.

Public Works staff is fully engaged in winter activities including extended work related to snow removal and work at intersections from major snowstorms in February. In addition, work has been undertaken to push back snow in areas that are prone to cause issues with the forecasted rain event.

Work continues at the Brierly Brook Solar Garden with an anticipated operational date of April, 2024.

An Open House for the Solar Garden is scheduled to be held at Town Hall on March 8<sup>th</sup> from 6 to 8 PM.

Staff are working on capital budgets – a workshop with Council is anticipated for mid-March. Details to follow.

**Highlights**

Summarize 2-3 noteworthy department projects, milestones, achievements or challenges that occurred in the past month. This section should be a maximum of 5 sentences written in paragraph format. This report compiles monthly updates and progress reports from the Town of Antigonish’s Administration, Community Development, Parks and Recreation, and Public Works departments.

**Strategic Initiatives Update:**

Projects
<b>Title: Carbon Inventory – PCP Milestone Tool</b>
<b>Status Update: Continuing to input data for Carbon Inventory</b>
<b>Next Step: On going</b>
<b>Title: Net Zero Engagement Strategies Funding Opportunity</b>
<b>Status Update: Submitted final application November 28<sup>th</sup>.</b>
<b>Next Step: Await approval in the new year</b>
<b>Title: Grid Modernization and New Substation</b>
<b>Status Update: Working with Strum on detailed engineering and site work preparation. Received Contribution Agreement from SREP and are currently reviewing it.</b>
<b>Next Step: On going</b>
<b>Title: Executive Assistant Duties</b>
<b>Status Update: Organize and schedule meetings for Mayor Boucher</b>
<b>Next Step: Ongoing Correspondence</b>

<b>Title: FCM/SCCF – Community District Energy System (CDES) Feasibility Study</b>
<b>Status Update: Had SCCF Funding announcement at Bayside Travel Centre</b>
<b>Next Step: Working on Community Stakeholder letter of consent – on going</b>
<b>Title: Green Municipal Fund – GHG Reduction Pathway Feasibility Study – Deep Energy Retrofits</b>
<b>Status Update: Council Presentation</b>
<b>Next Step: Investigating Capital funding opportunities to follow study.</b>
<b>Title: New SREP funding available for Capacity Building</b>
<b>Status Update: Submitted application January 31, 2024</b>
<b>Next Step: Awaiting approval.</b>
<b>Title: Diversity, Equity and Inclusion Plan</b>
<b>Status Update: Reviewing Final Report</b>
<b>Next Step: Follow up with Empowered once review is complete</b>
<b>Title:</b>
<b>Status Update:</b>
<b>Next Step:</b>
<b>Title:</b>
<b>Status Update:</b>
<b>Next Step:</b>
<b>Title:</b>
<b>Status Update:</b>
<b>Next Step:</b>

**AREA Update:**

<b>Projects</b>
<b>Title: AREA weekly updates</b>
<b>Status Update: Attend weekly update meetings</b>
<b>Next Step: On going</b>
<b>Title: HOME Program review</b>
<b>Status Update: Released Energy Survey via social media and bill insert</b>
<b>Next Step: On-going</b>
<b>Title: Solar Subscriptions</b>
<b>Status Update: Attended multiple meetings and workshops on subscription model</b>
<b>Next Step: on-going</b>
<b>Title:</b>
<b>Status Update:</b>
<b>Next Step:</b>
<b>Title:</b>
<b>Status Update:</b>
<b>Next Step:</b>
<b>Title:</b>

<b>Status Update:</b>
<b>Next Step:</b>

**Subject:** CAO Report  
**To:** Antigonish Town Council  
**Date Prepared:** February 2024  
**Prepared by:** Kate MacInnis, Director of Community Development

**Community Development**

**Strategic & Capital Projects of Council:**

<b>Projects</b>
<b>Active Transportation Corridor</b>
<b>Status Update:</b> Revised Tender Scope Ongoing
<b>Next Step:</b> Bell returned and moved the corner pole. They still need to come back to replace a pole on West Street that was hit by a motorist. WSP to provide tender packages for West Street sections that have been broken into two projects. Town staff to work on St. Ninian Street property impacts for 2025 construction season. Town staff and WSP to meet to discuss project tendering and construction timelines for 2024.
<b>Accessibility Ramp</b>
<b>Status Update:</b> Engineering Design Options Prepared
<b>Next Step:</b> Staff have been working with Strum to identify options for the installation of an accessible ramp to the Challenger Baseball Field. This area has been particularly challenging due to the slope and narrow working area. Staff will work with Strum to develop an RFP for construction services once the most cost effective path forward is determined. Construction would begin in the spring/early summer. Staff submitted a grant for provincial funding to supplement some of the construction costs for this project.
<b>Tourism</b>
<b>Status Update:</b> Marketing Levy Passed First Reading
<b>Next Step:</b> By-Law passed and adopted by Council. Staff have been doing outreach and registering properties. Registrations are coming in steadily. There are a few questions from Air BnB property owners and staff are following up as needed. Goal is to have Town properties registered by April 1.
<b>Regional Ball Field #2</b>
<b>Status Update:</b> Phase 1 of drainage work has been completed.
<b>Next Step:</b> Phase 2 request for drainage and grading will come as part of 24-25 budget.
<b>Arbor Drive Playground</b>
<b>Status Update:</b> Equipment has been ordered
<b>Next Step:</b> Install will happen in the Spring. Staff are exploring grant opportunities to add additional features to the park.
<b>Parking Meter Renewal</b>
<b>Status Update:</b> Complete.
<b>Next Step:</b> Phase 2 for Creighton Lane will be a part of 24-25 budget.
<b>Litter Cans</b>
<b>Status Update:</b> Staff developing standards and updates to locations for downtown core litter cans.
<b>Next Step:</b> Staff will come to Council with update on litter can service which will include locations and set up to reflect placemaking standards for March.
<b>Accessibility</b>
<b>Status Update:</b> Staff working on report card
<b>Next Step:</b> Staff and committee to review quick wins and goals for upcoming fiscal year. Staff to also bring the re-launch Accessible Antigonish to committee and Council.

## Operational Projects:

Project
<b>Beautification</b>
<p>The draft RFQ has been posted. Submissions will be accepted until March 8.</p>
<b>Pedestrian Safety</b>
<p>Staff working with WSP to develop recommendations to enhance overall pedestrian safety. The immediate focus will be reviewing midblock crosswalks. Staff met with RCMP, County, StFX and NS Public Works to review concerns and form a subcommittee. The subcommittee will be developing an outreach plan for both pedestrians and motorists about crosswalk safety.</p>
<b>Wayfinding &amp; Signage</b>
<p>Mock ups for new signage were developed. Initial round of feedback from Town and Paqtnkek have gone into Vibe Creative Group. Staff will receive a second copy of the design. Staff will work with Vibe and installers to get quote for the new set-ups for the welcome signage. The next phase of this work will involve recreation and look at new signage at The Landing, which will include a reflection on the cultural history and the Mi'kmaw people, as well as trail markers, mapping, and information on wildlife found in the area.</p>
<b>Town Hall Lighting</b>
<p>CBCL was onsite to conduct a structural and electrical assessment. CBCL will draft report to indicate the conditions of the building, plan for the lighting and recommendations for installation. This work is required before going to tender.</p>
<b>Town &amp; StFX Partnership</b>
<p>Following a review of the minutes and feedback from all partners, the Good Neighbours Working Group are reviewing options for Homecoming 2024. The Town has provided the Special Events Planning Guide and Application form to the Student Life for their review should it be helpful in determining a direction moving forward. The Town will look to ways to support StFX and the progress made, as well as the continued advancement of the Good Neighbours Program.</p>
<b>Security Camera Project</b>
<p>Staff from all departments are working on the development of a revised security camera system to protect the safety and security of Town assets and facilities. Staff have been working with StraitIT on the plan. Staff will come to Council in the coming months with an overview as well as a budget ask, which will included a phased implementation plan. This project is board in scope and involves many different aspects from the different types of equipment needed to the policy development of how to properly manage a security camera system.</p>
<b>Feasibility Study for Rec Centre – Investigation Phase</b>
<p>Staff will provide Town and County Council with initial information regarding an asset inventory as well as very preliminary cost analysis based on construction costs from facilities that have been built in other communities across Nova Scotia. Staff will provide Councils with this information prior to next steps being taken.</p>
<b>Programming</b>
<p>Open Gym sessions have returned for the winter. Multi-Sport is also ongoing. Recreation staff supported Keppoch Fun Day to provide free access to skis. The winter equipment loan has been very busy. Staff are already reviewing options for summer programming and summer camps to determine how best to meet the needs of the community as the demand for programming for both children and seniors.</p>
<b>Budget 2024-2025 Planning</b>
<p>Staff are preparing plans for budget. This includes review the recreation asset management plan for the replacement schedule and sourcing quotes and seeking professional services to determine a scope of work for proposed projects. Staff will also meet with committees to review budget and special requests for the coming year. The final plan and project list will be presented to Council in the coming months.</p>
<b>By-law, Policy &amp; Procedures:</b>
<ul style="list-style-type: none"> <li>• Traffic Control/Sidewalk Encroachment Policy – (research phase for potential proposal)</li> <li>• Sponsorship/Naming Rights Policy (Marking and Communications Officer Drafting)</li> </ul>

- Facility Allocation Policy (in progress and in partnership with the County)
- Community Events Policy (proposed)
- Nuisance Wildlife/Animal Feeding By-Law (proposed)
- Oversized Move Permit (proposed)
- Video Surveillance Policy (proposed)

### By-Law Enforcement Statistics:

Reporting Period: December 11, 2023 to January 9, 2024

*\*Please note the holiday break fell within this reporting period.*

#### Still Under Investigation:

Dog By-law: 1 (still under investigation)

Unsightly: 2 (still under investigation)

Solid Waste: 2 (still under investigation)

Signage Policy - Ongoing file to address collection of signage being put on Town owned utility pole

#### Closed:

Lodging Home: 1 file (investigation Opened and Closed)

Solid Waste: 5 files

#### Parking Violations:

100 parking violations (includes Town, Hospital & StFX)

50+ vehicles have been towed as a part of Overnight Enforcement this past month

**Subject:** CAO Report  
**To:** Antigonish Town Council  
**Date Prepared:** February 20, 2024  
**Prepared by:** Meaghan Barkhouse, Director of Corporate Services

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**Corporate Services**

**Highlights**

The Water Utility General Rate Application (GRA) hearing convened on February 20, 2024, with a panel consisting of Blaine Rooney (consultant), the Director of Corporate Services, the Director of Public Works, and the Supervisor of Facilities. The Board is aware of the upcoming request for rate changes on April 1 and remains on track to fulfill this request.

The Town of Antigonish Financial Statements, presented to the audit committee by MNP (the Town's auditor) on Thursday, February 15th, received Council approval on February 16th. Consolidated statements will be published on the Town website once available, anticipated around February 23rd.

The Electric Utility GRA hearing (M11441) is slated for March 26th and 27th. The Nova Scotia Utility and Review Board (NSUARB) and their consultant, Synapse, raised information requests (IRs) pertaining to the application. These IRs were addressed by Town staff and consultants (BDR NorthAmerica), with responses formally submitted on February 12th.

The Director is scheduled to participate in a two-day strategic development meeting with AREA staff and board members. Over the past five years, AREA has evolved from a single employee managing a ten-turbine windfarm to a team of four overseeing a windfarm, coordinating the construction of three solar gardens, assisting municipal electric utilities in navigating regulatory changes, and establishing a regional utility manager for the Mahone Bay, Berwick, and Riverport utilities.

**Department Update:**

Projects
<b>Title: 2024-25 Budget</b>
<b>Status Update:</b> With the 2022-23 Financial Statements presented to the Audit Committee and approved by Council, the Director will be focusing on working with senior leadership to create the 2024-25 budget. Senior leadership will be meeting February 21 to look at timelines for creating the capital and operating budgets. This will also include planning the timing of holding capital workshop meetings with Council to have their input shared and discussed before presenting a budget for approval.
<b>Next Step:</b> Develop budget timelines with senior management and plan capital budget workshop with Council
<b>Title: Inventory Accounting Policy</b>
<b>Status Update:</b> As discussed in the Audit Committee meeting, the Manager of Accounting will be developing an inventory accounting policy for the Town. This will focus on two methods depending on the inventory: <ol style="list-style-type: none"> <li>inventory that is unique or easily identifiable will be recorded at actual costs (i.e.: transformers by serial number)</li> </ol>

<p>2. inventory that is indistinguishable will be recorded following the First In-First Out (FIFO) method (i.e.: utility poles).</p>
<p><b>Next Step:</b> Develop Policy</p>
<p><b>Title: Human Resources</b></p>
<p><b>Status Update:</b> Posting for Superintendent of Public Works position is in the application review process, with the Director of Public works reviewing resumes on an on-going basis. The job posting closes on February 26<sup>th</sup>, at 1pm. The current Superintendent of Public Works last day with the Town is February 27<sup>th</sup>.</p>
<p><b>Next Step:</b> Review applications for interview candidates.</p>
<p><b>Title: Equity, Diversity, and Inclusion in the Workplace</b></p>
<p><b>Status Update:</b> Developing and implanting an Equity, Diversity, and Inclusion (EDI) policy in the workplace is one of the accords Council signed with when the Town began applying for funding related to the grid modernization funding. The Directors of Corporate Services and Community Development, and the Strategic Projects Coordinator have received a working draft of the consultant's report on EDI for Town of Antigonish, which has come with recommendations and steps to make improvements within the workplace. This is being reviewed for comment and will be presented to Council over the coming month.</p>
<p><b>Next Step:</b> Consultants Report in review</p>
<p><b>Title: Strait IT Update</b></p>
<p><b>Status Update:</b> The Director of Strait IT has provided the Director an estimate budget to upgrade the Town Hall and other building's network. This includes hardware and annual license fees for up to five years. This is in effort to approve wi-fi capabilities for the Town, and as well having the same equipment brand as our municipal counterparts in Strait-IT for cost savings and resource knowledge as our IT technicians will understand one system for all municipalities.</p>
<p><b>Next Steps:</b> Present IT network capital to Council</p>
<p><b>Title: Hurricane Fiona Disaster Finance Application</b></p>
<p><b>Status Update:</b> Corporate Services is complying the Town's expenses and working with insurance as part of the application process.</p>
<p><b>Next Step:</b> Ongoing</p>
<p><b>Title: Work from Home Policy</b></p>
<p><b>Status Update:</b> Corporate Services has finalized a draft Work from Home (WFH) policy that is ready for internal review.</p>
<p><b>Next Step:</b> Finalize and present to Council regarding a Work from Home Policy.</p>
<p><b>Title: In Development: Charitable Donation Policy</b></p>
<p><b>Status Update:</b> Corporate Services has prepared a charitable donation policy for the Town of Antigonish. This would formalize the charitable donation receipt program and outline the standards for evaluating donations in accordance with Canadian Revenue Agency (CRA) guide lines. This is in the review stage.</p>
<p><b>Next Step:</b> Finalize and prepare a memo to Council regarding a Charitable Donation Policy.</p>

**Subject:** CAO Report  
**To:** Antigonish Town Council  
**Date Prepared:** 20/February/2024  
**Prepared by:** Ken Proctor, P. Eng., Director of Public Works

## Engineering & Municipal Services

### Capital Projects/Tender Update:

Projects	
<b>Title:</b>	Budgets
<b>Status Update:</b>	: 23/24 Year end projections & 24/25 Budgets in progress
<b>Next Step</b>	
<b>Title:</b>	AT Trail Project (ToA)
<b>Status Update:</b>	Ongoing assistance with infrastructure
<b>Next Step:</b>	Ongoing followup meetings with consultants (WSP). Bell Aliant work for West St pole adjustments in progress. Project A – Review of West St section continues for revised scope and retender Project D – Dwgs at 95% design stage. Bell /CBNSR followups required Contacts with Stakeholder groups continues for right of way impacts
<b>Title:</b>	ICIP Applications – Bay St
<b>Status Update:</b>	: Application Review
<b>Next Step</b>	Design Services awarded to WSP. Project start up meeting held and site survey work started Design work in progress Contacts in process with CBNSR for railway crossings and EDPC for the J Paradis DA. Stakeholder list established for contacts
<b>Title:</b>	Hwy4 AT/Roundabout Project
<b>Status Update:</b>	Ongoing followups with NSTiR on concepts/proposed schedule for the phased 4 yr project
<b>Next Step:</b>	NSTiR contact on Municipal Infrastructure continues. Phase 1 (#7/Hwy 4) project - completed. Phase 2 (Church St/Hwy 4) design work in progress. Meetings with NSTiR/County ongoing Tender call expected in Mar/Apr
<b>Title:</b>	Municipal Capital Grant Program
<b>Status Update:</b>	: Application Review for project(s). Resolution of Council for approved project Submission made Dec13
<b>Next Step</b>	Awaiting results of application review

### Electric Utility (EU):

Projects	
<b>Title:</b>	23/24 , 24/25 &25/26 Budgets
<b>Status Update:</b>	Submission to NSURB for General Rate Adjustment (approved by NSURB) Submission to NSURB to amend its Schedule of Rates and its Rule/Regulations (in progress)
<b>Next Step:</b>	NSURB Hearing date – mid March/2024
<b>Title:</b>	Electric Utility Capital Modifications

<b>Status Update:</b> : NSURB approved capital expenditures Dec 15 SREP approval provided EU working group assessing project scheduling, major purchases items, service agreements
<b>Next Steps:</b>
<b>Title:</b> Solar Garden and BRBB Pole line for Solar Garden
<b>Status Update:</b> Frame system and solar panels constructed on both levels New pole line to Hawthorne: NSPi work for cross-over points under review with AREA EU pole line section to be completed following NSPi work.
<b>Next Step:</b> Project followups in progress
<b>Title:</b> EU Equipment
<b>Status Update:</b> All equipment is in service Tender issued for new ¾ T service truck. Tender awarded to MacDonald Chrysler Rigging course training completed Development of Rubber Glove Code of Practice continues
<b>Title:</b> Power Outages
<b>Status Update:</b> No outages during snow storms of Jan 29 , Feb 03-05 and Feb 15
<b>Next Step:</b>
<b>Title:</b> Operations Items
<b>Status Update:</b> Items as noted below
<b>Next Step:</b> Work Items – ongoing “Yellow” lites - replacement work ongoing Pole Line Work – for BRBB, EU awaiting NSPi work to completed. 77 Highland Dr in progress New poles installed for STMRH parking lot New Service Pole and Transformer bank for 219 Main St (completed) West St/Highland Dr intersection- ped buttons serviced Tree trimming work ongoing. Electrical Inspections Ongoing Meter reading
<b>Title:</b> Pole Mount transformers
<b>Status Update:</b> Additional deliveries received
<b>Next Step:</b> Installs being assessed with EU Grid project scheduling
<b>Title:</b> Updated COVID 19 Restrictions
<b>Status Update:</b> Assessing provincial updates
<b>Next Step:</b> Adjust as necessary and/or required
<b>Title:</b> Exploration of Municipal Consolidation
<b>Status Update:</b> Information provided and staff attending update sessions
<b>Next Step:</b> To be determined as process continues

**Water Utility:**

<b>Projects</b>
<b>Title:</b> 23/24, 24/25 & 25/26 Budgets
<b>Status Update:</b> Water Rate Application approved by Council and submitted to NSURB for rate adjustments
<b>Next Step:</b> Responses to NSURB Information Requests submitted for Jan 11 Hearing dates set for Feb 20, 2024 (Town Council Chamber)
<b>Title:</b> Source Water Review
<b>Next Step:</b> Study Followups continuing with Consultant.
<b>Next Steps:</b> Phase 4 continues with site assessment reviews Refinement of short listed sites established of refined drilling exploration. Updates in progress for site testing and MOUs Recent storms has delayed property contacts for site access pending
<b>Title:</b> Water Utility Items

<b>Status Update:</b> Meeting of James River Stewardship Board – Dec 14, 2023 Annual Dam inspection completed (Nov 17) Residuals Management review continues with consultants (CBCL) Annual NSE Report – preparation work in progress Bethany Tank Recoatings - preparation work in progress for call tender West St Watermain (#7 to James) – preparation work for tender call Church St at TiR Roundabout - preparation work for tender call
<b>Next Step:</b>
<b>Title: Fire Hydrants</b>
<b>Status Update:</b> Annual maintenance ongoing. (Various service work in progress) Policy-Bylaw for Private Hydrants – awaiting Municipal Affairs approval Winter Hydrant Maintenance in progress
<b>Next Step:</b>
<b>Title: Main Line Water Valves</b>
<b>Status Update:</b> Assessment of operational status continues
<b>Next Step:</b> Assessment for Work in 2nd quadrant continues for 2023/2024. Capping of old 4” main work on West St - 5 services relocated. Main disconnect in Spring Church/Mall and Hawthorne work- deferred to 24/25. Upper section of Hillcrest St experiencing water discoloration. Interim flushing in progress. (Install of New auto flushing valve - Spring )
<b>Title: Water Breaks</b>
<b>Status Update:</b> 3 breaks – Maple (Jan 18) , Pleasant (Jan 20), Highland (Jan 26)
<b>Next Step:</b>
<b>Title: Updated COVID 19 Restrictions</b>
<b>Status Update:</b> Assessing provincial updates
<b>Next Step:</b> Adjust as necessary and/or required
<b>Title: Exploration of Municipal Consolidation</b>
<b>Status Update:</b> Information provided and staff attending update sessions
<b>Next Step:</b> To be determined as process continues

### Sewer/Storm:

<b>Projects</b>
<b>Title: Budgets</b>
<b>Status Update:</b> : 23/24 Year end projections & 24/25 Budgets preparations in progress
<b>Next Step:</b>
<b>Title: NSE Permit to Operate</b>
<b>Status Update:</b> Requirement for System Assessment Report (SAR)
<b>Next Step:</b> Followup on CBCL SAR Report continues. Review of Consultant’s memo (CBCL) on options for STP Front End upgrades continues Equipment arrivals in progress ( Aerators chain, wet well pump, blower rebuild) Adjustments to lagoons levels and floatables ongoing as weather events occur
<b>Title: System Conveyance</b>
<b>Status Update</b> Checks of Murphy’s Brook areas ongoing Pipe sealing by Eastern Trenchless work completed Overview of Whidden- Centennial storm drainage continues Sewer Cleaning tender (GFL) completed Followup review to Safety Program and Training – pending
<b>Next Step:</b>
<b>Title: Hurricane Fiona / Other Storms</b>
<b>Status Update:</b> Provincial /DNR assessment of trees near river areas still pending
<b>Next Step:</b> Fiona costs compiled and forwarded to Corporate Services for recovery of costs

Jan/Feb storm events experienced – Jan 29 (snow), Feb 03-05 (snow), Feb 14(snow)
<b>Title: Updated COVID 19 Restrictions</b>
Status Update: Assessing provincial updates
Next Step: Adjust as necessary and/or required
<b>Title: Exploration of Municipal Consolidation</b>
Status Update: Information provided and staff attending update sessions
Next Step: To be determined as process continues

## Public Properties & Streets

<b>Projects</b>
<b>Title: Budgets</b>
Status Update: : 23/24 Year end projections & 24/25 Budgets in progress
Next Step:
<b>Title: Seasonal / Street Operations</b>
Status Update: Winter Operations - Standby/Oncall in place for 6:00am, Dec01 Salt usage -552 tonnes 3 major storm systems experienced. (Jan 29, Feb 03-05, Feb14) 2 removals of snow in Downtown core completed. (3 <sup>rd</sup> removal in planning stages) All streets widened following Feb 05 storm (85-100cm) Work to potholes ongoing with winter coldmix Followup review to Safety Program and Training – ongoing
Next Step: Work is ongoing pending weather conditions
<b>Title: PWD Equipment &amp; Bldg</b>
Status Update. 1 Sidewalk plow returned to service. Salt truck plow wings serviced and returned to service Backhoe being serviced. Rental unit in place for required needs All other equipment in service
Next Steps:
<b>Title: Staffing</b>
Status Update PWD Staff obtaining additional NSE system certifications Superintendent has submitted resignation. Position has been posted with closing Feb 26
Next Step:
<b>Title: Community Development</b>
Status Update: Discussions continue for review of various requests/inquires and or project overlaps Mid block crosswalk signage have been adjusted to reflect provincial regulations Review of winter parking ban enforcement Assessing Litter Can service Assessing ToA AT project details
Next Step: Awaiting followups
<b>Title Updated COVID 19 Restrictions</b>
Status Update Assessing provincial updates
Next Step: Adjust as necessary and/or required
<b>Title: : Exploration of Municipal Consolidation</b>
Status Update: Information provided and staff attending update sessions
Next Step: To be determined as process continues


## Waste Management:

<b>Projects</b>
<b>Title: Budgets</b>
Status Update: Y: 23/24 Year end projections & 24/25 Budgets preparations in progress
Next Step:


<b>Title: Solid Waste Items</b>
<b>Status Update: Waste Management Bylaw - Awaiting Municipal Affairs Approval Litter can service being assessed with Community Development Town Council Resolution provided for End Producers Program Followups required with Colchester MRF on status of future service contract</b>
<b>Next steps:</b>
<b>Title: Waste disposal weights – Jan 31, 2024</b>
<b>Status Update: RWC -900 T, ICI - 2922 T</b>
<b>Next Step:</b>

\_\_\_\_\_  
Ken Proctor, P.Eng.  
Director of Public Works

Municipality = Town of Antigonish



<i>Civc</i>	<i>New Units</i>	<i>Work</i>	<i>Bldg</i>	<i>Proposed Use</i>	<i>Permit</i>	<i>Value</i>
17 Gillis Way	0	Renovate	Single Dwelling	Accessory Uses-Solar	113.00	26,611.00
<b>Total</b>	<b>0</b>				<b>113.00</b>	<b>26,611.00</b>







# Pathway to Net Zero Emissions Feasibility Study Town of Antigonish


Final Report



237554.00 • February 2024

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0	Final Submission	D. Lea	2-Feb-2024	N. Downing
A	Issued for Review	D. Lea	30-Nov-2023	N. Downing
Rev.	Issue	Reviewed By:	Date	Issued By:
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February 2, 2024

Lise Roy  
Strategic Initiatives Coordinator  
Town of Antigonish  
274 Main Street  
Antigonish, NS, B2G 2C4  
Email: [lroy@townofantigonish.ca](mailto:lroy@townofantigonish.ca)

Dear Lise:

*RE: Town of Antigonish Pathway to Net Zero Emissions Feasibility Study*

CBCL Limited (CBCL) is pleased to present the final report for the Town of Antigonish Pathway to Net Zero Emissions Feasibility Study.

Please do not hesitate to contact the undersigned if you should have any questions. Thank you.

Yours very truly,

CBCL Limited

Prepared by:  
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Project No.: 237554.00

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# Executive Summary

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CBCL Limited (CBCL) was engaged by the Town of Antigonish (TOA) to conduct a comprehensive greenhouse gas (GHG) emissions reduction and energy saving pathway study for a group of selected facilities comprised of office buildings, recreational facilities, fire stations, and water/wastewater treatment plants. The scope of this study is to present pathways for the TOA to reduce cumulative carbon emissions by 50% by 2033, Phase 1, and by 80% by 2043, Phase 2. Most of the facilities are over 20 years old and much of the original equipment is very close to, or past, the end of its functional lifespan.

There are eight (8) facilities included in this study. In no particular order, the facilities are listed with their current major functionalities in Table ES.1.1.

**Table ES.1.1: Names of Study Facilities and their Current Application**

Facility Name	Current Use
Antigonish Arena	Recreational/Arena
Columbus Field Washrooms	Community Washrooms
Antigonish Fire Hall	Fire Safety
Antigonish Town and County Library	Community/Learning
Antigonish Public Works/Electric Utility	Electric Utility/Garage/Maintenance
Antigonish WWTP	Wastewater Treatment
Antigonish Town Hall	Community/Offices
Antigonish WTP	Drinking Water Treatment

The emission intensity factor used for electricity for the 2022 baseline was 0.5572 CO<sub>2</sub>e kg/kWh<sup>1</sup>, for NSPI. The Antigonish Electric Utility 2022 emission intensity, 0.3387 CO<sub>2</sub>e kg/kWh, was estimated to be comprised of 60% NSPI electricity and 40% electricity generated from the Ellershouse Wind Farm at an emission intensity of 0.011 kg CO<sub>2</sub>e/kWh<sup>2</sup>. The emission intensity for heating oil and propane used were 2.71 CO<sub>2</sub>e kg/L<sup>3</sup> and 1.52 CO<sub>2</sub>e kg/L<sup>3</sup>, respectively.

Due to the length of the study, 20 years, the reduction of carbon emissions as the grid become cleaner, needs to be considered. The 2030 and 2040 provincial proposed regulatory caps represent a 37% and 50% decrease respectively from the Provincial total

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<sup>1</sup> Source: [Air Emissions Reporting | Nova Scotia Power \(nspower.ca\)](https://www.nspower.ca/air-emissions-reporting). Retrieved: 2023-09-18

<sup>2</sup> Source: [How Wind Can Help Us Breathe Easier | Department of Energy](https://www2.gov.bc.ca/gov2/energy/department-of-energy/how-wind-can-help-us-breathe-easier). Retrieved: 2023-09-18

<sup>3</sup> Source: [Emission Factors for Greenhouse Gas Inventories \(epa.gov\)](https://www.epa.gov/emissions-factors-greenhouse-gas-inventories). Retrieved: 2023-09-18

emissions generated from electricity production in 2022<sup>4</sup>. There will also be an increase in electricity generation in the next 20 years; current projections estimate an increase of 2.1% and 16.8% by 2030 and 2040<sup>5</sup>.

The projected emission intensities for 2022, Phase 1: 2033 and Phase 2: 2043 for NSPI, Antigonish, heating oil and propane are summarized in Table ES.1.2.

**Table ES.1.2: Summary of Projected Emission Intensities**

Electricity Source	Carbon Emission: kg CO <sub>2</sub> e/kWh (kg CO <sub>2</sub> e/GJ)		
	Baseline: 2022	Phase 1: 2033	Phase 2: 2043
Antigonish Electric	0.3387 (94.1)	0.1565 (43.5)	0.03 (8.3)
NSPI	0.5572 (154.8)	0.3164 (87.9)	0.1760 (48.9)

The baseline energy usage for each of the buildings was obtained from the period of January/December 2022. This year was selected for the baseline as it was determined that this would more accurately depict the building's regular operations and energy usage after the COVID-19 pandemic. The baseline energy consumption for the facilities considered can be presented in Table ES.1.3.

**Table ES.1.3: Summary of Projected Emission Intensities**

Facility	Electricity Consumption (kWh)	Heating Oil Consumption (L)	Propane Consumption (L)
Antigonish Arena	532,800	36,775	4,310
Columbus Field Washrooms	7,111	0	0
Antigonish Fire Hall	14,685	12,925	0
Antigonish Town and County Library	202,490	0	0
Antigonish Public Works/Electric Utility	74,927	17,777	0
Antigonish WWTP	1,553,220	0	0
Antigonish Town Hall	55,040	17,411	0
Antigonish WTP	269,444	43,694	0

The cumulative annual carbon emissions for all eight buildings and the natural decarbonization of the facilities as both electric grid's emission intensities reduce over time are presented in Table ES.1.4, as well as the reduction in emissions in fossil fuels from the implementation of the Canadian Clean Fuel Regulations.

<sup>4</sup> Source: [Quantitative analysis of equivalency determination: coal-fired generation of electricity - Canada.ca](https://www.nspower.ca/quantitative-analysis-of-equivalency-determination-coal-fired-generation-of-electricity-canada). Retrieved: 2023-09-18

<sup>5</sup> Source: [IRP Evergreen - Assumptions and Analysis \(nspower.ca\)](https://www.nspower.ca/irp-evergreen-assumptions-and-analysis). Retrieved: 2023-12-28

**Table ES.1.4: Total Emissions by Source for all Eight Buildings**

Energy Source	2022 Energy Usage (GJ)	2022 Emissions (tonnes)	2033 Projected Emissions (tonnes)	2043 Projected Emissions
Antigonish Electric	8770.7	825.3	381.3	73.1
NSPI	970	150.1	85.3	47.4
PV System	14.3	0.17	0.17	0.17
Heating Oil	4951.6	348.3	348.3	348.3
Propane	109.7	6.6	6.6	6.6
<b>Total</b>	<b>14,816.3</b>	<b>1330.5</b>	<b>821.4</b>	<b>475.6</b>

The emission targets for the end of Phases 1 and 2 are a 50% and 80% reduction from 2022 values. This will be an annual emission of 665.2 and 266.1 tonnes CO<sub>2</sub>e by 2033 and 2043, respectively. Considering the natural reduction that will occur over this time period the implementation of energy efficiency measures will need to reduce carbon emissions by 156.2 tonnes in Phase 1 and 209.5 tonnes in Phase 2 to meet emissions targets.

The following list includes all the assumptions and variables considered for the technical and financial analysis:

▶ Cost of Electricity:	
o Antigonish Arena:	\$0.1258/kWh
o Columbus Field Washrooms:	\$0.2667/kWh
o Antigonish Fire Hall:	\$0.1745/kWh
o Antigonish Town and County Library:	\$0.1467/kWh
o Antigonish Public Works/Electric Utility:	\$0.1476/kWh
o Antigonish WWTP:	\$0.1268/kWh
o Antigonish Town Hall:	\$0.1541/kWh
o Antigonish WTP:	\$0.1775/kWh
o NSPI Electricity PV:	\$0.10521/kWh
▶ Cost of Heating Oil:	\$1.79/L
▶ Cost of Propane:	
o Antigonish Arena (Heating):	\$0.8/L
o Antigonish Arena (Ice Resurfacer):	\$0.97/L
o Antigonish WTP:	\$0.64
▶ Antigonish Electric GHG Emission Intensity Factor 2022:	0.3387 CO <sub>2</sub> e kg/kWh <sup>6</sup>
▶ Antigonish Electric GHG Emission Intensity Factor 2033:	0.1565 CO <sub>2</sub> e kg/kWh
▶ Antigonish Electric GHG Emission Intensity Factor 2043:	0.0300 CO <sub>2</sub> e kg/kWh
▶ NSPI GHG Emission Intensity Factor 2022:	0.5572 CO <sub>2</sub> e kg/kWh <sup>7</sup>
▶ NSPI GHG Emission Intensity Factor 2033:	0.3164 CO <sub>2</sub> e kg/kWh

<sup>6</sup> Source: [Air Emissions Reporting | Nova Scotia Power \(nspower.ca\)](https://www.nspower.ca). Retrieved: 2023-04-01

<sup>7</sup> Source: [Life Cycle Greenhouse Gas Emissions from Solar Photovoltaics \(Fact Sheet\), NREL \(National Renewable Energy Laboratory\)](https://www.nrel.gov/energy-laboratory/life-cycle-greenhouse-gas-emissions-from-solar-photovoltaics). Retrieved 2023-11-20

▶ NSPI GHG Emission Intensity Factor 2043:	0.1760 CO <sub>2</sub> e kg/kWh
▶ PV Electricity GHG Emission Intensity <sup>8</sup> :	0.046 CO <sub>2</sub> e kg/kWh
▶ Heating Oil GHG Emission Intensity Factor:	2.71 CO <sub>2</sub> e kg/L <sup>9</sup>
▶ Propane GHG Emission Intensity Factor:	1.52 CO <sub>2</sub> e kg/L <sup>9</sup>

When considering the implementation of Phase 1 reduction measures, the total emissions for each building are presented in Table ES.1.5. A cumulative natural reduction of emissions 508.9 tonnes can be observed, and an additional 211.1 tonnes can be attributed to the addition energy conservation measures implemented in Phase 1. The total annual emissions for all eight buildings is 609.0 tonnes, an emissions reduction of 54.1% compared to the baseline.

**Table ES.1.5: Town of Antigonish Phase 1 Emission Reductions Summary**

Building	2022 Baseline Emissions (Tonnes)	Natural Emission Reductions (Tonnes) - No ECMs Implemented	Phase 1 ECM Emissions Reductions (Tonnes)	2033 Building Emissions After ECMs	Emissions Saved %
Antigonish Arena	286.7	97.1	61.8	127.8	55.4%
Columbus Field Washroom	2.4	1.3	0.6	0.6	77.1%
Antigonish Fire Hall	40.0	2.7	11.6	25.7	35.7%
Antigonish Library	67.4	36.2	8.2	22.9	66.0%
Public Works/ Electric Utility	73.6	13.7	27.4	32.5	55.7%
WW Treatment Plant	526.1	283.0	3.1	240.0	54.4%
Antigonish Town Hall	65.8	10.0	34.3	21.5	67.4%
Water Treatment Plant	268.5	64.9	64.1	139.5	48.0%
<b>Totals</b>	<b>1330.5</b>	<b>508.9</b>	<b>211.1</b>	<b>610.5</b>	<b>54.1%</b>

The total capital cost to implement Phase 1 measures, as well as cost savings are presented in Table ES.1.6. The total estimated capital cost to implement Phase 1 will be \$1,539,022.

<sup>8</sup> Source: [Life Cycle Greenhouse Gas Emissions from Solar Photovoltaics \(Fact Sheet\)](#), NREL (National Renewable Energy Laboratory). Retrieved 2023-11-20

<sup>9</sup> Source: [Emission Factors for Greenhouse Gas Inventories \(epa.gov\)](#). Retrieved: 2023-04-01

This will have a cost savings of approximately \$142,098 per year. Based on this, Phase 1 will have a simple payback period of 10.8 years.

**Table ES.1.6: Town of Antigonish Phase 1 Capital Cost and Simple Payback Summary**

Building	CAPEX	CAPEX/Phase 1 ECM GHG Reduction (\$tonne)	Energy Savings (GJ)	Cost Savings	Simple Payback Period
Antigonish Arena	\$350,125	\$5,665	594.6	\$36,929	9.5
Columbus Field Washroom	\$2,060	\$3,668	12.9	\$973	2.1
Antigonish Fire Hall	\$195,060	\$16,820	132.4	\$6,147	31.7
Antigonish Library	\$8,000	\$991	185.7	\$5,867	1.4
Public Works/Electric Utility	\$227,822	\$8,329	218.0	\$12,363	18.4
WW Treatment Plant	\$213,780	\$69,445	70.8	\$2,530	84.5
Antigonish Town Hall	\$331,610	\$9,655	357.0	\$18,159	18.3
Water Treatment Plant	\$210,565	\$3,283	436.6	\$59,129	3.6
<b>Totals</b>	<b>\$1,539,022</b>	<b>\$7,292</b>	<b>2008.0</b>	<b>\$142,098</b>	<b>10.8</b>

When considering the implementation of Phase 2 reduction measures The total emissions savings for each building are presented in Table ES.1.7. A cumulative natural reduction of emissions 854.9 tonnes can be observed, and an additional 280.5 tonnes can be attributed to the addition energy conservation measures implemented in Phase 1. Phase 2 efficiency measures result in an additional savings of 4.0 tonnes. The total annual emissions for all eight buildings is 191.1 tonnes, an emissions reduction of 85.3% compared to the baseline.

**Table ES.1.7: Town of Antigonish Phase 2 Emission Reductions Summary**

Building	2022 Baseline Emissions (Tonnes)	Natural Emission Reductions (Tonnes) – No ECMs Implemented	Phase 1 ECM Emissions Reductions (Tonnes)	Phase 2 ECM Emissions Reductions (Tonnes)	2043 Building Emissions After ECMs	Emissions Saved %
Antigonish Arena	286.7	164.5	87.3	3.8	31.1	89.2%
Columbus Field Washrooms	2.4	2.2	0.1	0.01	0.1	96.1%
Antigonish Fire Hall	40.0	4.5	14.6	0.0	20.8	47.9%
Antigonish Library	67.4	61.4	1.5	0.0	4.4	93.4%

Building	2022 Baseline Emissions (Tonnes)	Natural Emission Reductions (Tonnes) – No ECMs Implemented	Phase 1 ECM Emissions Reductions (Tonnes)	Phase 2 ECM Emissions Reductions (Tonnes)	2043 Building Emissions After ECMs	Emissions Saved %
Public Works/ Electric Utility	73.6	23.1	43.1	0.2	7.2	90.2%
WW Treatment Plant	526.1	479.5	0.6	0.0	46.0	91.3%
Antigonish Town Hall	65.8	17.0	46.4	0.0	2.4	96.3%
Water Treatment Plant	268.5	102.7	86.9	0.0	79.0	70.6%
<b>Totals</b>	<b>1330.5</b>	<b>854.9</b>	<b>280.5</b>	<b>4.0</b>	<b>191.1</b>	<b>85.6%</b>

The total capital cost and cost savings for each building can be seen in Table ES.1.8. The total estimated capital cost to implement Phase 2 will be \$243,500. This will have a cost savings of approximately \$2,245 per year. Based on this, Phase 2 will have a simple payback period of 108.5 years.

**Table ES.1.8: Town of Antigonish Phase 2 Capital Cost and Simple Payback Summary**

Building	CAPEX	CAPEX/Phase 2 ECM GHG Reduction (\$/tonne)	Energy Savings (GJ)	Cost Savings	Simple Payback Period
Antigonish Arena	\$190,000	\$49,906	29.8	\$1,254	152
Columbus Field Washroom	\$6,000	\$547,945	1.3	\$97	62
Antigonish Fire Hall	\$34,500	\$936,980	2.1	102.4	336.8
Antigonish Library	\$0	\$0	0.0	0.0	0.0
Public Works/ Electric Utility	\$13,000	\$80,846	19.3	791.1	16.4
WW Treatment Plant	\$0	\$0	0.0	0.0	0.0
Antigonish Town Hall	\$0	\$0	0.0	0.0	0.0
Water Treatment Plant	\$0	\$0	0.0	0.0	0.0
<b>Totals</b>	<b>\$243,500</b>	<b>\$60,636.11</b>	<b>52.5</b>	<b>2244.9</b>	<b>108.5</b>

A life cycle cost analysis (LCCA) was completed for this study and includes annual O&M costs and replacement costs for major building components and equipment over a 30-year assessment horizon. The analysis parameters considered in the LCCA development are presented below:

▶ LCCA Term (Years):	30 Years
▶ Debt (%):	100%
▶ Equity (%):	0%
▶ Loan Term (Years):	30 Years
▶ Loan Amortization Every Month:	1
▶ Interest Rate:	4.5%
▶ Discount Rate:	3.75%
▶ Inflation Rate (Operation and Maintenance Cost):	2.0%
▶ Construction Cost Inflation:	3.5%
▶ Antigonish Electric Utility Inflation	4.1%
▶ NSPI Electric Utility Inflation	4.1%
▶ Heating Oil Inflation	10.9%
▶ Propane Inflation	10.9%
▶ Carbon Tax: \$50/ton in 2022, increased by \$15/ton/yr until 2030. Then, assuming \$300/ton in 2050. Lineal increased is assumed.	

The 30-year LCCA for each of the facilities, as well as the total all eight buildings included in this study are presented in Table ES.1.9.

**Table ES.1.9: 30-Year LCCA for Each of the Eight Facilities**

Building	Baseline (W/O Energy Efficiency Measures)	With Energy Efficiency Measures
Antigonish Arena	\$9,670,125	\$4,221,784
Columbus Field Washrooms	\$69,765	\$37,918
Antigonish Fire Hall	\$2,471,512	\$1,903,751
Antigonish Town and County Library	\$984,459	\$778,060
Antigonish Public Works/Electric Utility	\$5,348,272	\$3,103,804
Antigonish Wastewater Treatment Plant	\$6,644,684	\$6,688,173
Antigonish Town Hall	\$3,778,343	\$1,352,517
Antigonish Water Treatment Plant	\$9,408,296	\$5,306,300
<b>Totals for the Eight Facilities</b>	<b>\$38,375,455</b>	<b>\$23,392,306</b>

With the exception of the WWTP, the remainder of the facilities show a lower LCC over a 30-year-period, compared to the same building without the implementation of EEMs. Also, for the group of eight buildings with EEMs, the LCC is lower than the baseline LCC. This indicates that the implementation of the recommended EEM/phases will result in a lower operational cost over a 30-year-period.

Differences in the life cycle cost assessments between the baseline and proposed facilities are higher in buildings where switching from to a lower carbon emitting energy source was recommended. This is due to a combination of the inflation rate for fossil fuels being higher than that of electricity, as well as the increase in the carbon tax on building emissions over time.

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# 1 Introduction

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## 1.1 Background and Study Scope

CBCL Limited (CBCL) was contracted by the Town of Antigonish (TOA) to conduct a comprehensive greenhouse gas (GHG) emissions reduction and energy saving pathway study for a group of selected facilities comprised of office buildings, recreational facilities, fire stations, and water/wastewater treatment plants. The scope of this study is to present a pathway for the TOA to reduce cumulative carbon emissions by 50% by 2033, Phase 1, and by 80% by 2043, Phase 2. Most of the facilities are over 20 years old and much of the original equipment is very close to, or past, the end of its functional lifespan.

With the increasing pace in the development of new technologies and materials, decisions about the right course of action for equipment replacement or facility renewal can become complex. However, waiting too long to make these kinds of decisions could also lead to missed opportunities in implementing energy and cost saving upgrades. The timing for and the scale to which to undertake significant facility renewal actions without losing out on the new improvements is a delicate balance.

Several of the buildings in this study primarily serve to provide a comfortable place for people to conduct business in an office environment, or fans and spectators in the arena, or even community members in the library. The greater the degree of comfort provided to the occupants of a building, the more efficient and productive the occupants can be in their activities. People working in comfortable work environments are generally more productive and miss less work hours due to illness. Major influences on building environmental comfort are temperature, humidity, air quality, noise, space layout, and adequate water supply. Energy is required for the maintenance of most of these comfort indicators and has an influence on all of them. Similarly, given the energy source types, GHG emissions are directly proportional to the amount of energy consumed in maintaining these space comforts. Thus, reduction in energy and water consumption in the buildings can directly reduce GHG emissions.

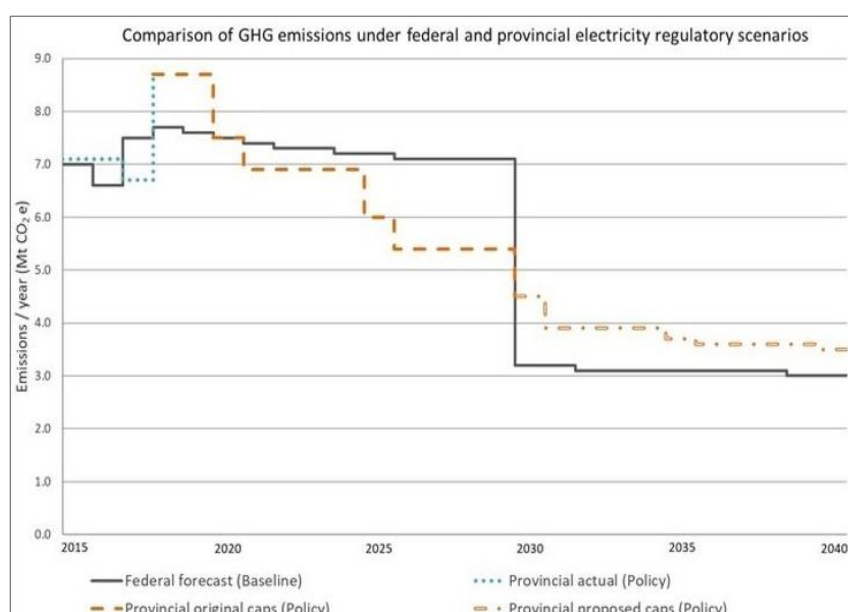
There are eight (8) facilities included in this study. In no particular order, the facilities are listed with their current major functionalities in Table 1.1.

**Table 1.1: Names of Study Facilities and their Current Application**

Facility Name	Current Use
Antigonish Arena	Recreational/Arena
Columbus Field Washrooms	Community Washrooms
Antigonish Fire Hall	Fire Safety
Antigonish Town and County Library	Community/Learning
Antigonish Public Works/Electric Utility	Electric Utility/Garage/Maintenance
Antigonish WWTP	Wastewater Treatment
Antigonish Town Hall	Community/Offices
Antigonish WTP	Drinking Water Treatment

## 1.2 Carbon Emission Intensity Projections

The emission intensity factor used for electricity for the 2022 baseline was 0.5572 CO<sub>2</sub>e kg/kWh<sup>10</sup>, for NSPI. The Antigonish Electric Utility 2022 emission intensity, 0.3387 CO<sub>2</sub>e kg/kWh, was estimated to be comprised of 60% NSPI electricity and 40% electricity generated from the Ellershouse Wind Farm at an emission intensity of 0.011 kg CO<sub>2</sub>e/kWh<sup>11</sup>. The emission intensity for heating oil and propane used were 2.71 CO<sub>2</sub>e kg/L<sup>12</sup> and 1.52 CO<sub>2</sub>e kg/L<sup>12</sup> respectively.



**Figure 1.1: Annual Electricity Generation Emissions Based Under Federal and Provincial Regulatory Scenarios**

Due to the length of the study, 20 years, the reduction of carbon emissions as the grid becomes cleaner needs to be considered. This will help provide a clearer estimate of the emission reductions necessary to reach the Phase 1 and Phase 2 emissions targets, as well as provide a more accurate estimate of the emissions reductions generated by each efficiency measure.

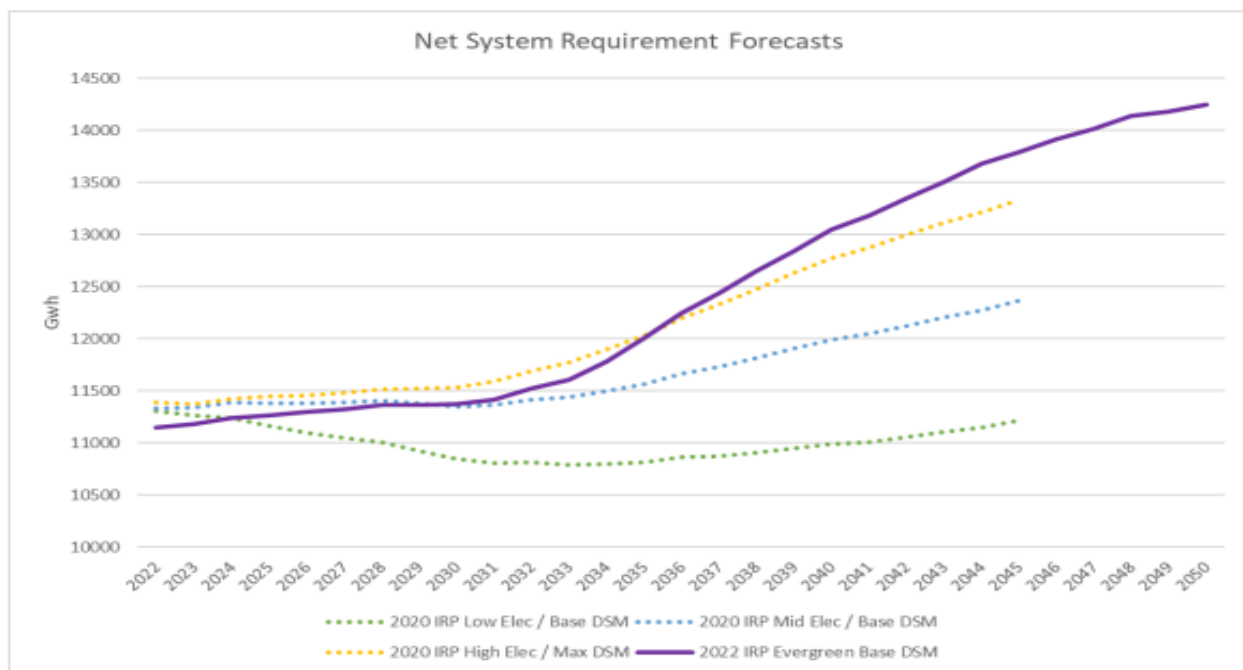
<sup>10</sup> Source: [Air Emissions Reporting | Nova Scotia Power \(nspower.ca\)](https://www.nspower.ca/Air-Emissions-Reporting). Retrieved: 2023-09-18

<sup>11</sup> Source: [How Wind Can Help Us Breathe Easier | Department of Energy](https://www2.gov.bc.ca/gov2/energy/How-Wind-Can-Help-Us-Breathe-Easier). Retrieved: 2023-09-18

<sup>12</sup> Source: [Emission Factors for Greenhouse Gas Inventories \(epa.gov\)](https://www.epa.gov/emissions-factors). Retrieved: 2023-09-18

Two factors were considered when projecting the emissions intensity of NSPI and Antigonish Electric grid. The first, shown in Figure 1.1<sup>13</sup>, is the annual total emissions from electricity generation in Nova Scotia under Federal and Provincial regulatory scenarios. The 2030 and 2040 provincial proposed regulatory caps represent a 37% and 50% decrease respectively from the Provincial total in 2022. A linear regression in total emissions was assumed between these points.

The second factor considered is the increase in electricity production during this time due to population increase and increased electrification. Current projections estimate an increase of 2.1% and 16.8% by 2030 and 2040, respectively, as seen in Figure 1.2<sup>14</sup>, labeled as the 2022 IRP Evergreen Baseline DSM. This results in an increased amount of electricity produced, with lower allowable annual emissions.



**Figure 1.2: Projected NSPI Load Requirements 2022-2050**

Both estimates for total emissions decrease, as well as increase in electricity production were applied to the current carbon emission intensity for NSPI to estimate values from 2022 to 2040. NSPI’s parent company Emera has a goal of net-zero by 2050<sup>15</sup>, net zero in this report is defined as 0.03 CO<sub>2</sub>e kg/kWh, which is the intensity at which carbon emissions can sufficiently be removed from the atmosphere at the same rate that they are being emitted<sup>16</sup>. A linear regression was assumed from 2040 to 2050.

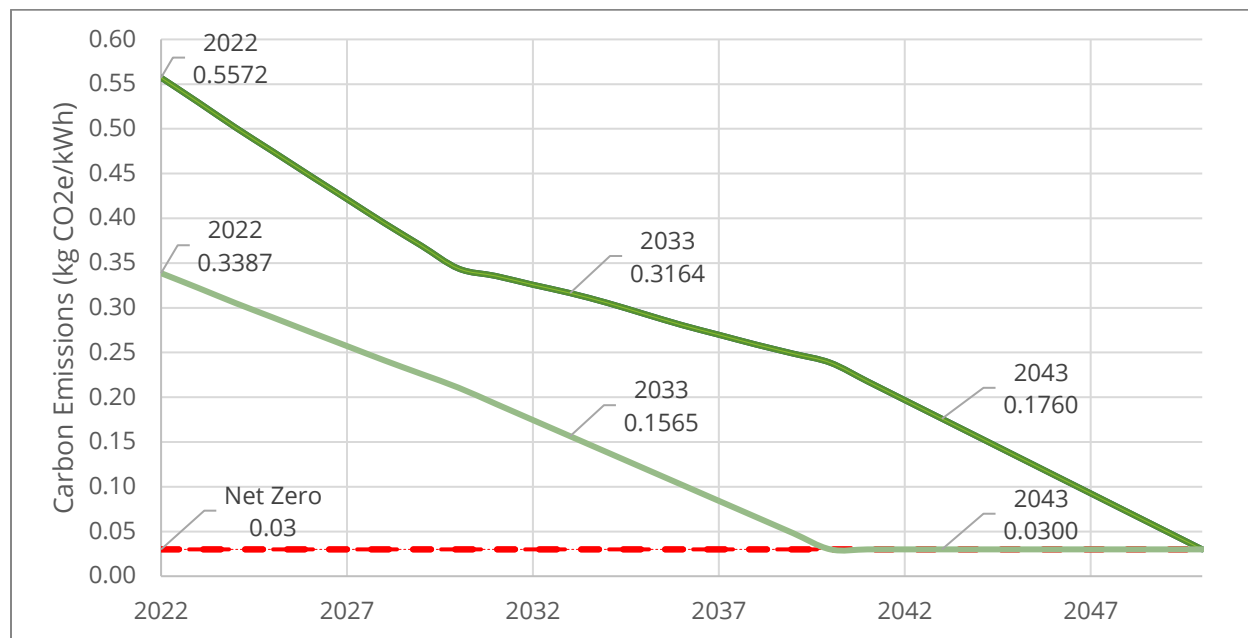
<sup>13</sup> Source: [Quantitative analysis of equivalency determination: coal-fired generation of electricity - Canada.ca](#). Retrieved: 2023-09-18

<sup>14</sup> Source: [IRP Evergreen - Assumptions and Analysis \(nspower.ca\)](#) Retrieved: 2023-12-28

<sup>15</sup> Source: [Our Climate Commitment | Emera](#). Retrieved: 2023-09-18

<sup>16</sup> Source: [Canada Gazette, Part 1, Volume 1, Number 1: Clean Electricity Regulations](#). Retrieved: 2023-11-20

To determine emission intensities for the Antigonish Electric Utility from 2022 to 2030 the same electricity source ratios, 60% NSPI and 40% wind energy, were used. The utility also has a goal of achieving net-zero by 2040, so a linear regression between 2030 and 2040 was used. These values can be seen in Figure 1.3 below.



**Figure 1.3: Electricity Carbon Emission Projections**

The projected emission intensities for 2022, Phase 1: 2033 and Phase 2: 2043 for NSPI, and Antigonish Electric are summarized in Table 1.2.

**Table 1.2: Summary of Projected Emission Intensities**

Electricity Source	Carbon Emission: kg CO <sub>2</sub> e/kWh (kg CO <sub>2</sub> e/GJ)		
	Baseline: 2022	Phase 1: 2033	Phase 2: 2043
Antigonish Electric	0.3387 (94.1)	0.1565 (43.5)	0.03 (8.3)
NSPI	0.5572 (154.8)	0.3164 (87.9)	0.1760 (48.9)

## 1.3 Energy Modelling Approach

To determine energy and carbon emissions savings based on the implementation of the prescribed efficiency measures, energy models were created in Carrier HAP V6.1, an 8760-hour simulation tool, for the following four buildings:

- ▶ Antigonish Arena
- ▶ Antigonish Fire Hall
- ▶ Antigonish Public Works/Electric Utility
- ▶ Antigonish Town Hall

The baseline energy usage for each of the buildings was obtained for the period of January/December 2022. This year was selected for the baseline as it was determined that

this would most accurately depict the building’s regular operations and energy usage after the COVID-19 pandemic.

The baseline model’s electricity consumption was calibrated by comparing the modeling outputs with the monthly electricity consumption obtained from the billing data provided by the Town of Antigonish . Each building’s electricity usage was calibrated to ASHRAE 14 guidelines which states that the difference between the monthly output from the energy model and the historic energy data should be within the following:

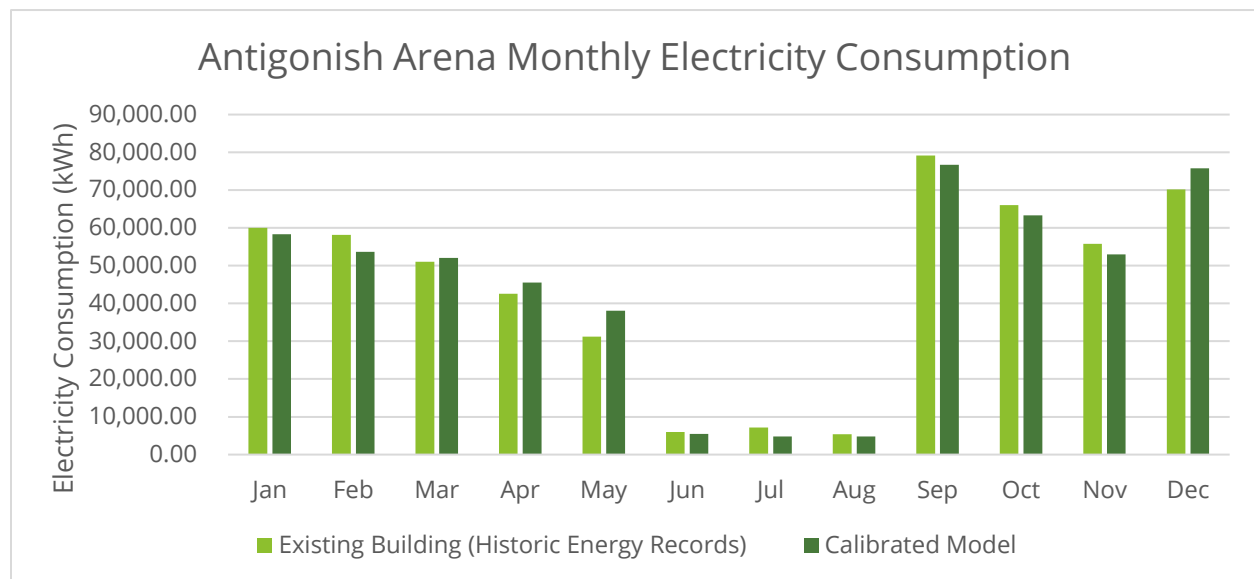
- ▶ Coefficient of Variation of the Root Mean (CVRMSE):  $\pm 15\%$ .
- ▶ Normalized Mean Bias Error (MBE):  $\pm 5\%$ .

Fossil fuel usage for the buildings was calibrated on an annual basis as information available was based on delivered quantities each month and does not necessarily reflect quantities consumed each month. Fossil fuel consumption was calibrated within  $\pm 5\%$  of annual consumption for all sites.

This calibration procedure is an estimation based on information collected during the site visit and from the drawings. This information can only be confirmed with dedicated submetering of the different electrical subpanels and fuel-fired equipment and appliances in the facility.

### 1.3.1 Antigonish Arena Energy Model

The monthly electricity usage of the calibrated model compared to the historic data provided is presented in Figure 1.4.



**Figure 1.4: Monthly Electricity Consumption: Calibrated Model versus Historical Energy Records**

Both the CVRMSE and NMBE for the calibrated model are within the range to meet the ASHRAE 14 standard as presented in Table 1.3.

**Table 1.3: Calibration of Antigonish Arena to ASHRAE 14 Guidelines**

CVRMSE (%) [ASHRAE 14: +/-15%]	NMBE (%) [ASHRAE: +/-5%]
8.01	0.25

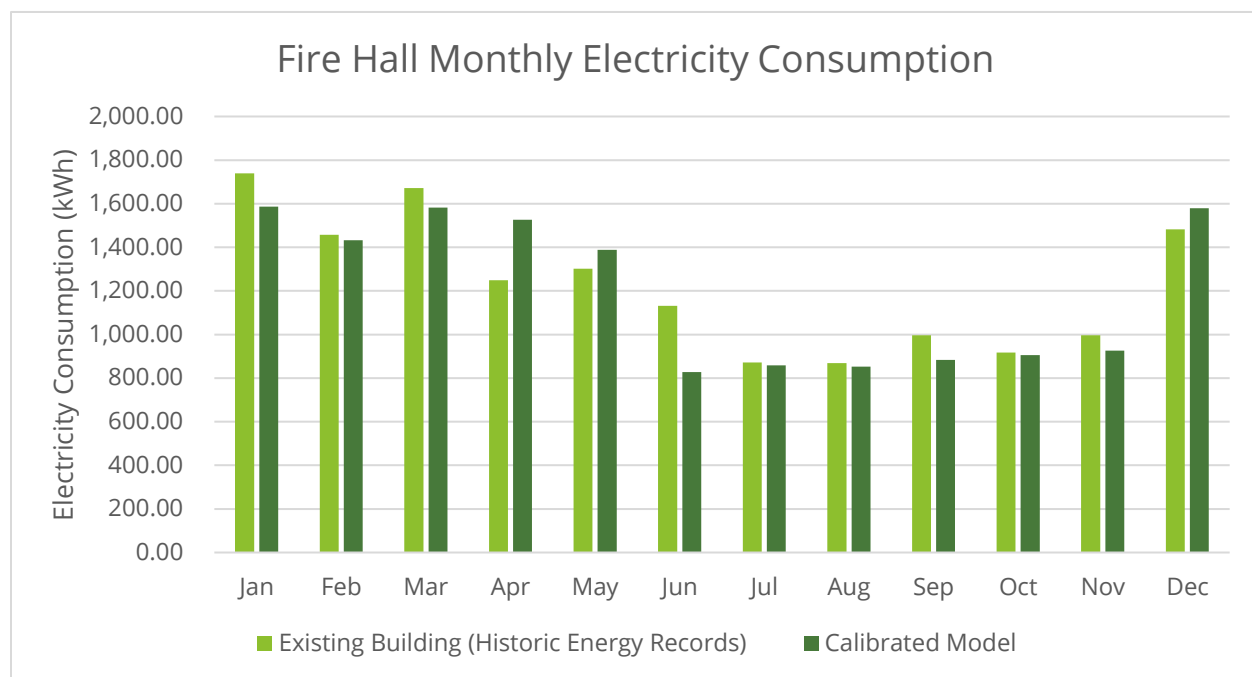
Two sources of fossil fuels are consumed on site: heating oil and propane. These values were both calibrated within 5% on an annual basis as presented in Table 1.4.

**Table 1.4: Calibration of Fossil Fuels on Site within 5%**

Energy Source	Historic Energy Consumption (L)	Calibrated Model (L)	% Difference
Heating Oil	36,775	36,595	-0.5%
Propane (Heating Only)	1,594.30	1,668	4.6%

### 1.3.2 Antigonish Fire Hall Energy Model

The monthly electricity usage of the calibrated model compared to the historic data provided are presented in Figure 1.5.



**Figure 1.5: Monthly Electricity Consumption: Calibrated Model versus Historical Energy Records**

Both the CVRMSE and NMBE for the calibrated model are within the range to meet the ASHRAE 14 standard as presented in Table 1.5.

**Table 1.5: Calibration of Antigonish Fire Hall to ASHRAE 14 Guidelines**

CVRMSE (%) [ASHRAE 14: +/-15%]	NMBE (%) [ASHRAE: +/-5%]
12.00	2.5

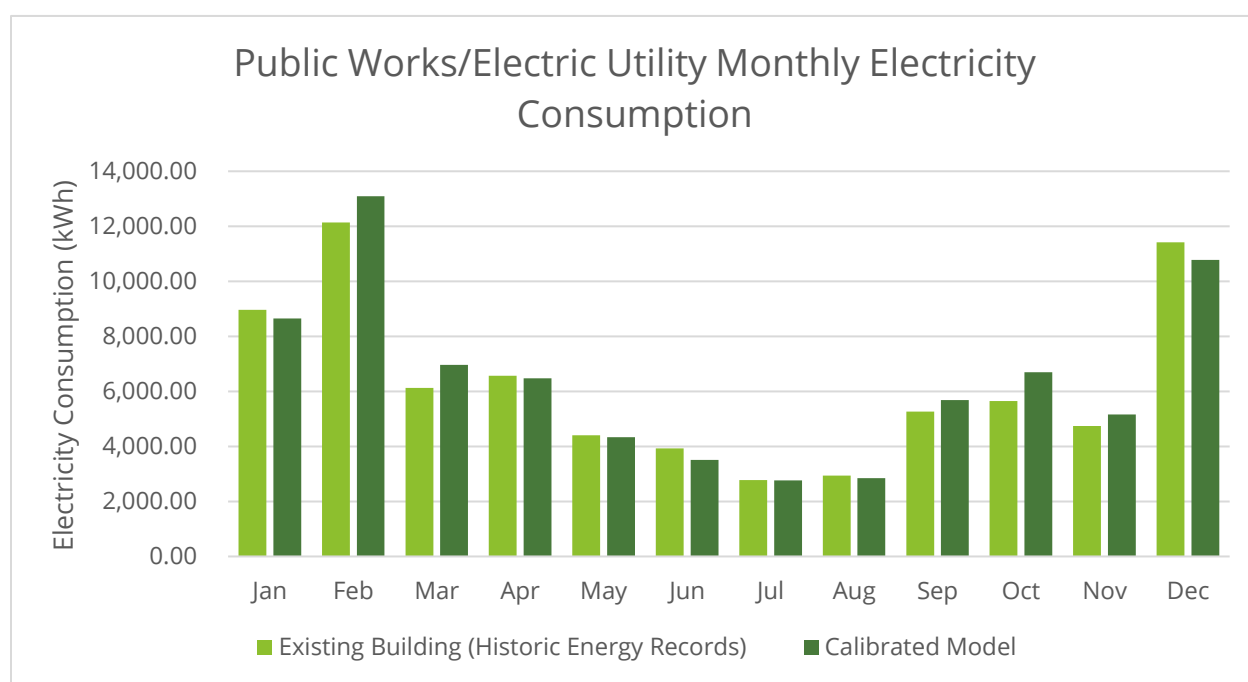
One source of fossil fuel is consumed on site: heating oil. This value was calibrated within 5% on an annual basis presented in Table 1.6.

**Table 1.6: Calibration of Fossil Fuels on Site within 5%**

Energy Source	Historic Energy Consumption (L)	Calibrated Model (L)	% Difference
Heating Oil	12,925.3	12,401	-4.1%

### 1.3.3 Antigonish Public Works/Electric Utility Energy Model

The monthly electricity usage of the calibrated model compared to the historic data provided is presented in Figure 1.6.



**Figure 1.6: Monthly Electricity Consumption: Calibrated Model vs Historical Energy Records**

Both the CVRMSE and NMBE for the calibrated model are within the range to meet the ASHRAE 14 standard as presented in Table 1.7.

**Table 1.7: Calibration of Public Works/Electric Utility to ASHRAE 14 Guidelines**

CVRMSE (%) [ASHRAE 14: +/-15%]	NMBE (%) [ASHRAE: +/-5%]
10.63	-2.83

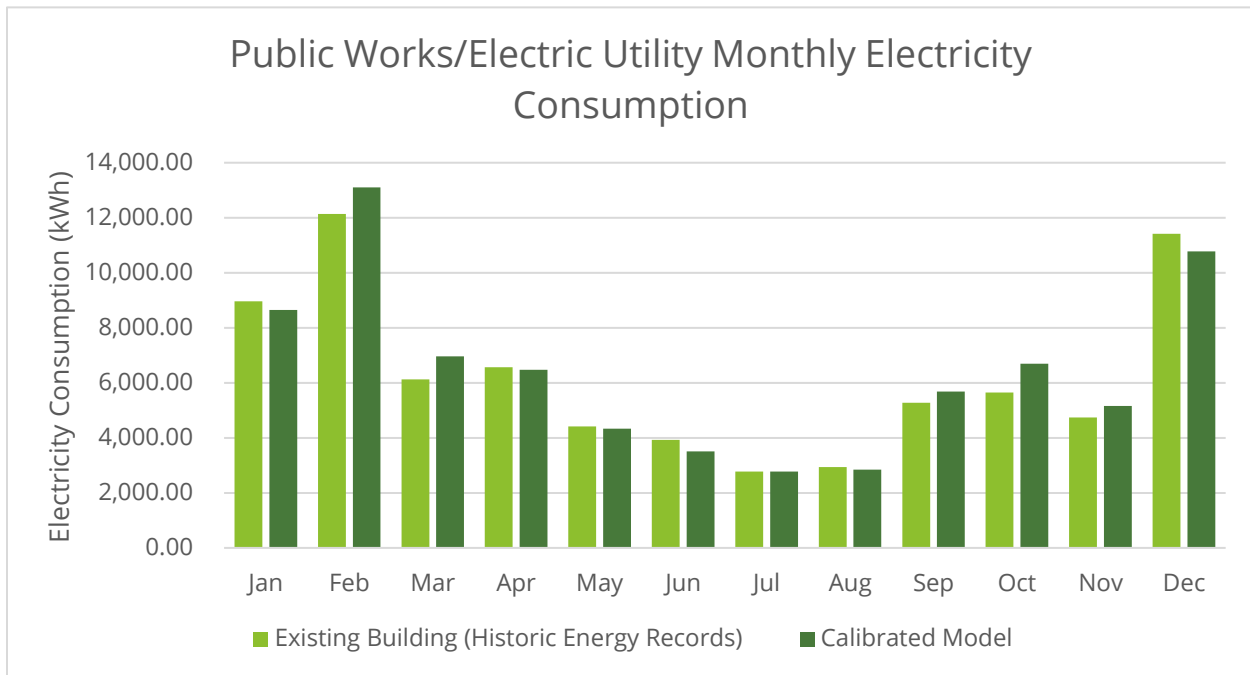
One source of fossil fuel is consumed on site: heating oil. This value was calibrated within 5% on an annual basis presented in Table 1.8.

**Table 1.8: Calibration of Fossil Fuels on Site within 5%**

Energy Source	Historic Energy Consumption (L)	Calibrated Model (L)	% Difference
Heating Oil	17,777.0	18,194	2%

### 1.3.4 Antigonish Town Hall Energy Model

The monthly electricity usage of the calibrated model compared to the historic data provided is presented in Figure 1.6Figure 1.7.



**Figure 1.7: Monthly Electricity Consumption: Calibrated Model vs Historical Energy Records**

Both the CVMSE and NMBE for the calibrated model are within the range to meet the ASHRAE 14 standard as presented in Table 1.9.

**Table 1.9: Calibration of Antigonish Town Hall to ASHRAE 14 Guidelines**

CVMSE (%) [ASHRAE 14: +/-15%]	NMBE (%) [ASHRAE: +/-5%]
9.37	-2.97

One source of fossil fuel is consumed on site: heating oil. This value was calibrated within 5% on an annual basis as presented in Table 1.10.

**Table 1.10: Calibration of Fossil Fuels on Site within 5%**

Energy Source	Historic Energy Consumption (L)	Calibrated Model (L)	% Difference
Heating Oil	17,411.0	17,271	-3%

## 2 Arena

### 2.1 Facility Description

The Antigonish Arena was constructed in 1969 as the community's indoor ice rink. The facility occupies a gross floor area of 36,300 ft<sup>2</sup>. The ice surface is installed in September and removed in May with an estimated area of 17,000 ft<sup>2</sup>. While the ice is installed, the building is open for 18 hours a day, seven days a week, from 6:00 a.m. to 12:00 a.m. Figure 2.1 presents a photograph of the site.



**Figure 2.1: Antigonish Arena Site**

An onsite refrigeration plant creates and maintains the ice sheet when the facility is used as an ice rink. Waste heat from the ice plant compressors is recovered to preheat service water used for ice resurfacing.

The building is equipped with a hydronic heating system with an oil-fired boiler and circulating pumps. The locker rooms utilize hydronic radiators, the remaining heated spaces have hydronic baseboards, apart from the hospitality room which utilizes electric baseboards. The spectator area in the arena has fire tube propane heaters which are used intermittently. No space cooling is provided to the building. Interior and exterior lighting is provided by a mixture of LED, fluorescent, incandescent, and HID lighting fixtures.

Electricity, heating oil, and propane are the sources of energy consumed on site. Electricity powers lighting, ice refrigeration, space heating, kitchen appliances, and a 3 hp air compressor, as well as other ancillary equipment. Heating oil is consumed in a boiler to produce heating to the administrative spaces and locker rooms, as well as to produce service and domestic hot water. Propane is used to provide heating in the arena's spectator area in addition to being the fuel source for the ice resurfacer.

The building and major existing equipment characteristics include:

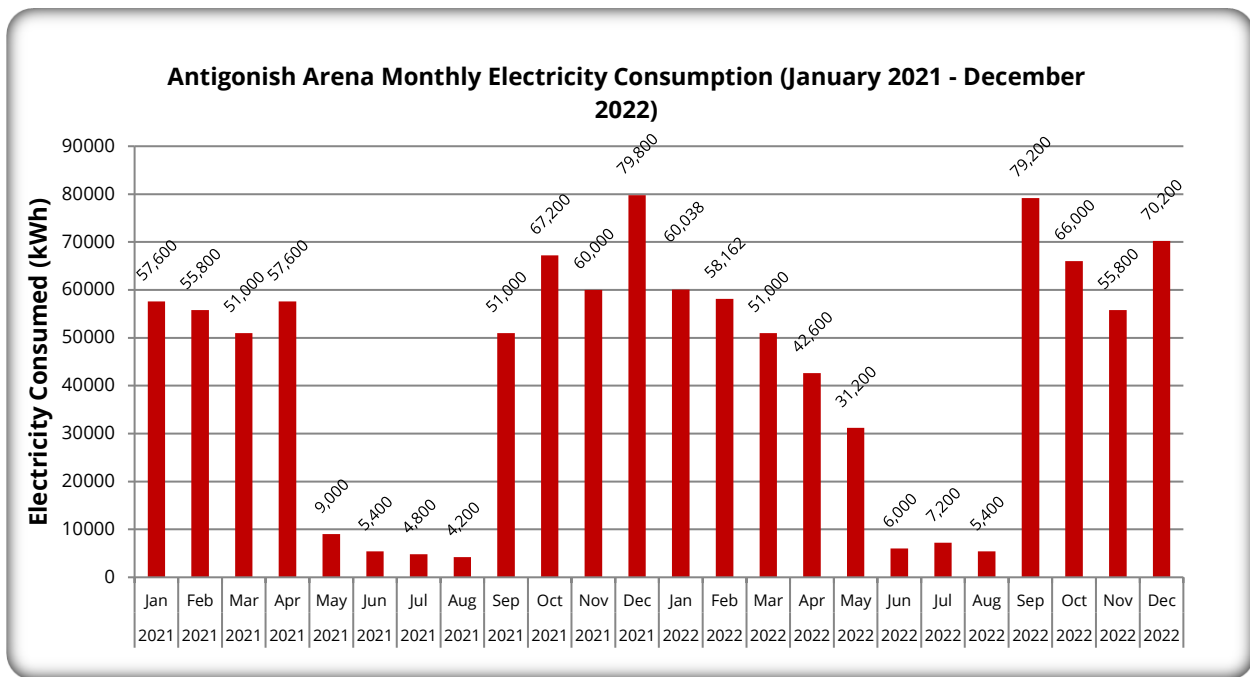
- ▶ The exterior walls appear to be in fair condition. The estimated R-value for the building is R-5.7.
- ▶ The building roof appears to be in fair condition. The estimated R-value is R-6.
- ▶ Metal frame, double paned windows are in fair condition. The estimated R value is 1.7.
- ▶ The floor is slab-on-grade. The estimated R-value is R-1.4.
- ▶ Exterior doors appear in good condition. R-values are estimated to be approximately R-5 for man doors and R-10 for the overhead doors.
- ▶ Weatherstripping around the man-doors appears to be in poor condition with some areas showing daylight through the gaps in the weatherstripping.
- ▶ The interior lighting is a combination of LED, incandescent, and fluorescent with manual ON/OFF switches.
- ▶ Domestic hot water is provided by the oil-fired boiler that serves the building washrooms, kitchens, and locker rooms.
- ▶ Hot water used for ice resurfacing is provided by an oil-fired boiler, where water is preheated using waste heat recovered from the ice plant.
- ▶ The temperature setpoint is 18°C year-round for the heated spaces with no nighttime setback. All the thermostats in this space are programmable.
- ▶ The ammonia/brine loop ice plant utilizes a 60 hp compressor with an estimated COP of 2.2. The compressor motor operates on a VFD.

## 2.2 Review of Historic Energy Performance

Electricity bills were provided for the 24-month period between January 2021 and December 2022. Heating oil bills were available for the same period. Propane bills were provided for January 2022 to December 2022. Energy consumption and demand were reviewed in annual terms to ensure that variation in seasonality was observable. With at least two periods available, a month-to-month comparison of the facility's energy performance was completed from one year to the next. Review of electricity consumption profiles, based on the information obtained from the two periods, was discussed, and is compared in this section.

### 2.2.1 Electricity Use Profiles

Figure 2.2 provides the monthly electricity usage profile which shows the 24-month period from January 2021 to December 2022. For the electricity consumption in 2022, energy consumption for January and February were provided together, the consumption for each individual month was estimated by following the same ratio between months as 2021. No energy consumption was provided for March 2022; values from March 2021 were used as an estimate.



**Figure 2.2: 2021/2022 Monthly Electricity Consumption**

Figure 2.2 depicts a trend with a lower electricity consumption during the summer. Electricity is used to operate the ice plant, which runs from September to May, so this is to be expected. The building usage is also much higher during these months, as well.

Total electricity usage during the period of January/December 2021 was 503,400 kWh and 532,800 kWh from January/December 2022. The average annual energy consumption considering these two 12-month periods was 518,100 kWh.

## 2.2.2 Heating Oil Consumption

The Town of Antigonish provided the heating oil delivery records to the site for the period of January 2021 to December 2022. Total heating oil usage for the period of January/December 2021 was 34,342 L and 36,775 L from January/December 2022. The average annual fuel consumption for this period was 32,625 L. Heating oil is consumed by a boiler to provide space heating as well as domestic hot water heating. The figures are based on delivered quantities each month and do not necessarily reflect quantities consumed each month.

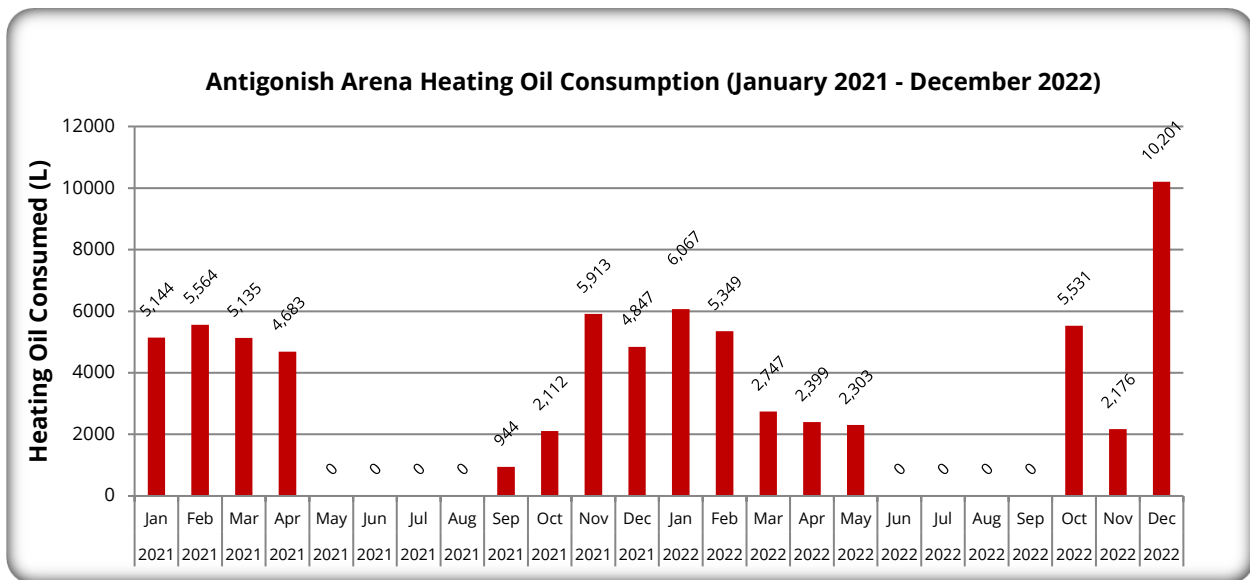


Figure 2.3: Monthly Heating Oil Consumption in L

### 2.2.3 Propane Consumption

The Town of Antigonish provided the propane delivery records to the site for the period of January 2022 to December 2022. Propane usage in 2021 was estimated to be the same as 2022. Total heating oil usage for the period of January/December 2022 was 4,310L. Propane is consumed for space heating, 1594.3L, and the ice resurfer, 2716L.

### 2.2.4 Electricity Cost

Electricity is provided by the Antigonish Electric Utility as a “General Services above 3 kilowatts connected load” electricity rate<sup>17</sup>.

**Above 3 kilowatts connected load:**

<u>Base Rate:</u>	\$8.75 per month per kilowatt of maximum demand.
<u>Energy Rates:</u>	\$0.15945 per kilowatt hour for the first 100 kilowatt hours per month per kilowatt of maximum demand.
	\$0.09993 per kilowatt hour for all additional consumption.
<u>Base Rate:</u>	\$8.75 per kilowatt of maximum demand.
<u>Minimum Bill:</u>	The greater of the Base Rate or \$10.53.
<u>Efficiency Nova Scotia Charges</u>	\$0.00 per kilowatt hour for all consumption.

Figure 2.4: Antigonish Electric Utility Tariff Rate

<sup>17</sup> Source [file.html \(townofantigonish.ca\)](file.html(townofantigonish.ca)). Retrieved: 2023-11-20

Table 2.1 presents the monthly power bill cost breakdown for the January 2021 to December 2022, 24-month period for the Antigonish Arena.

**Table 2.1: Monthly Power Bill Cost Breakdown for the January 2021 to December 2022**

Month-Year	Consumption (kWh)	Consumption Cost	Demand (kW)	Demand Cost	Invoice Amount
January 2021	57,600	\$6,720.19	162.00	\$1,391.58	\$8,111.77
February 2021	55,800	\$6,576.03	168.00	\$1,443.12	\$8,019.15
March 2021	51,000	\$6,096.37	168.00	\$1,443.12	\$7,539.49
April 2021	57,600	\$6,755.90	168.00	\$1,443.12	\$8,199.02
May 2021	9,000	\$1,149.35	42.00	\$360.78	\$1,510.13
June 2021	5,400	\$543.20	0.60	\$5.15	\$548.35
July 2021	4,800	\$515.38	6.00	\$51.54	\$566.92
August 2021	4,200	\$455.42	6.00	\$51.54	\$506.96
September 2021	51,000	\$6,096.37	168.00	\$1,443.12	\$7,539.49
October 2021	67,200	\$7,643.81	156.00	\$1,340.04	\$8,983.85
November 2021	60,000	\$6,995.74	168.00	\$1,443.12	\$8,438.86
December 2021	79,800	\$8,902.93	156.00	\$1,340.04	\$10,242.97
January 2022	7,800	\$1,243.71	156.00	\$1,340.04	\$2,583.75
February 2022	110,400	\$11,960.78	156.00	\$1,340.04	\$13,300.82
March 2022	-	\$0.00	156.00	\$1,340.04	\$1,340.04
April 2022	42,600	\$5,185.53	156.00	\$1,340.04	\$6,525.57
May 2022	31,200	\$4,046.33	156.00	\$1,340.04	\$5,386.37
June 2022	6,000	\$671.00	12.00	\$103.08	\$774.08
July 2022	7,200	\$933.77	36.00	\$309.24	\$1,243.01
August 2022	5,400	\$682.47	24.00	\$206.16	\$888.63
September 2022	79,200	\$8,914.39	168.00	\$1,443.12	\$10,357.51
October 2022	66,000	\$7,523.89	156.00	\$1,340.04	\$8,863.93
November 2022	55,800	\$6,504.61	156.00	\$1,340.04	\$7,844.65
December 2022	70,200	\$7,943.60	156.00	\$1,340.04	\$9,283.64

## 2.2.5 Heating Oil Cost

The Town of Antigonish provided the heating oil delivery records to the site for the period of January 2021 to December 2022. The average cost during this time period was \$1.25/L. Due to the significant increase in oil prices since the billing period, the cost savings calculations have been conducted using a value more representative of the current market price of \$1.79/L<sup>18</sup>.

<sup>18</sup> Source: [Weekly Average Retail Prices for Furnace Oil in 2023 | Natural Resources Canada \(nrcan.gc.ca\)](https://www.nrcan.gc.ca/energy/11777). Retrieved: 2023-04-01.

## 2.2.6 Propane Cost

The Town of Antigonish provided the propane delivery records to the site for the period of January 2021 to December 2022. The average cost during this time period for heating propane was \$1.06/L and approximately \$1.42/L for the ice resurfacers. The cost savings calculations were conducted using a value more representative of the current market price of \$0.8/L for heating propane and \$0.97/L for propane utilized by the ice resurfacers.

## 2.2.7 Total Energy Use Summary

<b>Antigonish Arena - Area: 3372 m<sup>2</sup></b>	<b>2021</b>	<b>2022</b>
<b>Electricity</b>		
Annual Electricity and Demand Cost (\$)	\$70,206.96	\$67,051.96
Annual Electricity Consumption (kWh)	503,400	532,800
Annual Electricity Consumption (GJ)	1,812	1,918
Cost per GJ (\$/GJ)	\$38.7	\$35.0
Percentage of Total Energy (%)	57.8%	55.7%
<b>Heating Oil</b>		
Annual Heating Oil Cost (\$)	\$32,434.95	\$57,182.88
Annual Heating Oil Consumption (L)	34,342	36,775
Annual Heating Oil Consumption (GJ)	1,322.5	1416.18
Cost per GJ (\$/GJ)	\$24.5	\$40.4
Percentage of Total Energy (%)	42.2%	41.1%
<b>Propane</b>		
Annual Propane Cost (\$)	\$5,544.84	\$5,544.84
Annual Propane Consumption (L)	4,310	4,310
Annual Propane Consumption (GJ)	109.7	109.72
Cost per GJ (\$/GJ)	50.5	50.5
Percentage of Total Energy (%)	3.5%	3.2%
<b>Summary - Total</b>		
Annual Energy Costs (\$)	\$102,641.91	\$124,234.84
Annual Energy Consumption (GJ)	3,135	3,444
Cost per GJ (\$/GJ)	32.7	36.1
Percentage of Total Energy (%)	100.00%	100.00%

The baseline energy usage for this study was determined using the January/December 2022 year. This year was selected for the baseline as it was determined that this would more accurately depict each facility's regular operations and energy usage after the COVID-19 pandemic.

## 2.2.8 Benchmarking

The energy use per area or energy use intensity (EUI) for this facility was 1.02GJ/m<sup>2</sup> in 2022. According to the Energy Star Portfolio Manager for Canada<sup>19</sup>, the average EUI for an ice arena is 1.10 GJ/m<sup>2</sup>. Currently, this facility sits approximately 7.3% lower than the average.

## 2.2.9 End-use Breakdown

A building energy model was created in Carrier HAP v6.1 considering the information and data collected from the drawings and the site visit. The energy model was calibrated based on the actual annual energy records for this facility, which allowed us to estimate the energy use breakdown shown in Table 2.2.

This energy use breakdown is an estimation based on information collected during the site visit and from the drawings. This information can only be confirmed with dedicated submetering of the different electrical subpanels and fuel-fired equipment and appliances in the facility. The review of this data allowed us to identify the following:

- ▶ The figure depicts that the majority of the energy consumption of the building, 30.8%, can be attributed to the space heating.
- ▶ The second largest source of energy usage is the ice plant at approximately 25.2%.
- ▶ The third largest source of energy consumption are the pumps at 15.8%.
- ▶ Hot water heating makes up 13.7% of the energy use, with 2.8% being attributed to ice resurfacing and 10.9% being service hot water.
- ▶ The remaining 14.4% is comprised of electrical equipment, lighting, fans and the ice resurfer at 2.8%, 7.6%, 2.0%, and 2.0%, respectively.

**Table 2.2: Energy Use Breakdown**

End-use	Energy Use Breakdown (%)	Site Energy (GJ)
Fans	2.0%	67.3
Space Heating	30.8%	1,059.5
Domestic Hot Water	10.9%	374.1
Ice Resurfacing Water	2.8%	95.7
Lighting	7.6%	262.1
Electrical Equipment	2.8%	97.0
Ice Plant and dehumidifiers	25.2%	865.8
Pumps	15.8%	543.9
Electric Resurfer	2.0%	69.1
<b>Total</b>	<b>100%</b>	<b>3,434.5</b>

<sup>19</sup> Source:

<https://portfoliomanager.energystar.gov/pdf/reference/Canadian%20National%20Median%20Table.pdf>.

Retrieved: 2023-01-23

## 2.3 Energy and GHG Reduction Pathway

### 2.3.1 Pathway Components

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#### 2.3.1.1 Electric Boiler with Outdoor Air Temperature Reset

The building is heated by a hydronic heating system that utilizes an oil-fired boiler with an estimated efficiency of 80%. An electric boiler can provide the same output at an average efficiency of 100%.

The boiler for the hydronic heating system currently heats the supply water to a constant temperature of 82°C (180°F) regardless of the air temperature outside. There is potential for energy consumption reduction in the modulation of supply water temperature for the terminal units according to the outdoor temperature. Outdoor reset control uses the heating curve to set the relationship between the outdoor temperature and the supply water temperature. The heating curve defines the amount the supply water temperature is raised for every 1° drop in outdoor air temperature. During mild outdoor temperatures, the supply water temperature will be low, while during the coldest day of the year the supply water temperature will be at design conditions. Outdoor reset reduces indoor temperature changes by more closely matching the output of the terminal units to the load. It also increases system efficiency by minimizing distribution losses. It is recommended that this system be implemented with the installation of an electric boiler.

#### 2.3.1.2 Upgrade Existing Lighting Fixtures to LEDs

The interior and exterior lighting for the facility is a mixture of LED, fluorescent, incandescent, and HID. LEDs can provide the same level of light as other types of fixtures while consuming less energy. Therefore, considering the difference between the consumption levels of the current lamps and LED lamps, the implementation of this recommendation could result in significant energy savings.

Based on the findings from the building condition assessment completed in parallel to the energy study, the lighting fixtures in this facility have reached the end of their expected useful life. Therefore, the recommendation is to replace the existing lighting fixtures with LED fixtures.

When calculating the input power of the existing lighting, we prepared estimates of the quantity and type of lamps (bulbs) based on visual observation of the fixtures. Since it is difficult to know what type of ballast is used in each fixture without disassembly, the analysis team considered a minimum factor of 1.1 for fluorescent fixtures and 1.2 for HID.

The implementation of LED lighting will result in reduced maintenance costs over the following years. This is due to LEDs having a longer lifespan than the existing lighting fixtures. It is estimated that a non-LED lighting fixture has a maintenance cost of \$4/yr,

while LEDs have an estimated maintenance cost of \$2/yr. This leads to a savings of \$2/yr in maintenance per fixture.

### 2.3.1.3 Occupancy Sensors for Lighting Control

Spaces within the facility are currently controlled by manual ON/OFF switches. To reduce the amount of time the lights are left on (or forgotten ON) with spaces unoccupied, it is recommended that occupancy sensors be installed. Occupancy sensors come in a wide range of configurations and characteristics. They can be installed on walls, ceilings, or at the switch location. Detection can be based on sound, infrared heat, or both. The sensor has a relay that interrupts the voltage to the fixtures in the circuit, thus turning them off when no occupancy is detected. The viability for installation of an occupancy sensor depends on the cost of electricity, the size of the load (number and wattage of lights) being controlled, and the approximate number of unoccupied hours they are often being left turned on.

### 2.3.1.4 Replace Weatherstripping on All Exterior Doors and Seal Exterior Openings

Some of the windows and doors in this facility exhibit gaps and cracks that will allow for outdoor air infiltration. This causes additional heating loads which impact the energy consumption from the HVAC systems. It is recommended that the envelope of conditioned spaces be inspected with caulking applied around the exterior windows, doors, and other exterior wall openings. Damaged and missing weatherstripping on the doors and windows in the facility should also be replaced.

### 2.3.1.5 Replace Existing Windows with Thermally Insulated Vinyl Windows Minimum R-4

The building has metal frame, double pane windows with an estimated R-value of R-1.7. All windows have exceeded their expected lifespan. It is anticipated that replacing the windows with high efficiency double pane, vinyl frame windows will help reduce energy usage for the building. The implementation of this measure will lower conductive losses through the windows, as well as lower infiltration levels.

### 2.3.1.6 Electric Radiant Heaters in Stands with Pay Control System

The only source of heating in the spectator area within the arena are propane radiant heaters with an estimated efficiency of 80%. An electric radiant heater can provide the same output at an average efficiency of 100%. It is also recommended that the heaters be pay operated to reduce usage and energy consumption.

### 2.3.1.7 Repair Exhaust Louvers

Two exhaust louvers located in the arena show some damage and appear to not shut properly. This allows for outdoor air infiltration which cause additional loads on the ice

plant and impact the energy consumption of the HVAC systems and dehumidifiers. It is recommended that these louvers be repaired to minimize infiltration.

### 2.3.1.8 Air Compressor Maintenance Program

Compressed air is an expensive form of energy due to its low efficiency. Most compressed air systems typically have efficiencies of less than 25%, meaning that less than ¼ of the energy input to a compressor results in useable energy at the terminal device utilizing the compressed air. While some inefficiency is impossible to remove, most compressed air systems can improve their efficiency through the elimination of distribution system leaks and improper use of compressed air.

Implementation of a compressed air leak detection and repair program is recommended. Detection and repair of leaks in the compressed air system is an ongoing requirement. The system requires regular inspection to detect leaks on a system and ensure that leaks, once discovered, are recorded and that the repair and confirmation of the repair is also recorded.

### 2.3.1.9 Hydronic Loop Pipe Insulation

The supply piping for the hydronic heating loop is uninsulated. The insulation of these pipes is recommended to reduce heat loss from the system before the hot water reaches the terminal units. The implementation of this measure will not result in significant savings since the piping is within the heated space and heat lost from the pipe will contribute to space heating, but it will contribute to a slight increase in the efficiency of the heating system. The more important reason to insulate heating piping is that it is a good industrial safety practice.

### 2.3.1.10 Cold Water Ice Resurfacing with DHW Heat Recovery

Hot water is traditionally used to resurface the ice surface in arenas; heating water removes dissolved gases in the water to improve the ice quality. The Antigonish Arena typically resurfaces the ice surface 13 times a day when the ice is installed. This resurfacing water is heated to approximately 76.7°C. The water is currently being heated by an oil-fired boiler with an efficiency of approximately 80% and utilizes a heat exchanger with an effectiveness of approximately 80%. Currently, resurfacing water is preheated using waste thermal energy recovered by the ice plant.

Dissolved gases can now be removed without heating the water thus allowing ice to be resurfaced with cold water. This reduces the amount of energy required to heat the water and allows for the heat recovered from the ice plant to be used instead to preheat domestic hot water for servicing the locker rooms, washrooms, and canteen. The use of cold water ice-resurfacing would also decrease the operational load of the compressors since the ice plant would no longer have to refreeze high temperature water.

### 2.3.1.11 Electric Ice Resurfacer

Ice resurfacing is performed by a propane fueled ice resurfacer; combustion engines typically have an efficiency of 40%. An electric vehicle has an efficiency of 70%. It is proposed that the existing propane ice resurfacer be replaced with an electric ice-resurfacer at the end of its life.

## 2.3.2 Energy Rates and Emission Intensity Factors

The following list includes some of the assumptions and variables considered for the technical and financial analysis. The life cycle cost assessment section will include more financial assumptions

▶ Cost of Electricity:	\$0.1258/kWh
▶ Cost of Heating Oil:	\$1.79/L
▶ Cost of Heating Propane :	\$0.8/L
▶ Cost of Ice Resurfacer Propane:	\$0.97/L
▶ Antigonish Electric GHG Emission Intensity Factor 2022:	0.3387 CO <sub>2</sub> e kg/kWh
▶ Antigonish Electric GHG Emission Intensity Factor 2033:	0.1565 CO <sub>2</sub> e kg/kWh
▶ Antigonish Electric GHG Emission Intensity Factor 2043:	0.03 CO <sub>2</sub> e kg/kWh
▶ Heating Oil GHG Emission Intensity Factor:	2.71 CO <sub>2</sub> e kg/L <sup>20</sup>
▶ Propane GHG Emission Intensity Factor:	1.52 CO <sub>2</sub> e kg/L <sup>20</sup>

**Table 2.3: Projected Annual Carbon Emissions, No Measures Implemented**

Energy Source	2022 Energy Usage (GJ)	2022 Emissions (tonnes)	2033 Projected Emissions (tonnes)	2043 Projected Emissions
Antigonish Electric	1918.1	180.5	83.4	16.0
Heating Oil	1416.2	99.6	99.6	99.6
Propane	109.7	6.6	6.6	6.6
<b>Totals</b>	<b>3444.0</b>	<b>286.7</b>	<b>189.6</b>	<b>122.2</b>

The baseline energy consumption, January-December 2022, for the Antigonish Arena resulted in a total energy consumption of 3444 GJ annually and carbon emissions of 286.7 tonnes/year based on 2022 emissions factors. The carbon emission intensity of the electric grid and fossil fuels are projected to decrease during the lifespan of this study. Table 2.3 shows the projected annual emission without the implementation of any energy conservation measures. Compared to the baseline, emissions are expected to decrease by 33.9% and 57.4% by 2033 and 2043, respectively.

<sup>20</sup> Source: [Emission Factors for Greenhouse Gas Inventories \(epa.gov\)](https://www.epa.gov/emissions-factors-and-intensity-factors). Retrieved: 2023-04-01

### 2.3.3 Phase 1 Measurement and Analysis

The baseline HAP was modified to estimate the building's performance considering the efficiency measures listed above. These modifications included:

- ▶ Replacement of the oil-fired boiler, efficiency 80%, with an electric boiler, efficiency of 99%, and an outdoor air temperature reset.
- ▶ Lighting wattages for spaces without LEDs were modelled with LED equivalent wattages.
- ▶ The lighting in intermittently occupied spaces was reduced by 12.5% when modelled to represent the savings from occupancy sensors.
- ▶ Infiltration values were decreased by 10% for all spaces to represent weatherstripping and sealing of exterior surfaces.
- ▶ Windows were upgraded to an R-value of R-4. In spaces with windows, infiltration was decreased by an additional 5%.

The following measures were calculated separately:

- ▶ **Exhaust Fan Louvers:** It was estimated under the assumption that the arena space had an average air temperature of 15°C, with an average outdoor air temperature of 2°C when the building was in operation. The existing air exhaust fans were assumed to have a ¼" gap along the louver and it was estimated to be ⅛" when repaired. Electric radiant heaters, 100%, were assumed to be on 50% of the time during operating hours to determine the savings.
- ▶ **Air Compressor Maintenance Program:** It was estimated that the 3 hp air compressor runs an average of six hours per day, with a motor efficiency of 80%. It was estimated that the implementation of this program will result in an 10-15% reduction in energy usage from the air compressor. This estimation is based on repairing five leaks of 0.8 mm in diameter, an inlet pressure of 101.3 kPa, a compressor operating pressure of 700 kPa, a compressor isentropic efficiency of 82%, a compressor motor efficiency of 90%, a specific heat ratio of 1.4, and applying the calculation method defined by Dumus Kaya et al.<sup>21</sup>
- ▶ **Pipe Insulation:** The addition of 1.5" of insulation to the hot water piping was considered. Savings were estimated with a 1 m long section of 3" pipe with and without insulation. It was estimated that the interior wall was 82°C (180°F) and the ambient temperature was 18°C (64.4°F). The U-value for uninsulated steel pipe is 5.1 BTU/ft<sup>2</sup> hr °F, the U-value for 1.5" thick insulation was considered as 0.167 BTU/ ft<sup>2</sup> hr. A diversity factor of 50% was assumed.

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<sup>21</sup> Energy Conservation in Compressed-Air System. Durmus Kaya, Patrick Phelan, David Chaun, and H. Ibrahim sarac. Industrial Assessment Centre, Arizona State University, Tempe, AZ 85287-6160, USA. TUBUTAK-MRC, Energy System and Environmental Research Institute, P.O. Box 21, 41470 Gebze-Kocaeli, Turkey. *International Journal of Energy Research. Int. J. Energy. 2002; 26:837-849 (DOI: 10.1002/er.823).*

- ▶ **Cold Water Ice Resurfacing:** Ice resurfacing was assumed to occur 13 times per day, using an average of 265 L/resurfacing of 76.7°C hot water and the incoming water temperature was assumed to be approximately 8°C.
- ▶ **For Savings associated with Water Heating:** A majority of resurfacing water heating comes from energy recovered from the ice plant. It was estimated that 40% of the electricity consumption of the building was the ice plant, 71% being the compressor. It was assumed that 60% of the compressor energy could be recovered as heat and the heat exchanger had an efficiency of 50%. Of the energy calculated for heating the resurfacing water, heat recovered for ice resurfacing was estimated to be 73% of the total load with the remaining 26% being provided by the boiler. The hot water boiler was assumed to have an 80% efficiency and the heat exchanger between the boiler and the incoming water was also assumed to have an efficiency of 80%.
- ▶ **For Savings associated with Water Freezing:** Savings associated with the energy required to refreeze the water was considered at 76.7°C and 8°C considering an ice plant COP of 2.2.
- ▶ **For Savings associated with Domestic Hot Water Preheating:** The energy available for heat recovery will decrease after the implementation of cold-water ice resurfacing, because the compressors will operate less. To determine how much energy is available to be recovered, the energy savings associated with freezing the water were removed from the baseline ice plant energy usage. It was estimated that 40% of the electricity consumption of the building was the ice plant, 71% being the compressor. It was assumed that 60% of the compressor energy could be recovered as heat and the heat exchanger had an efficiency of 50%. Based on the occupancy patterns of the building and that the demands for hot water could occur sporadically, a conservative estimate is that 10% of the DHW demand of the building could be supplied through the ice plant.
- ▶ **For Savings associated with Brine Loop Temperature Increase:** To implement cold water ice resurfacing, the brine loop temperature needs to operate at 3°F higher. It is estimated this will save 2% of the ice plant energy usage.

The implementation of these measures to the Antigonish Arena would result in a reduction of energy consumption from the baseline of 594.6GJ. The total cost to implement Phase 1 measures is approximately \$350,125 with a cost savings of an estimated \$36,929 for a payback period of 9.5 years. These measures will result in emissions savings of 61.8 tonnes/year in 2033 compared to the baseline building's emissions in the same year as presented in Table 2.4.

**Table 2.4: Antigonish Arena Phase 1 Efficiency Measures**

ECM	CAPEX (\$)	GHG Savings (tonne)	CAPEX/ GHG Reduction (\$/tonne)	Energy Savings GJ/yr	Cost Savings \$/yr	Cost Savings/ GHG Saved (\$/tonne CO <sub>2</sub> e)	Simple Payback (yr)
Electric Boiler with OAT Reset	\$45,000	51.7	\$5,828	362.4	\$28,785	\$557	10.5
Electrical Entrance Upgrade	\$110,000						
LED Lighting	\$41,680						
Occupancy Sensors for Lighting Control	\$2,400						
Infiltration Reduction	\$3,250						
Replace Aluminum Windows with R-4*	\$22,000						
Electric Radiant Heaters in Stands with Pay Control System*	\$77,000						
Air Compressor Maintenance Program	\$1,000	0.1	\$7,456	3.1	\$121	\$902	8.3
Repair Louvers on Exhaust Fans	\$720	0.05	\$15,595	1.062	\$37	\$804	19.4
Hydronic Loop Pipe Insulation (per meter)	\$75	0.21	\$357	4.7	\$183	\$871	0.4
Cold Water Ice Resurfacing with DHW Heat Recovery	\$47,000	9.7	\$4,841.42	223.3	\$7,804	\$804	6.0
<b>ECM Implementation Total</b>	<b>\$350,125</b>	<b>61.8</b>	<b>\$5,665</b>	<b>594.6</b>	<b>\$36,929</b>	<b>597.6</b>	<b>9.5</b>

### 2.3.4 Phase 2 Measurement and Analysis

The following measure was considered:

- ▶ **Electric Ice Resurfacer:** The annual energy usage provided was 69.1 GJ/year. Internal combustion engines have an average efficiency of 40%, which allows for the useful energy to be recovered. It was assumed that an electric unit will have an efficiency of approximately 70%.

The implementation of this measure to the Antigonish Arena would result in a reduction of energy consumption from the baseline of 29.8 GJ per year. The total cost to implement the Phase 2 measures is approximately \$190,000 with a cost savings of an estimated \$1,254 for a payback period of 151.5 years. The simple payback calculation assumes that a zero-cost alternative is available which is untrue since this measure is scheduled to only occur when the current ice resurfacer is at the end of life and must be replaced. These measures would have an emissions savings 3.8 tonnes per year in 2043 compared to the baseline building's emissions in the same year.

**Table 2.5: Antigonish Arena Phase 2 Efficiency Measures**

ECM	CAPEX (\$)	GHG Savings (tonne)	CAPEX/ GHG Reduction (\$/tonne)	Energy Savings GJ/yr	Cost Savings \$/yr	Cost Savings/ GHG Saved (\$/tonne CO <sub>2</sub> e)	Simple Payback (yr)
Electric Zamboni	\$190,000	3.8	\$49,906	29.8	\$1,254	\$329	151.5
<b>ECM Implementation Total</b>	<b>\$190,000</b>	<b>3.8</b>	<b>\$49,906</b>	<b>29.8</b>	<b>\$1,254</b>	<b>\$329</b>	<b>151.5</b>

### 2.3.5 Measures Considered but Not Recommended

The following measures were considered for this building but are ultimately not currently recommended for implementation:

- **Upgrade Exterior Insulation of Heated Spaces and Install Partition Insulation:** The building currently has exterior insulation but not along the partition between the heated spaces to the arena. This allows for heat loss from the conditioned spaces to the arena. The implementation of insulation to the partition walls and the upgrade of the existing insulation levels would lower conductive losses through the walls, as well as lower infiltration levels. This measure is ultimately not being recommended because the cost of the measure would result in a long payback period.

## 3 Columbus Field Washrooms

### 3.1 Facility Description

The Columbus field washrooms were constructed in 2005. The building is accessible to the public from 14 hours a day from 8:00 a.m. to 10:00 p.m., seven days a week from March to October. Figure 3.1 presents a photograph of the site.



**Figure 3.1: Columbus Field Washrooms**

The building is equipped with electric radiant heaters. Interior and exterior lighting is provided by fluorescent and LED lighting fixtures. Electricity is the only

source of energy consumed on site. Electricity powers the space heating, lighting, and service hot water, as well as other ancillary equipment. The building is also the location of an electric vehicle charger. This charger is metered separately from the building.

The building and major existing equipment characteristics include:

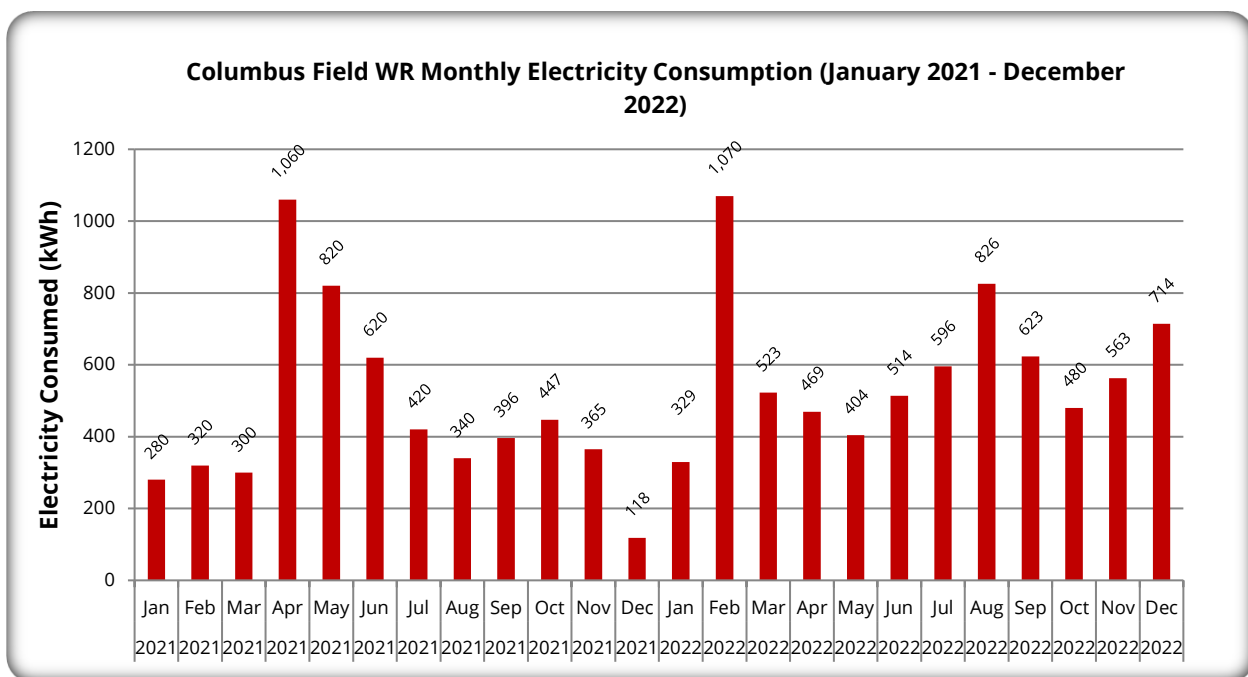
- ▶ The exterior walls appear to be in fair condition. The estimated R-value for the building is R-21.
- ▶ The building roof appears to be in fair condition. The estimated R-value is R-31.
- ▶ A vinyl, double paned window is in good condition. The estimated R value is R-2.
- ▶ The floor is suspended above grade and supported on concrete columns. The underneath of the floor is not insulated. The estimated R value is R-3.
- ▶ Exterior doors appear in good condition. R-values are estimated to be approximately R-3.
- ▶ Weatherstripping around the man-doors appears to be in poor condition with some areas showing daylight through gaps in the weatherstripping.
- ▶ The interior lighting is fluorescent with manual ON/OFF switches.
- ▶ Domestic hot water is provided by a 47 US gallon electric hot water heater.
- ▶ The temperature setpoint is assumed to be 15°C year-round with no nighttime setback.

## 3.2 Review of Historic Energy Performance

Electricity bills were provided for the 24-month period between January 2021-2022. Energy consumption and demand were reviewed in annual terms to ensure that variation in seasonality was observable. With at least two periods available, a month-to-month comparison of the facility's energy performance was completed from one year to the next. Review of the electricity consumption profiles, based on the information obtained from the two periods, was discussed, and is compared in this section.

### 3.2.1 Electricity Use Profiles

Figure 3.2 provides the monthly electricity usage profile which shows the 24-month period from January 2021 to December 2022.



**Figure 3.2: 2021/2022 Monthly Electricity Consumption**

Figure 3.2 depicts a trend with a lower electricity consumption during the shoulder seasons and higher consumption in the summer and winter. Electricity consumption in the winter can be attributed to electric space heating. Increased consumption in the summer may be due to increased usage.

Total electricity consumption during the period of January/December 2021 was 5,486 kWh and 7,111 kWh from January/December 2022. The average annual energy consumption considering these two 12-month periods was 6,299 kWh. This does not include any consumption from the electric vehicle charger, as that is metered separately, and may vary depending on EV charging demands from its users.

## 3.2.2 Electricity Cost

Electricity is provided by the Antigonish Electric Utility as a “General Services above 3 kilowatts connected load” electricity rate<sup>22</sup>.

<b>Above 3 kilowatts connected load:</b>	
<u>Base Rate:</u>	\$8.75 per month per kilowatt of maximum demand.
<u>Energy Rates:</u>	\$0.15945 per kilowatt hour for the first 100 kilowatt hours per month per kilowatt of maximum demand.
	\$0.09993 per kilowatt hour for all additional consumption.
<u>Base Rate:</u>	\$8.75 per kilowatt of maximum demand.
<u>Minimum Bill:</u>	The greater of the Base Rate or \$10.53.
<u>Efficiency Nova Scotia Charges</u>	\$0.00 per kilowatt hour for all consumption.

**Figure 3.3: Antigonish Electric Utility Tariff Rate**

Table 3.1 presents the monthly power bill cost breakdown for the January 2021 to December 2022, 24-month period for the Columbus Field Washrooms.

**Table 3.1: Monthly Power Bill Cost Breakdown for the January 2021 to December 2022**

Month-Year	Consumption (kWh)	Consumption Cost	Demand (kW)	Demand Cost	Invoice Amount
January 2021	280	\$39.88	2.00	\$17.18	\$57.06
February 2021	320	\$46.26	2.40	\$20.62	\$66.88
March 2021	300	\$44.27	2.40	\$20.62	\$64.89
April 2021	1,060	\$160.68	9.20	\$79.03	\$239.71
May 2021	820	\$115.27	5.60	\$48.10	\$163.37
June 2021	620	\$92.90	5.20	\$44.67	\$137.57
July 2021	420	\$66.97	4.20	\$36.08	\$103.05
August 2021	340	\$54.21	4.00	\$34.36	\$88.57
September 2021	396	\$63.14	4.40	\$37.80	\$100.94
October 2021	447	\$68.30	3.97	\$34.10	\$102.40
November 2021	365	\$58.20	4.23	\$36.34	\$94.54
December 2021	118	\$18.82	1.18	\$10.14	\$28.96
January 2022	329	\$32.88	1.18	\$10.14	\$43.02
February 2022	1,070	\$120.32	1.07	\$9.19	\$129.51
March 2022	523	\$77.68	4.27	\$36.68	\$114.36

<sup>22</sup> Source [file.html \(townofantigonish.ca\)](file.html(townofantigonish.ca)). Retrieved: 2023-11-20

Month-Year	Consumption (kWh)	Consumption Cost	Demand (kW)	Demand Cost	Invoice Amount
April 2022	469	\$74.78	5.80	\$49.82	\$124.60
May 2022	404	\$64.42	4.08	\$35.05	\$99.47
June 2022	514	\$81.96	15.46	\$132.80	\$214.76
July 2022	596	\$95.03	11.57	\$99.39	\$194.42
August 2022	826	\$131.71	18.03	\$154.88	\$286.59
September 2022	623	\$99.34	9.62	\$82.64	\$181.98
October 2022	480	\$76.54	8.14	\$69.92	\$146.46
November 2022	563	\$89.77	9.61	\$82.55	\$172.32
December 2022	714	\$113.85	8.73	\$74.99	\$188.84

### 3.2.3 Total Energy Use Summary

Columbus Field Washrooms – Area: 37 m <sup>2</sup>	2021	2022
<b>Electricity</b>		
Annual Electricity and Demand Cost (\$)	\$1,247.94	\$1,896.33
Annual Electricity Consumption (kWh)	5,486	7,111
Annual Electricity Consumption (GJ)	20	25.6
Cost per GJ (\$/GJ)	63.2	74.1
Percentage of Total Energy (%)	100%	100%

The baseline energy usage for this study was determined using the January/December 2022 year. This year was selected for the baseline as it was determined that this would more accurately depict each facility's regular operations and energy usage after the COVID-19 pandemic.

### 3.2.4 Benchmarking

The energy use per area or energy use intensity (EUI) for this facility was 0.69 GJ/m<sup>2</sup> in 2022. According to the Energy Star Portfolio Manager for Canada<sup>23</sup>, the average EUI for a public service-other space is 0.86 GJ/m<sup>2</sup>. Currently, this facility sits approximately 19.8% lower than the average.

### 3.2.5 End-use Breakdown

The energy use breakdown for this building was estimated by assuming the hours of operation of the lighting and exhaust fan based on building occupancy. The domestic hot

<sup>23</sup> Source:

<https://portfoliomanager.energystar.gov/pdf/reference/Canadian%20National%20Median%20Table.pdf>.

Retrieved: 2023-01-23

water tank was assumed to have a diversity factor of 10% during months that the building is occupied. The remainder of energy consumption per year was attributed to space heating.

The estimate of the energy use breakdown is shown in Table 3.2. This energy use breakdown is an estimation based on information collected during the site visit and from the drawings. This information can only be confirmed with dedicated submetering of the different electrical subpanels and appliances in the facility. The review of this data allowed us to identify the following:

- ▶ The figure depicts that the majority of the energy consumption of the building, 49.1%, can be attributed to heating.
- ▶ The second largest source of energy usage is building lighting at approximately 24.8%.
- ▶ The remaining 26.1% is comprised of hot water heating and fans 24.6% and 1.4%, respectively.

**Table 3.2: Energy Use Breakdown**

End-use	Energy Use Breakdown (%)	Site Energy (GJ)
Space Heating	24.8%	6.4
Lights	24.6%	6.3
Domestic Hot Water	1.4%	0.4
Space Fans	49.1%	12.6
<b>Total</b>	<b>100%</b>	<b>25.6</b>

## 3.3 Energy and GHG Reduction Pathway

### 3.3.1 Pathway Components

#### 3.3.1.1 Upgrade Existing Lighting to LEDs

The interior lighting for the facility are fluorescent fixtures. LEDs can provide the same level of light as other types of fixtures while consuming less energy. Therefore, considering the difference between the consumption levels of the current lamps and LED lamps, the implementation of this recommendation could result in energy savings.

Based on the age of the building, it is expected that the lighting fixtures in this facility will have reached the end of their expected useful life by the end of Phase 1, 2033. Therefore, the recommendation is to replace the existing lighting fixtures with LED fixtures.

When calculating the input power of the existing lighting, we prepared estimates of the quantity and type of lamps (bulbs) based on visual observation of the fixtures. Since it is difficult to know what type of ballast is used in each fixture without disassembly, the analysis team considered a minimum factor of 1.1 for fluorescent fixtures and 1.2 for HID.

The implementation of LED lighting will result in reduced maintenance costs over the following years. This is due to LEDs having a longer lifespan than the existing lighting fixtures. It is estimated that a non-LED lighting fixture has a maintenance cost of \$4/yr, while LEDs have an estimated maintenance cost of \$2/yr. This leads to a savings of \$2/yr in maintenance per fixture.

### 3.3.1.2 Install Occupancy Sensors for Intermittently Used Spaces

Lights within the facility are currently controlled by manual ON/OFF switches. To reduce the amount of time the lights are left on (or forgotten ON) with spaces unoccupied, it is recommended that occupancy sensors be installed. Occupancy sensors come in a wide range of configurations and characteristics. They can be installed on walls, ceilings, or at the switch location. Detection can be based on sound, infrared heat, or both. The sensor has a relay that interrupts the voltage to the fixtures in the circuit, thus turning them off when no occupancy is detected. The viability for installation of an occupancy sensor depends on the cost of electricity, the size of the load (number and wattage of lights) being controlled, and the approximate number of unoccupied hours they are often being left turned on.

### 3.3.1.3 Replace Washroom Exhaust On/Off Switch with Timer Switch

Two exhaust fans, assumed to be 150 cfm each, located in the facility are manually controlled and operate at maximum speed when on. Each cubic metre of air extracted from the building must be replaced by one cubic metre of conditioned air. To reduce the amount of time the exhaust fans are left on (or forgotten ON) with spaces unoccupied, it is recommended that timers be installed.

### 3.3.1.4 Turn off Electric Heating During Seasonal Closure

The facility is operational for an estimated eight months of the year, with a closure in the winter. The water to the building is shut off during this time and heating is not required to prevent the freezing of the pipes. Therefore, since the space is unoccupied, and there is nothing onsite that could be damaged due to the cold temperature, it is recommended that the electric heating is turned off when the building is closed for the winter.

### 3.3.1.5 Replace Weatherstripping on All Exterior Doors and Seal Exterior Openings

Some of the windows and doors in this facility exhibit gaps and cracks that will allow for outdoor air infiltration. This causes additional heating loads which impact the energy consumption from the HVAC systems. It is recommended that the envelope of conditioned spaces be inspected with caulking applied around the exterior windows, doors, and other exterior wall openings. Damaged and missing weatherstripping on the doors and windows in the facility should also be replaced.

### 3.3.2 Energy Rates and Emission Intensity Factors

The following list includes the assumptions and variables considered for the technical and financial analysis:

- ▶ Cost of Electricity 2022: \$0.2667/kWh
- ▶ Antigonish Electric GHG Emission Intensity Factor 2022: 0.3387 CO<sub>2</sub>e kg/kWh
- ▶ Antigonish Electric GHG Emission Intensity Factor 2033: 0.1565 CO<sub>2</sub>e kg/kWh
- ▶ Antigonish Electric GHG Emission Intensity Factor 2043: 0.03 CO<sub>2</sub>e kg/kWh

**Table 3.3: Projected Annual Carbon Emissions, No Measures Implemented**

Energy Source	2022 Energy Usage (GJ)	2022 Emissions (tonnes)	2033 Projected Emissions (tonnes)	2043 Projected Emissions
Antigonish Electric	25.6	2.41	1.11	0.21
<b>Total</b>	<b>25.6</b>	<b>2.41</b>	<b>1.11</b>	<b>0.21</b>

The baseline energy consumption, January-December 2022, for the Columbus Field Washrooms resulted in a total energy consumption of 25.6 GJ annually and carbon emissions of 2.41 tonnes/year based on 2022 emissions factors. The carbon emission intensity of the electric grid and fossil fuels are projected to decrease during the lifespan of this study. Table 3.3 shows the projected annual emission without the implementation of any energy conservation measures. Compared to the baseline, emissions are expected to decrease by 53.8% and 91.1% by 2033 and 2043, respectively.

### 3.3.3 Phase 1 Measurement and Analysis

A HAP model of the building was created and modified to estimate the building's performance considering the efficiency measures listed above. These modifications included:

- ▶ **Turn Off Heating when Building is Unoccupied and Provide Weatherstripping:** The building model baseline had heating provided 12 months a year. To account for the energy savings due to these measures, the heating systems were turned off for a four-month period from November to February, and the infiltration to the building was reduced by 10%. The savings percentage was applied to the energy usage of the building to determine savings.

The savings from the following measures were calculated separately:

- ▶ **Upgrade the Lighting to LED with Occupancy Sensors:** The baseline building was assumed to have four fixtures that have two 32 W fluorescent bulbs with a ballast factor of 1.1. The LED lighting was assumed to be 25 W per fixture. It was assumed that the lights were on from 8:00 a.m. to 10:00 p.m., seven days per week for eight months per year for the baseline building. The time on was reduced by 12.5% to account for savings from the occupancy sensor.

► **Install Timer Switch to Control Exhaust Fans:** Two 150 cfm fans, at approximately 188 W each are located on site; it is assumed that each fan is on for 270 hours per year. The implementation of a control for the exhaust fan was assumed to reduce the operating hours by 50%.

The implementation of these measures to the Columbus Field Washroom will result in a reduction of energy consumption from the baseline of 12.9 GJ per year. The total cost to implement Phase 1 measures is approximately \$2,060 with a cost savings of an estimated \$973 for a payback period of 2.1 years. These measures will have an emissions savings 0.56 tonnes/year in 2033 compared to the baseline building's emissions in the same year as seen in Table 3.4.

**Table 3.4: Columbus Field Washrooms Phase 1 Efficiency Measures**

ECM	CAPEX (\$)	GHG Savings (tonne)	CAPEX/ GHG Reduction (\$/tonne)	Energy Savings GJ/yr	Cost Savings \$/yr	Cost Savings/ GHG Saved (\$/tonne CO <sub>2</sub> e)	Simple Payback (yr)
Upgrade Lighting to LED	\$960	0.17	\$7,931	3.9	\$308	\$1,707	4.4
Occupancy Sensor for Lighting	\$400						
Turn off Heat when Building is Closed	\$300	0.37	\$804	8.6	\$636	\$1,704	0.5
Infiltration Reduction							
Bathroom Exhaust Timers	\$400	0.02	\$23,666	0.4	\$29	\$1,704	13.9
<b>ECM Implementation Total</b>	<b>\$2,060</b>	<b>0.56</b>	<b>\$3,668</b>	<b>12.9</b>	<b>\$973</b>	<b>\$1,733</b>	<b>2.1</b>

### 3.3.4 Phase 2 Measurement and Analysis

The following measures were calculated separately:

► **Instantaneous Water Heater:** The building currently has a 47 US Gallon hot water heater. The water is turned off when the building is closed so it is assumed that the hot water tank operated eight months of the year, with a diversity factor of 10% for a total energy usage of 1752 kWh per year. The only hot water fixtures in the building are lavatories which do not require the higher flow rates that a tank water heater can provide. Instantaneous hot water heaters can save 20% compared to storage tank hot water heaters due to the removal of standby losses resulting in an estimated savings of 350.4 kWh per year. This measure should be implemented when the current domestic water heater is at the end of its life and requires replacement.

The implementation of this measure to the Columbus Field Washrooms will result in a reduction of energy consumption from the baseline of 1.3 GJ per year. The total cost to implement the Phase 2 measures is approximately \$6,000 with a cost savings of an estimated \$97 for a payback period of 61.6 years. These measures will have an emissions savings of 0.01 tonnes per year in 2043 compared to the baseline building's emissions in the same year.

**Table 3.5: Columbus Field Washrooms Phase 2 Efficiency Measures**

ECM	CAPEX (\$)	GHG Savings (tonne)	CAPEX/ GHG Reduction (\$/tonne)	Energy Savings GJ/yr	Cost Savings \$/yr	Cost Savings/ GHG Saved (\$/tonne CO <sub>2</sub> e)	Simple Payback (yr)
Upgrade Electric Service Entrance	\$3,000	0.01	\$547,945.21	1.3	\$97	\$8,890.0	61.6
Install a Tankless Hot Water Heater	\$3,000						
<b>ECM Implementation Total</b>	<b>\$6,000</b>	<b>0.01</b>	<b>\$547,945</b>	<b>1.3</b>	<b>\$97</b>	<b>\$8,890.0</b>	<b>61.6</b>

### 3.3.5 Measures Considered but Not Recommended

The following measures were considered for this building but are ultimately not currently recommended for implementation:

- **Insulate the Floor Deck:** The building is currently suspended above the ground with the floor being insulated. This allows for heat loss from the conditioned spaces to the immediate surroundings. The addition of insulation to the floor will lower conductive losses as well as lower infiltration levels. This measure is ultimately not being recommended because the majority of the heating load would occur when the building is unoccupied and unused, and the heating system does not need to be on during this time.

# 4 Antigonish Fire Hall

## 4.1 Facility Description

The Antigonish Fire Hall was built in 1961. The building has undergone renovations since the initial construction, including the addition of a HRV to the fire apartment. The fire chief's office and the activity room were drywalled and are assumed to have received additional insulation. The building is accessible 24/7 in the event of a fire but the majority of the building is primarily unoccupied throughout the week.



**Figure 4.1: Antigonish Fire Hall**

Taekwondo classes are held in the rec room Mondays and Wednesdays for three hours from 5:15 p.m. to 8:15 p.m., Fridays for two hours from 6:00 p.m. to 8:00 p.m. and Saturdays for one and a half hours from 9:00 a.m. to 10:30 a.m. Meetings and practises are held every Monday evening for 2-3 hours, 10 months of the year, between the activity room and truck bay. Additional training is held intermittently throughout the year in the activity room on the weekends. Figure 4.1 presents a photograph of the site.

The building is equipped with a hydronic heating system with an oil-fired boiler and circulating pumps. The administrative space utilizes hydronic baseboards, while the garage has a hydronic unit heater. No cooling is provided to the space. Interior and exterior lighting is provided by a mixture of LED, fluorescent, and halogen lighting fixtures. Electricity and heating oil are the two sources of energy consumed on site. Electricity powers the lighting, refrigeration, kitchen appliances, and a 5 hp air compressor, as well as other ancillary equipment. Heating oil is consumed in a boiler to produce heating to the administrative spaces and garage, as well as to produce service hot water. Mechanical ventilation is provided by a HRV to the fire apartment on the second floor.

The building and major existing equipment characteristics include:

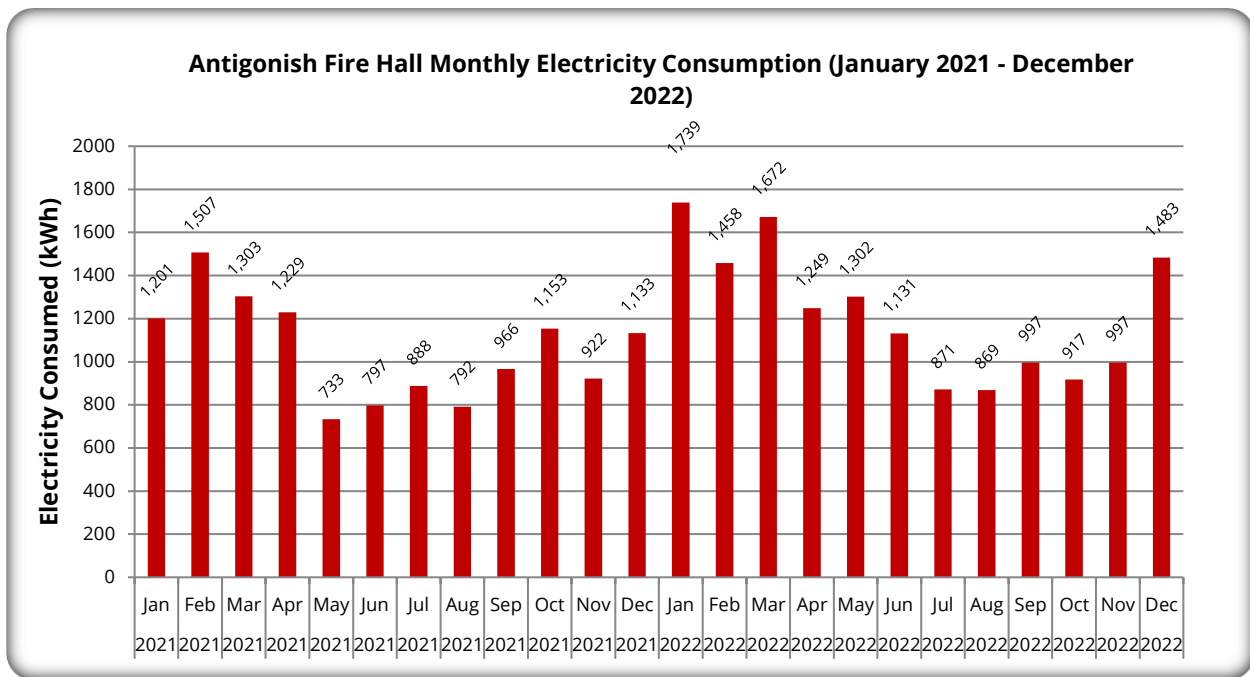
- ▶ The exterior walls appear to be in fair condition. The estimated R-value for the building is R-3. Exterior walls in the activity room and fire chief's office are estimated to be R-10.
- ▶ The building roof appears to be in fair condition. The estimated R-value is R-11.
- ▶ Aluminum frame, double paned windows located in the weight room and fire apartment are in poor condition. The estimated R value is R-1.8. Vinyl frame, double paned windows in the remainder of the building are in fair condition. The estimated R value is R-2.1.
- ▶ The floor is slab-on-grade. The estimated R-value is R-1.8.
- ▶ Exterior doors appear in good condition. R-values are estimated to be approximately R-3 for the man-doors and R-5 for the overhead doors.
- ▶ Weatherstripping around the man-doors appears to be in poor to fair condition with some areas showing daylight through the gaps in the weatherstripping. Weatherstripping around the overhead doors is in good condition.
- ▶ The interior lighting is a combination of LED and fluorescent with manual ON/OFF switches except for the truck bays. Truck bay lighting has been converted to LEDs and has an occupancy sensor.
- ▶ The exterior lighting is provided by a combination of LED and HID.
- ▶ One oil-fired boiler provides hot water up to 82°C (180°F) for the hydronic heating system at an estimated efficiency of approximately 80-90%.
- ▶ Domestic hot water is provided by the boiler heater that serves the building washrooms, kitchen, and fire apartment.
- ▶ The temperature setpoint is 15°C year-round for all spaces with the exception of the fire chief's office and activity room which are 18°C with no nighttime setback. All the thermostats in this space are manual.
- ▶ Cooking appliances are electric.
- ▶ A heat recovery ventilator (HRV) serves the fire apartment with an estimated efficiency of 65%. It has a variable speed fan, operates continuously, and is controlled based on relative humidity.

## 4.2 Review of Historic Energy Performance

Electricity bills were provided for the 24-month period between January 2021-2022. Energy consumption and demand were reviewed in annual terms to ensure that variation in seasonality was observable. With at least two periods available, a month-to-month comparison of the facility's energy performance was completed from one year to the next. Review of the electricity consumption profiles, based on the information obtained from the two periods, was discussed, and is compared in this section.

### 4.2.1 Electricity Use Profiles

Figure 4.2 provides the monthly electricity usage profile which shows the 24-month period from January 2021 to December 2022.



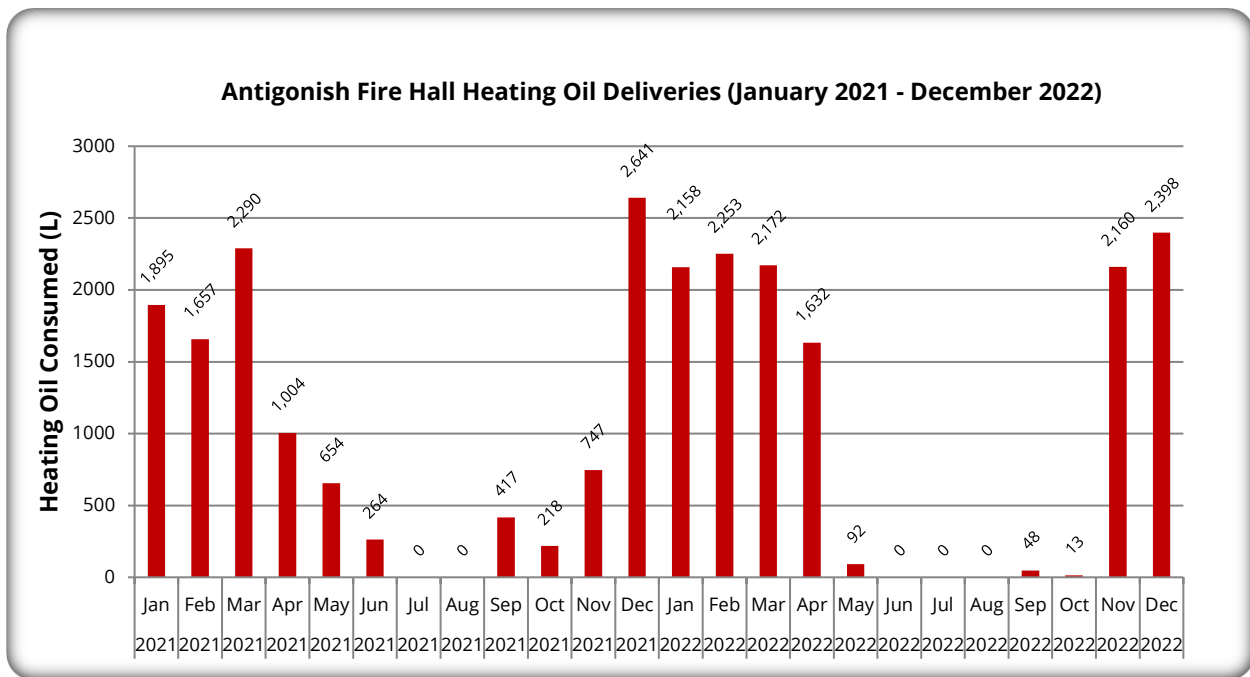
**Figure 4.2: 2021/2022 Monthly Electricity Consumption**

Figure 4.2 depicts a trend with a lower electricity consumption during the summer. Since electricity is not used for heating, this fluctuation is most likely due to lighting energy and hydronic pumping consumption, as well as changes in building operating schedules.

Total electricity usage during the period of January/December 2021 was 12,624 kWh and 14,685 kWh from January/December 2022. The average annual energy consumption considering these two 12-month periods was 13,655 kWh.

### 4.2.2 Heating Oil Consumption

The Town of Antigonish provided the heating oil delivery records to the site for the period of January 2021 to December 2022. Total heating oil usage for the period of January/December 2021 was 11,789 L and 12,985 L from January/December 2022. The average annual fuel consumption for this period was 12,357 L. Heating oil is consumed by a boiler to provide space and service water heating to the building. The figures are based on delivered quantities each month and do not necessarily reflect quantities consumed each month.



**Figure 4.3: Monthly Heating Oil Deliveries in L**

### 4.2.3 Electricity Cost

Electricity is provided by the Antigonish Electric Utility as a “General Services above 3 kilowatts connected load” electricity rate<sup>24</sup>.

<b><u>Above 3 kilowatts connected load:</u></b>	
<u>Base Rate:</u>	\$8.75 per month per kilowatt of maximum demand.
<u>Energy Rates:</u>	\$0.15945 per kilowatt hour for the first 100 kilowatt hours per month per kilowatt of maximum demand.
	\$0.09993 per kilowatt hour for all additional consumption.
<u>Base Rate:</u>	\$8.75 per kilowatt of maximum demand.
<u>Minimum Bill:</u>	The greater of the Base Rate or \$10.53.
<u>Efficiency Nova Scotia Charges</u>	\$0.00 per kilowatt hour for all consumption.

**Figure 4.4: Antigonish Electric Utility Tariff Rate**

Table 4.1 presents the monthly power bill cost breakdown for the January 2021 to December 2022, 24-month period for the Antigonish Fire Hall.

<sup>24</sup> Source [file.html \(townofantigonish.ca\)](file.html(townofantigonish.ca)). Retrieved: 2023-11-20

**Table 4.1: Monthly Power Bill Cost Breakdown for the January 2021 to December 2022**

Month-Year	Consumption (kWh)	Consumption Cost	Demand (kW)	Demand Cost	Invoice Amount
January 2021	1,201	\$152.93	5.53	\$47.50	\$200.43
February 2021	1,507	\$195.83	7.60	\$65.28	\$261.11
March 2021	1,303	\$171.10	6.87	\$59.01	\$230.11
April 2021	1,229	\$157.63	5.85	\$50.25	\$207.88
May 2021	733	\$99.08	4.34	\$37.28	\$136.36
June 2021	797	\$113.33	5.66	\$48.62	\$161.95
July 2021	888	\$126.41	6.33	\$54.37	\$180.78
August 2021	792	\$107.00	4.68	\$40.20	\$147.20
September 2021	966	\$135.22	6.50	\$55.84	\$191.06
October 2021	1,153	\$150.10	5.86	\$50.34	\$200.44
November 2021	922	\$131.42	6.60	\$56.69	\$188.11
December 2021	1,133	\$143.94	5.16	\$44.32	\$188.26
January 2022	1,739	\$202.70	4.86	\$41.75	\$244.45
February 2022	1,458	\$186.35	6.83	\$58.67	\$245.02
March 2022	1,672	\$210.65	7.32	\$62.88	\$273.53
April 2022	1,249	\$157.84	5.55	\$47.67	\$205.51
May 2022	1,302	\$180.29	8.43	\$72.41	\$252.70
June 2022	1,131	\$152.54	6.64	\$57.04	\$209.58
July 2022	871	\$123.52	6.13	\$52.66	\$176.18
August 2022	869	\$113.98	4.56	\$39.17	\$153.15
September 2022	997	\$144.21	7.49	\$64.34	\$208.55
October 2022	917	\$125.69	5.72	\$49.13	\$174.82
November 2022	997	\$134.27	5.82	\$49.99	\$184.26
December 2022	1,483	\$183.79	5.98	\$51.37	\$235.16

#### 4.2.4 Heating Oil Cost

The Town of Antigonish provided the heating oil delivery records to the site for the period of January 2021 to December 2022. The average cost during this time period was \$1.23/L. Due to the significant increase in oil prices since the billing period, the cost savings calculations have been conducted using a value more representative of the current market price of \$1.79/L<sup>25</sup>.

<sup>25</sup> Source: [Weekly Average Retail Prices for Furnace Oil in 2023 | Natural Resources Canada \(nrcan.gc.ca\)](https://www.nrcan.gc.ca/energy/11320). Retrieved: 2023-04-01.

## 4.2.5 Total Energy Use Summary

Antigonish Fire Hall- Area: 686m <sup>2</sup>	2021	2022
<b>Electricity</b>		
Annual Electricity and Demand Cost (\$)	\$2,293.69	\$2,562.91
Annual Electricity Consumption (kWh)	12,624	14,685
Annual Electricity Consumption (GJ)	45	53
Cost per GJ (\$/GJ)	50.5	48.5
Percentage of Total Energy (%)	9.1%	9.6%
<b>Heating Oil</b>		
Annual Heating Oil Cost (\$)	\$10,903.44	\$19,839.60
Annual Heating Oil Consumption (L)	11,789	12,925
Annual Heating Oil Consumption (GJ)	454.0	497.75
Cost per GJ (\$/GJ)	24.0	39.9
Percentage of Total Energy (%)	90.9%	90.4%
<b>Summary - Total</b>		
Annual Energy Costs (\$)	\$13,197.13	\$22,402.51
Annual Energy Consumption (GJ)	499	551
Cost per GJ (\$/GJ)	26.4	40.7
Percentage of Total Energy (%)	100.00%	100.00%

The baseline energy usage for this study was determined using the January/December 2022 year. This year was selected for the baseline as it was determined that this would more accurately depict each facility's regular operations and energy usage after the COVID-19 pandemic.

## 4.2.6 Benchmarking

The energy use per area or energy use intensity (EUI) for this facility was 0.8 GJ/m<sup>2</sup> in 2022. According to the Energy Star Portfolio Manager for Canada<sup>26</sup>, the average EUI for a fire station is 0.66 GJ/m<sup>2</sup>. Currently, this facility sits approximately 21.2% higher than the average.

## 4.2.7 End-use Breakdown

A building energy model was created in Carrier HAP V6.1 considering the information and data collected from the drawings and the site visit. The energy model was calibrated based

<sup>26</sup> Source:

<https://portfoliomanager.energystar.gov/pdf/reference/Canadian%20National%20Median%20Table.pdf>.

Retrieved: 2023-01-23

on the actual annual energy records for this facility, which allowed us to estimate the energy use breakdown shown in Table 4.2.

This energy use breakdown is an estimation based on information collected during the site visit and from the drawings. This information can only be confirmed with dedicated submetering of the different electrical subpanels and fuel-fired equipment and appliances in the facility. The review of this data allowed us to identify the following:

- ▶ The figure depicts that the majority of the energy consumption of the building, 84.9%, can be attributed to heating.
- ▶ The second largest source of energy usage is hot water heating at approximately 5.4%.
- ▶ The third largest source of energy consumption is lighting at 4.6%.
- ▶ The remaining 5.2% is comprised of mechanical equipment, electrical equipment, air system fans, 2.4%, 1.5%, 1.3%, respectively.

**Table 4.2: Energy Use Breakdown**

End-use	Energy Use Breakdown (%)	Site Energy (GJ)
Space Heating	84.9%	449.0
Lights	4.6%	24.2
Electrical Equipment	1.5%	7.8
Mechanical Equipment	2.4%	12.9
Hot Water	5.4%	28.4
Air System Fans	1.3%	6.8
<b>Total</b>	<b>100%</b>	<b>529.1</b>

## 4.3 Energy and GHG Reduction Pathway

### 4.3.1 Pathway Components

#### 4.3.1.1 Implement an Outdoor Air Temperature Reset on the Existing Oil Fired Boiler

The building is heated by a hydronic heating system that utilizes an oil-fired boiler with an estimated efficiency of 80% with supply water being heated to a constant temperature of 82°C (180°F) regardless of the air temperature outside.

There is potential for energy consumption reduction in the modulation of supply water temperature for the terminal units according to the outdoor temperature. Outdoor reset control uses the heating curve to set the relationship between the outdoor temperature and the supply water temperature. The heating curve defines the amount the supply water temperature is raised for every 1° drop in outdoor air temperature. During mild outdoor temperatures, the supply water temperature will be low, while during the coldest day of the year the supply water temperature will be at design conditions. Outdoor reset reduces

indoor temperature changes by more closely matching the output of the terminal units to the load. It also increases system efficiency by minimizing distribution losses.

Most standard oil-fired boilers, equipped with outdoor air reset systems, have a minimum temperature cutoff of 160°F. This protects against the risk of accelerated corrosion associated with lower water temperatures due to the products of combustion. Usually, fuel switching from fossil fuels to electricity is recommended to reduce carbon emission. However, considering that this facility is classified as an emergency building, it is more practical to keep the fossil fuel boiler. For example, in case of an emergency and power outage, the existing emergency generation would power the lighting system, the boiler ancillary equipment, and other plug loads. Whereas if the fire hall has an electric boiler, the facility will require a larger generator with a larger fuel tank and electrical main panel to be able to provide heating to the building.

#### 4.3.1.2 Install Air Source Heat Pumps in Administrative and Recreational Spaces

The building is heated by a hydronic heating system that utilizes an oil-fired boiler with an estimated efficiency of 80%.

Air source heat pumps are recommended for installation in the following spaces: activity room, fire chief's office, fire apartment and rec room, to mitigate heating oil usage in the building. In heating mode, heat pumps can have an average efficiency of 200-250% (COP 2-2.5) and peak efficiencies of 300-350%. The warmer the outdoor air, the more heat available, the higher the heat pump efficiency. The heat pump will also provide cooling, if required by the space, with an efficiency of at least EER 17. The availability of cooling will improve occupant comfort.

The heat pumps will be the primary sources of heating and cooling in these spaces, with the oil-fired boiler providing supplemental heating. In the case of an emergency, the spaces should be heated via the oil-fired boiler, which is powered by the existing generator and the heat pumps must remain off.

#### 4.3.1.3 Replace Existing Hydronic Fan Forced Heaters

The vehicle garage is equipped with fan forced heaters, but it is suspected that they are no longer operational. Heating to the space would be provided by uninsulated piping running along the ceiling. It is recommended that new hydronic fan forced heaters be installed in the space.

#### 4.3.1.4 Air Compressor Maintenance Program

Compressed air is an expensive form of energy due to its low efficiency. Most compressed air systems typically have efficiencies of less than 25%, meaning less than ¼ of the energy input to a compressor results in useable energy at the terminal device utilizing the compressed air. While some inefficiency is impossible to remove, most compressed air

systems can improve their efficiency through the elimination of distribution system leaks and improper use of compressed air.

Implementation of a compressed air leak detection and repair program is recommended. Detection and repair of leaks in the compressed air system is an ongoing requirement. The system requires regular inspection to detect leaks on a system and ensure that leaks, once discovered, are recorded and that the repair and confirmation of the repair is also recorded.

#### 4.3.1.5 Upgrade Existing Lighting to LEDs

The interior and exterior lighting for the facility is a mixture of LED, fluorescent, and HID lighting fixtures. LEDs can provide the same level of light as other types of fixtures while consuming less energy. Therefore, considering the difference between the consumption levels of the current lamps and LED lamps, the implementation of this recommendation could result in significant energy savings.

Based on the findings from the building condition assessment completed in parallel to the energy study, lighting fixtures in this facility have reached the end of their expected useful life. Therefore, the recommendation is to replace the existing lighting fixtures with LED fixtures.

When calculating the input power of the existing lighting, we prepared estimates of the quantity and type of lamps (bulbs) based on visual observation of the fixtures. Since it is difficult to know what type of ballast is used in each fixture without disassembly, the analysis team considered a minimum factor of 1.1 for fluorescent fixtures and 1.2 for HID.

The implementation of LED lighting will result in reduced maintenance costs over the following years. This is due to LEDs having a longer lifespan than the existing lighting fixtures. It is estimated that a non-LED lighting fixture has a maintenance cost of \$4/yr, while LEDs have an estimated maintenance cost of \$2/yr. This leads to a savings of \$2/yr in maintenance per fixture.

#### 4.3.1.6 Install Occupancy Sensors for Intermittently Used Spaces

With the exception of the truck bay, spaces within the facility are currently controlled by manual ON/OFF switches. To reduce the amount of time the lights are left on (or forgotten ON) with spaces unoccupied, it is recommended that occupancy sensors be installed. Occupancy sensors come in a wide range of configurations and characteristics. They can be installed on walls, ceilings, or at the switch location. Detection can be based on sound, infrared heat, or both. The sensor has a relay that interrupts the voltage to the fixtures in the circuit, thus turning them off when no occupancy is detected. The viability for installation of an occupancy sensor depends on the cost of electricity, the size of the load (number and wattage of lights) being controlled, and the approximate number of unoccupied hours they are often being left turned on.

#### 4.3.1.7 Replace Weatherstripping on All Exterior Doors and Seal Exterior Openings

Some of the windows and doors in this facility exhibit gaps and cracks that will allow for outdoor air infiltration. This causes additional heating loads which impact the energy consumption from the HVAC systems. It is recommended that the envelope of conditioned spaces be inspected and caulking applied around the exterior windows, doors, and other exterior wall openings. Damaged and missing weatherstripping on the doors and windows in the facility should also be replaced.

#### 4.3.1.8 Replace Washroom Exhaust On/Off Switch with Timer Switch

Four exhaust fans, assumed to be 100 cfm each, located in the facility are manually controlled and operate at maximum speed when on. Each cubic metre of air extracted from the building must be replaced by one cubic metre of conditioned air. To reduce the amount of time the exhaust fans are left on (or forgotten ON) with spaces unoccupied, it is recommended that timers be installed.

#### 4.3.1.9 Upgrade Existing Windows to Thermally Insulated Vinyl Windows Minimum R-4

The building has aluminum frame, double pane windows with an estimated R-value of R-1.8 and vinyl frame, double paned windows with an estimated R-value of R-2.1. The aluminum frame windows will have reached the end of their expected lifespan during Phase 1 and are recommended for replacement during this time. The vinyl windows will reach the end of their expected lifespan during Phase 2 and should be replaced at that point. It is anticipated that replacing the windows with high efficiency, double pane, vinyl frame windows will help reduce energy usage for the building. The implementation of this measure will lower conductive losses through the windows, as well as lower infiltration levels.

### 4.3.2 Energy Rates and Emission Intensity Factors

The following list includes the assumptions and variables considered for the technical and financial analysis:

▶ Cost of Electricity:	\$0.1745/kWh
▶ Cost of Heating Oil:	\$1.79/L
▶ Antigonish Electric GHG Emission Intensity Factor 2022:	0.3387 CO <sub>2</sub> e kg/kWh
▶ Antigonish Electric GHG Emission Intensity Factor 2033:	0.1565 CO <sub>2</sub> e kg/kWh
▶ Antigonish Electric GHG Emission Intensity Factor 2043:	0.03 CO <sub>2</sub> e kg/kWh
▶ Heating Oil GHG Emission Intensity Factor 2022:	2.71 CO <sub>2</sub> e kg/L <sup>27</sup>

<sup>27</sup> Source: [Emission Factors for Greenhouse Gas Inventories \(epa.gov\)](https://www.epa.gov/greenhouse-gas-inventories). Retrieved: 2023-04-01

**Table 4.3: Projected Annual Carbon Emissions, No Measures Implemented**

Energy Source	2022 Energy Usage (GJ)	2022 Emissions (tonnes)	2033 Projected Emissions (tonnes)	2043 Projected Emissions
Antigonish Electric	52.9	5.0	2.3	0.44
Heating Oil	497.7	35.0	35.0	35.0
<b>Total</b>	<b>550.6</b>	<b>40.0</b>	<b>37.3</b>	<b>35.5</b>

The baseline energy consumption, January-December 2022, for the Antigonish Fire Hall resulted in a total energy consumption of 550.6 GJ annually and carbon emissions of 40.0 tonnes per year based on 2022 emissions factors. The carbon emission intensity of the electric grid and fossil fuels are projected to decrease during the lifespan of this study. Table 4.3 shows the projected annual emissions without the implementation of any energy conservation measures. Compared to the baseline, emissions are expected to decrease by 6.7% and 11.3% by 2033 and 2043, respectively.

### 4.3.3 Phase 1 Measurement and Analysis

The baseline HAP was modified to estimate the building's performance considering the efficiency measures listed above. These modifications included:

- ▶ Implementation of an outdoor air temperature reset on the existing oil-fired boiler.
- ▶ In the following spaces: activity room, fire apartment, fire chief's office and the rec room heat pumps were modelled, with a COP of 3.3 and a EER of 17. A cooling setpoint of 24°C was assumed.
- ▶ Hydronic heaters located in the garage were replaced with new hydronic fan forced heaters.
- ▶ Lighting wattages for spaces without LEDs were modelled with LED equivalent wattages.
- ▶ The lighting in intermittently occupied spaces was reduced by 12.5% when modelled to represent the savings from occupancy sensors.
- ▶ Infiltration values were decreased by 10% for all spaces to represent weatherstripping and sealing of the exterior surfaces.
- ▶ Aluminum windows were upgraded to an R-value of R-4. In spaces with these windows, infiltration was decreased by an additional 5%.
- ▶ The exhaust fans had originally been estimated to operate one hour per day. The utilization of a timer is estimated to reduce this by 50%.

The following measures were calculated separately:

- ▶ **Air Compressor Maintenance Program:** It is estimated that the 5 hp air compressor runs an average of 4.3 hours per day, with a motor efficiency of 80%. It is estimated that the implementation of this program will result in a 10-15% reduction in energy usage from the air compressor. This estimation was based on repairing five leaks of 0.8 mm in diameter, an inlet pressure of 101.3 kPa, a compressor operating pressure of 700 kPa, a compressor isentropic efficiency of 82%, a compressor motor efficiency of 90%, a

specific heat ratio of 1.4, and applying the calculation method defined by Dumus Kaya et al.<sup>28</sup>

The implementation of these measures at the Antigonish Fire Hall will result in a reduction of energy consumption from the baseline of 132.4 GJ per year. The total cost to implement Phase 1 measures is approximately \$195,060 with a cost savings of an estimated \$6,147 for a payback period of 31.7 years. These measures will have an emissions savings 11.6 tonnes per year in 2033 compared to the baseline building's emissions in the same year as seen in Table 4.4.

**Table 4.4: Antigonish Fire Hall Phase 1 Efficiency Measures**

ECM	CAPEX (\$)	GHG Savings (tonne)	CAPEX/ GHG Reduction (\$/tonne)	Energy Savings GJ/yr	Cost Savings \$/yr	Cost Savings/ GHG Saved (\$/tonne CO <sub>2</sub> e)	Simple Payback (yr)
Upgrade Lighting to LEDs	\$8,210	11.4	\$16,969	128.7	\$5,968	\$522	32.5
Occupancy Sensors for Lighting	\$2,000						
Bathroom Exhaust Timers	\$800						
Install New Fan Forced in the Garage	\$40,000						
Implement OAT Reset on Boiler	\$2,500						
Install Air Source Heat Pumps in: Activity Room, Fire Chiefs Office, Fire Apartment and Rec Room	\$40,000						
Electrical Service Upgrade	\$80,000						

<sup>28</sup> Energy Conservation in Compressed-Air System. Durmus Kaya, Patrick Phelan, David Chaun, and H. Ibrahim sarac. Industrial Assessment Center, Arizona State University, Tempe, AZ 85287-6160, USA. TUBUTAK-MRC, Energy System and Environmental Research Institute, P.O. Box 21, 41470 Gebze-Kocaeli, Turkey. *International Journal of Energy Research. Int. J. Energy. 2002; 26:837-849 (DOI: 10.1002/er.823).*

ECM	CAPEX (\$)	GHG Savings (tonne)	CAPEX/ GHG Reduction (\$/tonne)	Energy Savings GJ/yr	Cost Savings \$/yr	Cost Savings/ GHG Saved (\$/tonne CO <sub>2</sub> e)	Simple Payback (yr)
Replace Aluminum Windows with Minimum R-4	\$21,500						
Infiltration Reduction	\$1,550						
Air Compressor Maintenance Program	\$1,000	0.16	\$6,098	3.70	\$179	\$1,094	5.6
<b>ECM Implementation Total</b>	<b>\$195,060</b>	<b>11.6</b>	<b>\$16,820</b>	<b>132.4</b>	<b>\$6,147</b>	<b>\$530.1</b>	<b>31.7</b>

#### 4.3.4 Phase 2 Measurement and Analysis

The Phase 1 HAP model was modified to estimate the building's performance considering the efficiency measures listed above. These modifications included:

- ▶ Vinyl windows were upgraded to an R-value of R-4. In spaces with these windows, infiltration was decreased by an additional 5% compared to baseline levels.

The implementation of this measures at the Antigonish Fire Hall will result in a reduction of energy consumption from the baseline of 2.1 GJ per year. The total cost to implement Phase 2 measures is approximately \$34,500 with a cost savings of an estimated \$489 for a payback period of 336.8 years. The simple payback calculation assumes that a zero-cost alternative is available which is untrue since this measure is scheduled to only occur when the vinyl windows would be at the end of life and must be replaced. These measures will have an emissions savings of 0.04 tonnes per year in 2043 compared to the baseline building's emissions in the same year as seen in Table 4.4.

**Table 4.5 Antigonish Fire Hall Phase 2 Efficiency Measures**

ECM	CAPEX (\$)	GHG Savings (tonne)	CAPEX/ GHG Reduction (\$/tonne)	Energy Savings GJ/yr	Cost Savings \$/yr	Cost Savings/ GHG Saved (\$/tonne CO <sub>2</sub> e)	Simple Payback (yr)
Existing Vinyl Windows with Vinyl R-4	\$34,500	0.04	\$936,980	2.1	\$102	\$2,782	336.8
<b>ECM Implementation Total</b>	<b>\$34,500</b>	<b>0.04</b>	<b>\$936,980</b>	<b>2.1</b>	<b>\$102</b>	<b>\$2,782</b>	<b>336.8</b>

### 4.3.5 Measures Considered but Not Recommended

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The following measures were considered for this building but are ultimately not currently recommended for implementation:

- ▶ **Upgrade Exterior Insulation of Heated Spaces:** The building currently has minimal exterior insulation. This allows for heat loss from the conditioned spaces to the immediate surroundings. The upgrade of the exterior wall and roof insulation levels would lower conductive losses through the building envelope, as well as lower infiltration levels. This measure is ultimately not being recommended because the cost of the measure would result in a long payback period with minimal additional GHG reductions.

# 5 Antigonish Town and County Library

## 5.1 Facility Description

The facility was originally built in the 1940s. In 2011, the building underwent extensive renovations to be able to house the Antigonish Public Library, which included a new addition of approximately 1,400 ft<sup>2</sup> on the east facing side of the building. Renovations included a new a 3.69 kWDC PV array on the roof and vacuum tube solar water heaters to preheat service water.

The building is open seven days a week, from 1:00 p.m. to

4:00 p.m. on Sundays, 9:00 a.m. to 5:00 p.m. on Mondays, Fridays, and Saturdays, and 9:00 a.m. to 9:00 p.m. on Tuesdays, Wednesdays, and Thursdays. Figure 5.1 presents a photograph of the site.



**Figure 5.1: Antigonish Town and County Library**

The building is equipped with a forced air system that provides ventilation, heating (hydronic), and cooling (DX). Supply air is a mixture of recirculated and fresh air provided by two HRVs. Heating and cooling of supply air is provided by water-to-air heat pumps and in floor radiant heating to the new addition is provided by a water-to-water heat pump. The heat pumps are part of a vertical closed geothermal loop system. An electric boiler is utilized as a supplementary heat source for the hydronic loop.

Interior and exterior lighting is provided by a mixture of fluorescent and LED lighting. Electricity is the only source of energy on site. Electricity powers the space heating, cooling, lighting, refrigeration, and kitchen appliances, as well as any other ancillary equipment.

The building and major existing equipment characteristics include:

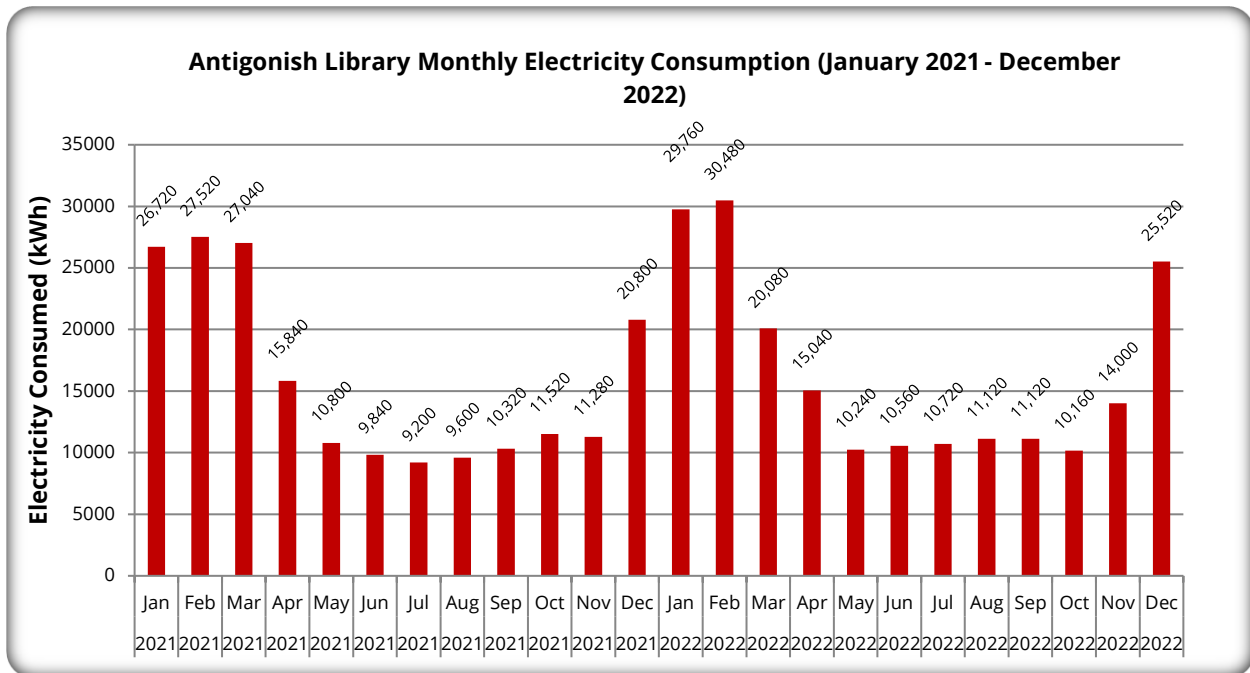
- ▶ The exterior walls appear to be in good condition. The estimated R-value for the building is R-20.
- ▶ The building roof appears to be in good condition. The estimated R-value is R-30.
- ▶ Aluminum frame windows appear in good condition. The estimated R value is R-3.
- ▶ The floor is slab-on-grade. The estimated R-value is R-1.5.
- ▶ Exterior doors appear in good condition. R-values are estimated to be approximately R-3.
- ▶ Weatherstripping around the man-doors appears to be in good condition.
- ▶ The interior lighting is a combination of LED and fluorescent with manual ON/OFF switches.
- ▶ The exterior lighting is provided by a combination of LED and fluorescent lighting.
- ▶ Continuous ventilation is provided to the building with supply air being a mixture fresh and return air. Hydronic heating coils are supplied by water-to-air heat pumps (15) providing hot water up to 49°C (120°F) with an estimated COP of 3.6. DX cooling is also provided by the water-to-air heat pumps with an estimated EER of 17.
- ▶ In floor radiant heating is provided by a water-to-water heat pump which provides hot water up to 49°C (120°F) with an estimated COP of 2.85.
- ▶ Two Heat Recovery Ventilators (HRVs) serve the facility with an estimated flow rate of 1200 cfm each and an estimated efficiency of 65%. They have variable speed fans, operate continuously, and are controlled based on relative humidity.
- ▶ The building loop and ground loop sides of the heat exchanger operate using variable frequency drive (VFD) pumps. The zone valves for each heat pump were manually set to open and currently do not actuate.
- ▶ Two electric boilers act as a supplemental heating source for the hydronic heating loops with an estimated efficiency of approximately 90-99%.
- ▶ The temperature setpoint is assumed to be 21°C in the winter and be 23°C in the summer. All spaces have programmable thermostats; no nighttime setback has been implemented.
- ▶ Domestic hot water is provided by a 75-gallon electric water heater that serves the building washrooms, kitchens, and café. Service water is preheated by using vacuum tube solar water heaters.
- ▶ Cooking appliances are electric.

## 5.2 Review of Historic Energy Performance

Electricity bills were provided for the 24-month period between January 2021-2022. Energy consumption and demand were reviewed in annual terms to ensure that variation in seasonality was observable. With at least two periods available, a month-to-month comparison of the facility's energy performance was completed from one year to the next. Review of electricity consumption profiles, based on the information obtained from the two periods, was discussed, and is compared in this section.

## 5.2.1 Electricity Use Profiles

Figure 5.2 provides the monthly electricity usage profile which shows the 24-month period from January 2021 to December 2022.



**Figure 5.2: 2021/2022 Monthly Electricity Consumption from Antigonish Electric Grid**

Figure 5.2 depicts a trend with a lower electricity consumption during the summer. Electricity is used for heating in the facility, so, as expected, the consumption is higher during the winter than it is in the summer months.

Total electricity purchased from the Antigonish Electric Utility in the period of January/December 2021 was 190,480 kWh and 198,800 kWh from January/December 2022. The average annual energy consumption considering these two 12-month periods was 194,460 kWh. It is assumed that the electricity produced by the PV array was not included in the electricity bills and this would include an additional estimated 3,690 kWh per year.

## 5.2.2 Electricity Cost

Electricity is provided by the Antigonish Electric Utility as a “General Services above 3 kilowatts connected load” electricity rate<sup>29</sup>.

<sup>29</sup> Source: [file.html\(townofantigonish.ca\)](file.html(townofantigonish.ca)). Retrieved: 2023-11-20

**Above 3 kilowatts connected load:**

<u>Base Rate:</u>	\$8.75 per month per kilowatt of maximum demand.
<u>Energy Rates:</u>	\$0.15945 per kilowatt hour for the first 100 kilowatt hours per month per kilowatt of maximum demand.
	\$0.09993 per kilowatt hour for all additional consumption.
<u>Base Rate:</u>	\$8.75 per kilowatt of maximum demand.
<u>Minimum Bill:</u>	The greater of the Base Rate or \$10.53.
<u>Efficiency Nova Scotia Charges</u>	\$0.00 per kilowatt hour for all consumption.

**Figure 5.3: Antigonish Electric Utility Tariff Rate**

Table 5.1 presents the monthly power bill cost breakdown for the January 2021 to December 2022, 24-month period for the Antigonish Arena.

**Table 5.1: Monthly Power Bill Cost Breakdown for the January 2021 to December 2022**

Month-Year	Consumption (kWh)	Consumption Cost	Demand (kW)	Demand Cost	Invoice Amount
January 2021	26,720	\$3,162.00	82.64	\$709.88	\$200.43
February 2021	27,520	\$3,210.04	77.28	\$663.84	\$261.11
March 2021	27,040	\$3,173.50	79.20	\$680.33	\$230.11
April 2021	15,840	\$2,002.38	70.48	\$605.42	\$207.88
May 2021	10,800	\$1,458.74	63.76	\$547.70	\$136.36
June 2021	9,840	\$1,119.49	22.88	\$196.54	\$161.95
July 2021	9,200	\$1,076.49	26.40	\$226.78	\$180.78
August 2021	9,600	\$1,141.22	30.56	\$262.51	\$147.20
September 2021	10,320	\$1,169.36	23.20	\$199.29	\$191.06
October 2021	11,520	\$1,306.43	26.08	\$224.03	\$200.44
November 2021	11,280	\$1,541.00	69.52	\$597.18	\$188.11
December 2021	20,800	\$2,612.32	89.68	\$770.35	\$188.26
January 2022	29,760	\$3,446.27	79.36	\$681.70	\$244.45
February 2022	30,480	\$3,520.12	79.68	\$684.45	\$245.02
March 2022	20,080	\$2,477.99	79.20	\$680.33	\$273.53
April 2022	15,040	\$1,929.59	71.68	\$615.73	\$205.51
May 2022	10,240	\$1,176.13	25.68	\$220.59	\$252.70
June 2022	10,560	\$1,236.67	30.48	\$261.82	\$209.58
July 2022	10,720	\$1,254.09	30.72	\$263.88	\$3,871.88
August 2022	11,120	\$1,301.69	32.00	\$274.88	\$3,873.88
September 2022	11,120	\$1,287.40	29.60	\$254.26	\$3,853.83
October 2022	10,160	\$1,198.13	30.72	\$263.88	\$2,607.80
November 2022	14,000	\$1,851.85	76.08	\$653.53	\$2,006.44
December 2022	25,520	\$2,988.28	73.60	\$632.22	\$1,316.03

## 5.2.3 Total Energy Use Summary

Antigonish Town and County Library – Area: 1858 m <sup>2</sup>	2021	2022
<b>Electricity</b>		
Annual Electricity and Demand Cost (\$)	\$28,656.82	\$29,155.48
Annual Electricity Consumption (kWh)	194,170	202,490
Annual Electricity Consumption (GJ)	699	729
Cost per GJ (\$/GJ)	41.0	40.0
Percentage of Total Energy (%)	100.0%	100.0%

The baseline energy usage for this study was determined using the January/December 2022 year. This year was selected for the baseline as it was determined that this would more accurately depict each facility's regular operations and energy usage after the COVID-19 pandemic.

## 5.2.4 Benchmarking

The energy use per area or energy use intensity (EUI) for this facility is 0.39GJ/m<sup>2</sup>. According to the Energy Star Portfolio Manager for Canada<sup>30</sup>, the average EUI for a library is 1.03 GJ/m<sup>2</sup>. Currently, this facility sits approximately 62.1% lower than the average.

## 5.2.5 End-use Breakdown

A building energy model was created in HAPv6.1 considering the information and data collected from the drawings and the site visit. The energy model allowed us to estimate the energy use breakdown, shown in Table 5.2, by applying the energy use breakdown modelled to the annual energy use of the building. This energy use breakdown is an estimation based on the information collected during the site visit and from the drawings. This information can only be confirmed with dedicated submetering of the different electrical subpanels and appliances in the facility. The review of this data allowed us to identify the following:

- ▶ The figure depicts that the majority of the energy consumption of the building, 38.5%, can be attributed to heating.
- ▶ The second largest source of energy usage is building lighting at approximately 26.4%.
- ▶ The third largest source of energy consumption is the mechanical equipment at 9.4%.
- ▶ The remaining 25.5% is comprised of electrical equipment, space cooling, and air system fans at 6.1%, 7.3%, and 12.1%, respectively.

<sup>30</sup> Source:

<https://portfoliomanager.energystar.gov/pdf/reference/Canadian%20National%20Median%20Table.pdf>.

Retrieved: 2023-01-23

**Table 5.2: Energy Use Breakdown**

End-use	Energy Use Breakdown (%)	Site Energy (GJ)
Air System Fans	12.1	88.2
Space Cooling	6.1	44.5
Space Heating	38.5	280.7
Mechanical Equipment	9.4	68.5
Lights	26.5	193.2
Electric Equipment	7.3	53.2
<b>Total</b>	<b>100.0</b>	<b>728.2</b>

## 5.3 Energy and GHG Reduction Pathway

### 5.3.1 Pathway Components

#### 5.3.1.1 Reactivate and Access Existing Building Automation System (BAS)

The facility currently has an existing building automation system (BAS) that allows for the building wide control and observation of the HVAC systems. The staff currently do not have access to the existing BAS. It is recommended that the control system be recommissioned and staff both receive access and training to operate the system.

#### 5.3.1.2 Reconnect Electronic Control Valves for Each Heat Pump

The pumps that are part of the hydronic heating system have VFD controls. VFDs slow the speed of a pump as required to meet the load, and every single speed reduction below nominal results in energy savings. The ground-source heat pumps located on site have electronic valves that are currently manually set to operate in the open position. The pumps are not connected to a control system; therefore, they cannot be modulated based on heating/cooling requirements. Currently, even when the demand for heat is low, the valves remain open, and the pumps need to operate at higher speeds. By reconnecting the controls to these valves, it will allow them to actuate between open and closed as designed and allow the VFDs to reduce speeds as they will not have to maintain as high a pressure. Pump affinity laws state that the pumping energy is directly related to pump speed. Savings can be determined by applying a factor that is equivalent to the ratio of the pump speeds cubed.

#### 5.3.1.3 Implement a Nighttime Setback

The facility currently has programmable thermostats. These thermostats have the capability to control temperature setpoints for occupied or unoccupied periods and will adjust the temperature accordingly. These thermostats are programmed to reduce or increase the setpoint temperature during unoccupied periods depending upon whether they are controlling heating or cooling equipment. Currently, no heating or cooling setbacks have been programmed. Generally, the setpoint can be decreased by 3°F to 5°F for at least eight (8) hours a day (in heating mode), which can lead to significant savings.

## 5.3.2 Energy Rates and Emission Intensity Factors

The following list includes all the assumptions and variables considered for the technical and financial analysis:

▶ Cost of Electricity:	\$0.1467/kWh
▶ Annual Maintenance Cost of BAS Controls Contract:	\$1,701/year
▶ Antigonish Electric GHG Emission Intensity Factor 2022:	0.3387 CO <sub>2</sub> e kg/kWh
▶ Antigonish Electric GHG Emission Intensity Factor 2033:	0.1565 CO <sub>2</sub> e kg/kWh
▶ Antigonish Electric GHG Emission Intensity Factor 2043:	0.03 CO <sub>2</sub> e kg/kWh
▶ PV Electricity GHG Emission Intensity <sup>31</sup> :	0.046 CO <sub>2</sub> e kg/kWh

**Table 5.3: Projected Annual Carbon Emissions, No Measures Implemented**

Energy Source	2022 Energy Usage (GJ)	2022 Emissions (tonnes)	2033 Projected Emissions (tonnes)	2043 Projected Emissions
Antigonish Electric	715.7	67.3	31.1	6.0
PV System	13.3	0.17	0.17	0.17
<b>Total</b>	<b>729.0</b>	<b>67.5</b>	<b>31.3</b>	<b>6.1</b>

The baseline energy consumption, January-December 2022, for the Antigonish Town and County Library resulted in a total energy consumption of 729.0 GJ annually and carbon emissions of 67.5 tonnes per year based on 2022 emissions factors. The carbon emission intensity of the electric grid and fossil fuels are projected to decrease during the lifespan of this study. Table 5.3 shows the projected annual emission without the implementation of any energy conservation measures. Compared to the baseline, emissions are expected to decrease by 53.7% and 90.9% by 2033 and 2043, respectively.

## 5.3.3 Phase 1 Measurement and Analysis

A HAP model was created based on the existing equipment in the building and was modified to be able to estimate the building's performance considering the efficiency measures listed above. The percentage savings found was applied to the existing buildings energy consumption.

- ▶ **Reconnect Existing Control Valve and Implement a Nighttime Setback:** During the site visit in May, it was observed that the VFDs were operating at 50% of a full load. The HAP model estimated that the building was using 33% more energy for pumping than necessary compared to the current pumping energy use. The pumping energy for the HAP model was then increased by this percentage to create a baseline that more accurately estimated the current operation of the building. Another model was then created to determine the savings from the implementation of this measure. It includes an unoccupied setpoint for heating and cooling and no increase in pumping energy.

<sup>31</sup> Source: [Life Cycle Greenhouse Gas Emissions from Solar Photovoltaics \(Fact Sheet\), NREL \(National Renewable Energy Laboratory\)](#). Retrieved 2023-11-20

The heating setpoint during this period was decreased by 5°F from the baseline; for cooling the temperature setpoint was increased by 1.8°F. The unoccupied cooling setpoint should be determined by considering the temperature and humidity required to preserve the books and other documents in the building.

The following measures were calculated separately:

- **Reactivate and Access the Existing BAS Controls:** BAS allows for a better control of the building equipment. The data gathered by the BAS system can also be used to identify malfunctions from equipment and unwanted changes of the sequence of operation. Therefore, if unusual energy consumption is observed, action can be taken to solve the issue. Usually, when data from the BAS is used to keep track of the energy consumption, it results in an energy savings between 3% to 8%. Therefore, an additional savings of 5% in electricity consumption was estimated for the BAS controls savings applied.

The implementation of these measures to the Antigonish Town and County Library will result in a reduction of energy consumption from the baseline of 185.7 GJ. The total cost to implement Phase 1 measures is approximately \$8,000 with a cost savings of an estimated \$5,867 for a payback period of 1.4 years. These measures will have an emissions savings of 8.1 tonnes per year in 2033 compared to the baseline building's emissions in the same year as seen in Table 5.4.

**Table 5.4: Antigonish Town and Country Library Phase 1 Efficiency Measures**

ECM	CAPEX (\$)	GHG Savings (tonne)	CAPEX/ GHG Reduction (\$/tonne)	Energy Savings GJ/yr	Cost Savings \$/yr	Cost Savings/ GHG Saved (\$/tonne CO <sub>2</sub> e)	Simple Payback (yr)
Implement Nighttime Setback	\$8,000	8.1	\$991	185.7	\$5,867	\$727	1.4
Re-connect Electronic Controlled Valves to Each Heat Pump							
Reactivate Existing BAS							
<b>ECM Implementation Total</b>	<b>\$8,000</b>	<b>8.1</b>	<b>\$991</b>	<b>185.7</b>	<b>\$5,867</b>	<b>\$727</b>	<b>1.4</b>

### 5.3.4 Phase 2 Measurement and Analysis

No additional measures were considered for implementation in this facility in Phase 2.

# 6 Antigonish Public Works/Electric Utility

## 6.1 Facility Description

The Antigonish Public Works/Electric Utility building was built in 1976. Since the initial construction of the building an electrical utility garage has been added to the building.



**Figure 6.1: Antigonish Public Works/Electric Utility**

Additionally, within the last five years a partition was installed to separate the Public Works office from the Public Works garage. The Public Works and electric utility sections of the building are both open eight and a half (8.5) hours per day, Monday to Friday from 8:00 a.m. to 4:30 p.m. Figure 6.1 presents a photograph of the site.

The building is equipped with a forced air heating system and an oil-fired furnace on the electric utility side. The Public Works portion of the building utilizes electric radiant baseboards in administrative spaces, and an oil-fired furnace venting directly into the garage space. No cooling is provided to either side of the building. Interior and exterior lighting is provided by a mixture of fluorescent, incandescent, LED, and HID lighting. Electricity and heating oil are the two sources of energy consumed on site. Electricity powers the space heating, service hot water, lighting, refrigeration, kitchen appliances, and a 6.5 hp air compressor, as well as other ancillary equipment. Heating oil is consumed in two furnaces on site to heat the electric utility administrative areas and both garages. Mechanical ventilation is provided by two HRVs to the Public Works' administrative area.

The building and major existing equipment characteristics include:

- ▶ The exterior walls appear to be in poor condition. The estimated R-value for the building is R-14 for the original building and R-20 for the new addition.

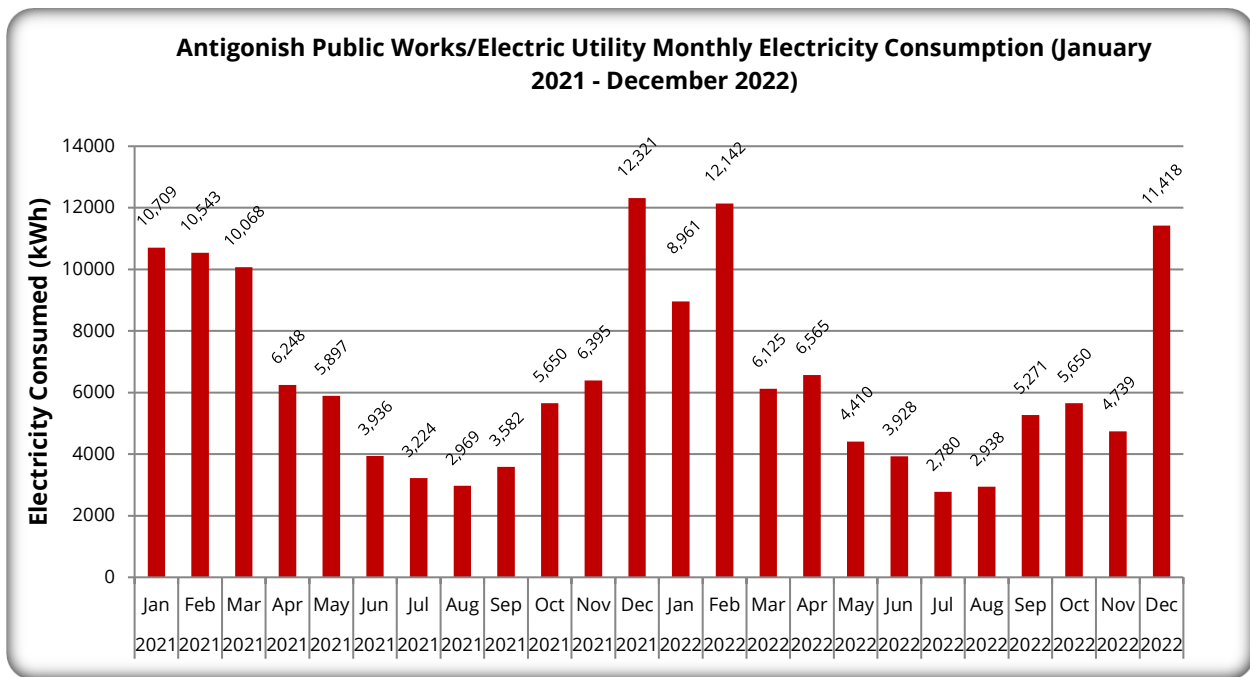
- ▶ The building roof appears to be in good condition. The estimated R-value on the new addition is estimated to be R-20. The estimated R-value for the original building is estimated to be R-12.
- ▶ The facility has wood frame and aluminum frame, double paned windows in fair condition. The estimated R value is R-1.8 for both. Vinyl frame, double paned windows in the remainder of the building are in good condition. The estimated R value is R-2.1.
- ▶ The floor is slab-on-grade. The estimated R-value is R-1.8.
- ▶ The exterior doors appear in good condition. R-values are estimated to be approximately R-3 for the man-doors and R-10 for the overhead doors.
- ▶ Weatherstripping around the man-doors and overhead doors appears to be in poor condition with some areas showing daylight through the gaps in the weatherstripping.
- ▶ The interior lighting is a combination of fluorescent, incandescent, and LED lighting with manual ON/OFF switches.
- ▶ The exterior lighting is provided by a combination of LED and HID lighting.
- ▶ Two oil-fired furnaces provide hot air. The forced air heating system has an estimated efficiency of approximately 80-90% to the electric utility's administrative spaces and all garage spaces.
- ▶ Domestic hot water is provided by three electric hot water heaters, all 47 US gallons, that serve the building washrooms, laundry, and kitchens.
- ▶ The temperature setpoint is 18°C year-round for the administrative spaces with no nighttime setback, except for the electric utility kitchen which is at 21°C. All the thermostats in this space are programmable.
- ▶ The temperature setpoint is 15°C in the winter for the garage spaces, with no nighttime setback. The thermostat for this space is manual.
- ▶ Cooking appliances are electric.
- ▶ Two Heat Recovery Ventilators (HRVs) serve the Public Work's administrative areas with an estimated efficiency of 65%. They have a variable speed fan, operate continuously, and are controlled based on relative humidity.

## 6.2 Review of Historic Energy Performance

Electricity bills were provided for the 24-month period between January 2021-2022. Energy consumption and demand were reviewed in annual terms to ensure that variation in seasonality was observable. With at least two periods available, a month-to-month comparison of the facility's energy performance was completed from one year to the next. Review of electricity consumption profiles, based on the information obtained from the two periods, was discussed, and is compared in this section.

### 6.2.1 Electricity Use Profiles

Figure 6.2 provides the monthly electricity usage profile which shows the 24-month period from January 2021 to December 2022. No electricity usage was provided for October 2022, so it was assumed to be the same as the previous year.



**Figure 6.2: 2021/2022 Monthly Electricity Consumption**

Figure 6.2 depicts a trend with a lower electricity consumption during the summer, than in the winter. Electricity is for space heating in the Public Works’ offices so this is to be expected.

Total electricity usage in the period of January/December 2021 was 81,542 kWh and 74,927 kWh from January/December 2022. The average annual energy consumption considering these two 12-month periods was 78,235 kWh.

### 6.2.2 Heating Oil Consumption

The Town of Antigonish provided the heating oil delivery records to the site for the period of January 2021 to December 2022. Total heating oil usage for the period of January/December 2021 was 18,435 L and 17,777 L from January/December 2022. The average annual fuel consumption for this period was 18,106 L. Heating oil is consumed by a boiler to provide space and service water heating to the building. The figures are based on delivered quantities each month and do not necessarily reflect the quantities consumed each month.

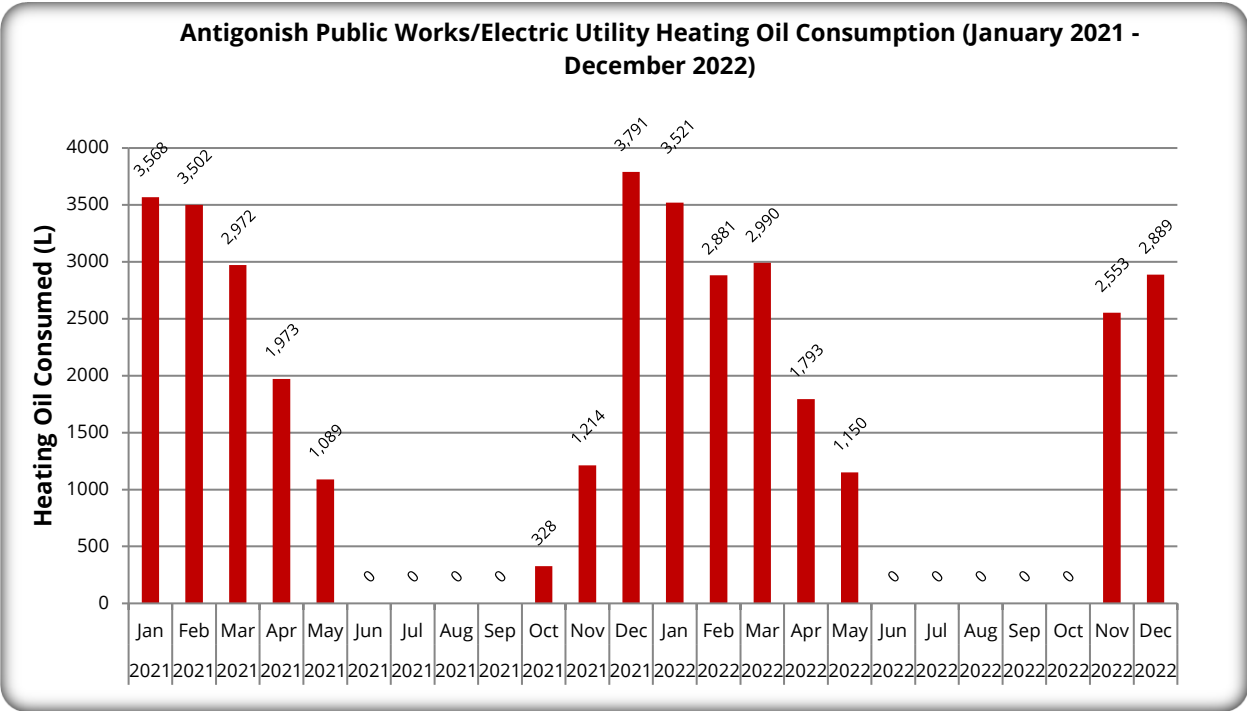


Figure 6.3: Monthly Heating Oil Consumption in L

### 6.2.3 Electricity Cost

Electricity is provided by the Antigonish Electric Utility as a “General Services above 3 kilowatts connected load” electricity rate<sup>32</sup>.

<b>Above 3 kilowatts connected load:</b>	
<u>Base Rate:</u>	\$8.75 per month per kilowatt of maximum demand.
<u>Energy Rates:</u>	\$0.15945 per kilowatt hour for the first 100 kilowatt hours per month per kilowatt of maximum demand.
	\$0.09993 per kilowatt hour for all additional consumption.
<u>Base Rate:</u>	\$8.75 per kilowatt of maximum demand.
<u>Minimum Bill:</u>	The greater of the Base Rate or \$10.53.
<u>Efficiency Nova Scotia Charges</u>	\$0.00 per kilowatt hour for all consumption.

Figure 6.4: Antigonish Electric Utility Tariff Rate

<sup>32</sup> Source [file.html \(townofantigonish.ca\)](file.html (townofantigonish.ca)). Retrieved: 2023-11-20

Table 6.1 presents the monthly power bill cost breakdown for the January 2021 to December 2022, 24-month period for the Antigonish Pubic Works and Electric Utility.

**Table 6.1: Monthly Power Bill Cost Breakdown for the January 2021 to December 2022**

Month-Year	Consumption (kWh)	Consumption Cost	Demand (kW)	Demand Cost	Invoice Amount
January 2021	10,709	\$1,216.92	24.66	\$211.83	1,429
February 2021	10,543	\$1,216.76	27.42	\$235.54	1,452
March 2021	10,068	\$1,154.18	24.88	\$213.72	1,368
April 2021	6,248	\$735.90	18.74	\$160.98	897
May 2021	5,897	\$704.93	19.43	\$166.90	872
June 2021	3,936	\$502.84	18.40	\$158.06	661
July 2021	3,224	\$400.21	13.11	\$112.61	513
August 2021	2,969	\$378.06	13.67	\$117.43	495
September 2021	3,582	\$431.82	12.41	\$106.60	538
October 2021	5,650	\$680.25	19.43	\$166.90	847
November 2021	6,395	\$762.32	20.71	\$177.90	940
December 2021	12,321	\$1,395.57	27.61	\$237.17	1,633
January 2022	8,961	\$1,062.67	28.09	\$241.29	1,304
February 2022	12,142	\$1,372.45	26.73	\$229.61	1,602
March 2022	6,125	\$744.15	22.19	\$190.61	935
April 2022	6,565	\$788.12	22.19	\$190.61	979
May 2022	4,410	\$548.96	18.19	\$156.25	705
June 2022	3,928	\$503.59	18.66	\$160.29	664
July 2022	2,780	\$359.58	13.74	\$118.03	478
August 2022	2,938	\$374.78	13.64	\$117.17	492
September 2022	5,271	\$641.79	19.33	\$166.04	808
October 2022	5,650	\$680.25	19.43	\$166.90	847
November 2022	4,739	\$593.74	23.08	\$173.43	767
December 2022	11,418	\$1,278.37	-	\$198.26	1,477

## 6.2.4 Heating Oil Cost

The Town of Antigonish provided the heating oil delivery records to the site for the period of January 2021 to December 2022. The average cost during this time period was \$1.22/L. Due to the significant increase in oil prices since the billing period, the cost savings calculations have been conducted using a value more representative to current market prices of \$1.79/L<sup>33</sup>.

<sup>33</sup> Source: [Weekly Average Retail Prices for Furnace Oil in 2023 | Natural Resources Canada \(nrcan.gc.ca\)](https://www.nrcan.gc.ca/energy/11320). Retrieved: 2023-04-01.

## 6.2.5 Total Energy Use Summary

Antigonish Public Works/Electric Utility- Area: 689 m <sup>2</sup>	2021	2022
<b>Electricity</b>		
Annual Electricity and Demand Cost (\$)	\$11,645.40	\$11,056.94
Annual Electricity Consumption (kWh)	81,542	74,927
Annual Electricity Consumption (GJ)	294	270
Cost per GJ (\$/GJ)	39.7	41.0
Percentage of Total Energy (%)	29.3%	28.3%
<b>Heating Oil</b>		
Annual Heating Oil Cost (\$)	\$16,833.15	\$27,253.20
Annual Heating Oil Consumption (L)	18,435	17,777
Annual Heating Oil Consumption (GJ)	709.9	684.6
Cost per GJ (\$/GJ)	23.7	39.8
Percentage of Total Energy (%)	70.7%	71.7%
<b>Summary - Total</b>		
Annual Energy Costs (\$)	\$28,478.55	\$38,310.14
Annual Energy Consumption (GJ)	1,003	954
Cost per GJ (\$/GJ)	28.4	40.1
Percentage of Total Energy (%)	100.00%	100.00%

The baseline energy usage for this study was determined using the January/December 2022 year. This year was selected for the baseline as it was determined that this would more accurately depict each facility's regular operations and energy usage after the COVID-19 pandemic.

## 6.2.6 Benchmarking

The energy use per area or energy use intensity (EUI) for this facility was 1.38 GJ/m<sup>2</sup> in 2022. According to the Energy Star Portfolio Manager for Canada<sup>34</sup>, the average EUI for a 'Public Services - Other' is 0.86 GJ/m<sup>2</sup>. Currently, this facility sits approximately 60.5% higher than the average.

## 6.2.7 End-use Breakdown

A building energy model was created in Carrier HAP V6.1 considering the information and data collected from the drawings and the site visit. The energy model was calibrated based on the actual annual energy records for this facility, which allowed us to estimate the

<sup>34</sup> Source:

<https://portfoliomanager.energystar.gov/pdf/reference/Canadian%20National%20Median%20Table.pdf>.

Retrieved: 2023-01-23

energy use breakdown shown in Table 6.2. This energy use breakdown is an estimation based on information collected during the site visit and from the drawings. This information can only be confirmed with dedicated submetering of the different electrical subpanels and fuel-fired equipment and appliances in the facility. The review of this data allowed us to identify the following:

- ▶ The figure depicts that the majority of the energy consumption of the building, 78.1%, can be attributed to heating.
- ▶ The second largest source of energy usage is the electrical equipment at approximately 9.6%.
- ▶ The third largest source of energy consumption is the lighting at 5.8%.
- ▶ The remaining 6.5 % is comprised of air systems fans and domestic hot water.

**Table 6.2: Energy Use Breakdown**

End-use	Energy Use Breakdown (%)	Site Energy (GJ)
Space Heating	78.1%	736.0
Lights	5.8%	54.6
Electrical Equipment	9.6%	90.3
Air System Fans	5.4%	50.6
Hot Water	1.1%	10.5
<b>Total</b>	<b>100%</b>	<b>942.0</b>

## 6.3 Energy and GHG Reduction Pathway

### 6.3.1 Pathway Components

#### 6.3.1.1 Upgrade Existing Windows to Thermally Insulated Vinyl Windows Minimum R-4

The building has a combination of wood frame, aluminum frame, and vinyl frame, double pane windows with estimated R-values of R-1.8, R-1.8, and R-2.1, respectively. All wood and aluminum windows have exceeded their expected lifespans and the vinyl windows are expected to be at the end of their life before 2043. It is anticipated that replacing the windows with high efficiency double pane, vinyl frame windows with a minimum R-value of R-4 will help reduce energy usage for the building. The implementation of this measure will lower conductive losses through the windows, as well as lower infiltration levels. It is recommended that this measure be implemented as the windows reach the end of their life. It is recommended that the wood and aluminum frame windows be replaced during Phase 1 and vinyl windows be replaced during Phase 2.

### 6.3.1.2 Replace Weatherstripping on All Exterior Doors and Seal Exterior Openings

Some of the windows and doors in this facility exhibit gaps and cracks that will allow for outdoor air infiltration. This causes additional heating loads which impact the energy consumption from the HVAC systems. It is recommended that the envelope of conditioned spaces be inspected, and caulking applied around the exterior windows, doors, and other exterior wall openings. Damaged and missing weatherstripping on the doors and windows in the facility should also be replaced.

### 6.3.1.3 Upgrade Existing Lighting to LEDs

The interior and exterior lighting for the facility is a mixture of LED, fluorescent, incandescent, and HID. LEDs can provide the same level of light as other types of fixtures while consuming less energy. Therefore, considering the difference between the consumption levels of the current lamps and LED lamps, the implementation of this recommendation could result in significant energy savings.

Based on the findings from the building condition assessment completed in parallel to the energy study, the lighting fixtures in this facility have reached their expected useful life. Therefore, the recommendation is to replace the existing lighting fixtures with LED fixtures.

When calculating the input power of the existing lighting, we prepared estimates of the quantity and type of lamps (bulbs) based on visual observation of the fixtures. Since it is difficult to know what type of ballast is used in each fixture without disassembly, the analysis team considered a minimum factor of 1.1 for fluorescent fixtures and 1.2 for HID.

The implementation of LED lighting will result in reduced maintenance costs over the following years. This is due to LEDs having a longer lifespan than the existing lighting fixtures. It is estimated that a non-LED lighting fixture has a maintenance cost of \$4/yr, while LEDs have an estimated maintenance cost of \$2/yr. This leads to a savings of \$2/yr in maintenance per fixture.

### 6.3.1.4 Install Occupancy Sensors for Intermittently Used Spaces

With the exception on the truck bay, spaces within the facility are currently controlled by manual ON/OFF switches. To reduce the amount of time the lights are left on (or forgotten ON) with spaces unoccupied, it is recommended that occupancy sensors be installed. Occupancy sensors come in a wide range of configurations and characteristics. They can be installed on walls, ceilings, or at the switch locations. Detection can be based on sound, infrared heat, or both. The sensor has a relay that interrupts the voltage to the fixtures in the circuit, thus turning them off when no occupancy is detected. The viability for installation of an occupancy sensor depends on the cost of electricity, the size of the load (number and wattage of lights) being controlled, and the approximate number of unoccupied hours they are often being left turned on.

### 6.3.1.5 Replace Existing Oil Fired Furnaces with Baseboard Electric Heating and Heat Pumps in Administrative Spaces and Electric Radiant Heaters in Garage Spaces

Currently, electric radiant heaters provide heating to the Public Works office space within the building with an efficiency of 99%. An oil-fired furnace with an efficiency of approximately 80%, provides heating to the Electric Utility administrative areas and both garages. Electric radiant heaters can provide heat with an efficiency of 99% and are recommended for the garage spaces, with controls that will turn off the heaters if the bay doors are open for a period exceeding five (5) minutes.

Heat pumps are recommended for the administrative areas. In heating mode, heat pumps can have an average efficiency of 200-250% (COP 2-2.5) and peak efficiencies of 300-350%. The warmer the outdoor air, the more heat available, the higher the heat pump efficiency. The heat pump will also provide cooling, if required by the space, with an efficiency of at least EER 17. The availability of cooling will improve occupant comfort. It is also recommended that electric baseboard heaters be installed as a backup heat source in areas receiving heat pumps and not already equipped with electric baseboards.

### 6.3.2 Energy Rates and Emission Intensity Factors

The following list includes all the assumptions and variables considered for the technical and financial analysis:

▶ Cost of Electricity:	\$0.1476/kWh
▶ Cost of Heating Oil:	\$1.79/L
▶ Antigonish Electric GHG Emission Intensity Factor 2022:	0.3387 CO <sub>2</sub> e kg/kWh
▶ Antigonish Electric GHG Emission Intensity Factor 2033:	0.1565 CO <sub>2</sub> e kg/kWh
▶ Antigonish Electric GHG Emission Intensity Factor 2043:	0.03 CO <sub>2</sub> e kg/kWh
▶ Heating Oil GHG Emission Intensity Factor:	2.71 CO <sub>2</sub> e kg/L <sup>35</sup>

**Table 6.3: Projected Annual Carbon Emissions, No Measures Implemented**

Energy Source	2022 Energy Usage (GJ)	2022 Emissions (tonnes)	2033 Projected Emissions (tonnes)	2043 Projected Emissions
Antigonish Electric	269.7	25.4	11.7	2.2
Heating Oil	684.6	48.1	48.1	48.1
<b>Total</b>	<b>954.3</b>	<b>73.5</b>	<b>59.9</b>	<b>50.4</b>

The baseline energy consumption, January-December 2022, for the Antigonish Public Works Building/Electric Utility resulted in a total energy consumption of 954.3 GJ annually and carbon emissions of 73.5 tonnes per year based on 2022 emissions factors. The carbon

<sup>35</sup> Source: [Emission Factors for Greenhouse Gas Inventories \(epa.gov\)](https://www.epa.gov/greenhouse-gas-inventories). Retrieved: 2023-04-01

emission intensity of the electric grid and fossil fuels are projected to decrease during the lifespan of this study. Table 6.4 shows the projected annual emissions without the implementation of any energy conservation measures. Compared to the baseline, emissions are expected to decrease by 18.6% and 31.5% by 2033 and 2043, respectively.

### 6.3.3 Phase 1 Measurement and Analysis

The baseline HAP model was modified to estimate the building’s performance considering the efficiency measures listed above. These modifications included:

- ▶ In spaces heated with an of oil-fired furnace, efficiency was 80%, with electric radiant heaters for garage spaces, and electric baseboards for administrative spaces efficiency was 99%.
- ▶ In the office spaces and breakrooms heat pumps, with a COP of 3.3 and a EER of 17, were modelled. A cooling setpoint of 24°C was assumed.
- ▶ Lighting wattages for spaces without LEDs were modelled with LED equivalent wattages.
- ▶ The lighting in intermittently occupied spaces was reduced by 12.5% when modelled to represent the savings from occupancy sensors.
- ▶ Infiltration values were decreased by 10% to all spaces to represent weatherstripping and sealing of the exterior surfaces.
- ▶ Aluminum and wood frame windows were upgraded to an R-value of R-4, and in spaces with these windows, infiltration was decreased by an additional 5%.

The implementation of these measures to the Antigonish Public Works/Electric Utility will result in a reduction of energy consumption from the baseline of 218 GJ. The total cost to implement Phase 1 measures is approximately \$227,882 with a cost savings of an estimated \$12,363 for a payback period of 18.4 years. These measures will have an emissions savings 27.4 tonnes per year in 2033 compared to the baseline building’s emissions in the same year as seen in Table 6.4.

**Table 6.4: Antigonish Public Works/Electric Utility Phase 1 Efficiency Measures**

ECM	CAPEX (\$)	GHG Savings (tonne)	CAPEX/ GHG Reduction (\$/tonne)	Energy Savings GJ/yr	Cost Savings \$/yr	Cost Savings/ GHG Saved (\$/tonne CO <sub>2</sub> e)	Simple Payback (yr)
Upgrade Lighting to LEDs	\$3,472	27.4	\$8,329	218.0	\$12,363	\$452	18.4
Occupancy Sensors for Lighting	\$1,600						
Install Electric Radiant Heaters in the Garage with	\$62,000						

ECM	CAPEX (\$)	GHG Savings (tonne)	CAPEX/ GHG Reduction (\$/tonne)	Energy Savings GJ/yr	Cost Savings \$/yr	Cost Savings/ GHG Saved (\$/tonne CO <sub>2e</sub> )	Simple Payback (yr)
Electric Baseboard heating in Electric Utility. Install Control Program to Turn Heaters Off when Garage Door is Open.							
Install Split Source Heat Pumps in Office Spaces and Breakrooms	\$20,000						
Electrical Upgrades	\$130,000						
Replace Aluminum Frame and Wood Frame Windows with R-4	\$5,750						
Infiltration Reduction	\$5,000						
<b>ECM Implementation Total</b>	<b>\$228,822</b>	<b>27.4</b>	<b>\$8,329</b>	<b>218.0</b>	<b>\$12,363</b>	<b>\$452</b>	<b>18.4</b>

### 6.3.4 Phase 2 Measurement and Analysis

The Phase 1 HAP model was modified to estimate the building's performance considering the efficiency measures listed above. These modifications included:

- ▶ Vinyl frame windows were upgraded to an R-value of R-4. In spaces with these windows, infiltration was decreased by an additional 5% compared to the baseline.

The implementation of these measures to the Antigonish Public Works/Electric Utility will result in a reduction of energy consumption from the baseline of 11.1 GJ. The total cost to implement Phase 2 measures is approximately \$13,000 with a cost savings of an estimated \$791 for a payback period of 16.4 years. These measures will have an emissions savings 0.16 tonnes per year in 2043 compared to the baseline building's emissions in the same year as seen in Table 6.5.

**Table 6.5: Antigonish Public Works/Electric Utility Phase 2 Efficiency Measures**

ECM	CAPEX (\$)	GHG Savings (tonne)	CAPEX/ GHG Reduction (\$/tonne)	Energy Savings GJ/yr	Cost Savings \$/yr	Cost Savings/ GHG Saved (\$/tonne CO <sub>2</sub> e)	Simple Payback (yr)
Upgrade Vinyl Windows to Minimum R4	\$13,000	0.16	\$80,846	19.3	\$791	\$4,920	16.4
<b>ECM Implementation Total</b>	<b>\$13,000</b>	<b>0.16</b>	<b>\$80,846</b>	<b>19.3</b>	<b>\$791</b>	<b>\$4,920</b>	<b>16.4</b>

# 7 Antigonish Wastewater Treatment Plant

## 7.1 Facility Description

The Antigonish Wastewater Plant consists of two buildings: the treatment plant building or filter building and the pumping station. The filter building was built in 2006. The building is available to employees eight (8) hours a day, seven days a week, from 8:30 a.m. to 4:30 p.m. year-round. However, the building is typically occupied for about two (2) hours per day. The pumping station houses two large pumps and electrical panels and is typically unoccupied. Figure 7.1 presents a photograph of the site.



**Figure 7.1: Antigonish Wastewater Plant**

The Town of Antigonish Wastewater Treatment Plant (WWTP) is a lagoon-based treatment system that discharges to Wright River. The treatment process in the warmer months also includes sand filtration and UV disinfection prior to discharge. Raw wastewater from the collection system enters an influent wet well and passes through a grinder to break down large debris. The water is then pumped up to the lagoons. The lagoons consist of six aerated lagoon cells separated by a concrete wall/berm and several floating baffles. The total lagoon surface area is 38,500 m<sup>2</sup> and has a depth of 5.15 m.

Process air is supplied to the lagoon cells via four positive-displacement blowers and fine bubble diffusers, suspended from a floating lateral connected to the main aeration header. The majority of the aeration for BOD reduction is supplied to Cell 1A with 60 aerators on six (6) aeration chains. Cell 1B includes 30 aerators on 3 aeration chains. Cells 2A and 2B are equipped with 20 and 10 aerators on two (2) and one (1) aeration chains, respectively.

Aeration is reduced in the final cells to promote settling for TSS removal. Cell 3A has three (3) aerators and 3B has only one (1).

The lagoon effluent enters the process room from a series of pipes and manholes to a main header ahead of the filter trough. There are three sand filters, arranged in parallel. The filters are only used in the summer to provide effluent polishing and are bypassed in the winter when the effluent limits are less stringent, and the flows exceed the design capacity of the filters. The filters are rated for a flow of 6,800 m<sup>3</sup>/d each. Traditionally, the filters have been aided with the use of alum for coagulation. The plant has an average daily flow of 9,027m<sup>3</sup>.

Following the sand filters is the UV disinfection system, which is rated for a flow of 6,800 m<sup>3</sup>/d. The UV system is a Trojan UV3000B system which consists of two banks, each with 72 lamps rated at 85.2 Watts/lamp as presented in Table 7.1. Once effluent has been treated by UV, it is discharged into the Wright River via a submerged outfall.

**Table 7.1: Wastewater Treatment Plant Existing UV Arrays**

Equipment	Wattage (W)	Estimated Percentage of Year Operating	Efficiency
UV Lights Bank 1	6134.4	100%	-
UV Lights Bank 2	6134.4	100%	-

A summary of major process equipment using electric motors, the respective motor size, estimated efficiencies, and operating schedules, is listed below in Table 7.2. Currently pump 1 and submersible pump 3 are equipped with VFDs.

**Table 7.2: Wastewater Treatment Plant Existing Mechanical Process Equipment**

Equipment	Motor HP	Estimated Percentage of Year Operating	Motor Efficiency
Blower 1	25	100.00%	93.6
Blower 2	25	100.00%	93.6
Blower 3	50	100.00%	94.5
Blower 4	50	100.00%	94.5
Compressor (main)	15	10.00%	90.2
Compressor (backup)	7.5	50.00%	90.2
Pump 1	50	100.00%	94.5
Pump 2	50	<1.00%	94.5
Submersible Pump 3	40	100.00%	94.1
Submersible Pump 4	40	25.00%	92
Submersible Pump 5	40	25.00%	92
Grinder	5	100.00%	87

Diffusers are used to distribute air into the aeration tanks for the biological treatment of wastewater. If the existing diffusers are clogged or worn out, they may impede the proper distribution of air, resulting in increased resistance and higher blower static pressure. The plant uses fine bubble diffusers for aeration, which consist of a nozzle with a membrane to facilitate air transfer into the lagoons as small bubbles, with a high surface area to volume ratio. As these diffusers age, they foul, and the membrane stretches resulting in reduced OTE. OTE losses from fouling can range between 10% and 30% at the diffuser end-of-life condition. As these diffusers age, they should be replaced with new fine bubble diffusers to improve OTE, resulting in lower blower output requirements.

The pumping station is equipped with one electric unit heater. No cooling or service water is provided to the building. Interior lighting is provided by LED lighting; exterior lighting is provided by HID. Electricity is the only source of energy consumed onsite. Electricity powers space heating, lighting, and all process equipment. Mechanical ventilation is provided by one wall mounted exhaust fan.

The filter building is equipped with electric unit heaters. No cooling is provided to the space. Interior and exterior lighting is provided by a mixture of LED, and fluorescent lighting fixtures. Electricity is the only source of energy consumed on site. Electricity powers space heating, water heating, lighting, lab equipment, and all sanitation process equipment. Mechanical ventilation is provided by multiple exhaust fans on site.

The building and major existing equipment characteristics include:

► **Pumping Station:**

- The exterior walls appear in fair condition. The estimated R-value is R-11.
- The building roof appears to be in fair condition. The estimated R-value is R-12.
- The floor is slab-on-grade and in poor condition. The estimated R-value is R-1.4.
- No windows are present in the space.
- The exterior doors appear to be in good condition. R-values are estimated to be approximately R-3.
- Weatherstripping around the man-doors appears to be in good condition.
- One electric unit heater provides heating to the space; the size is assumed to be 3 kW.
- The temperature setpoint is 15°C year-round. The thermostat in the space is manual.
- There is one wall mounted exhaust fan; the fan louvers are non-operational.
- This facility has no service water.

► **Filter Building:**

- The exterior walls appear to be in fair condition. Estimated R-value is R-11.
- The building roof appears to be in fair condition. The estimated R-value is R-12.
- The floor is slab-on-grade and in poor condition. The estimated R-value is R-1.4.
- Windows in the building are vinyl, double paned windows with an estimated R-value of R-1.7.

- o The exterior doors appear to be in good condition. R-values are estimated to be approximately R-3.
- o Weatherstripping around the man-doors appears to be in good condition.
- o The electric unit heater provides heating to the space the size is assumed to be 3 kW.
- o The temperature setpoint is 15°C year-round for most spaces; the lab space is assumed to be at 18°C. The thermostats in the spaces are manual.
- o Domestic hot water is provided by one 47 US gallon electric hot water heater that serves the building washrooms and the lab space.

## 7.2 Review of Historic Energy Performance

Electricity bills were provided for the 24-month period between January 2021-2022. Energy consumption and demand were reviewed in annual terms to ensure that variation in seasonality was observable. With at least two periods available, a month-to-month comparison of the facility's energy performance was completed from one year to the next. Review of electricity consumption profiles, based on the information obtained from the two periods, was discussed, and is compared in this section.

### 7.2.1 Electricity Use Profiles

Figure 7.2 provides the monthly electricity usage profile which shows the 24-month period from January 2021 to December 2022.

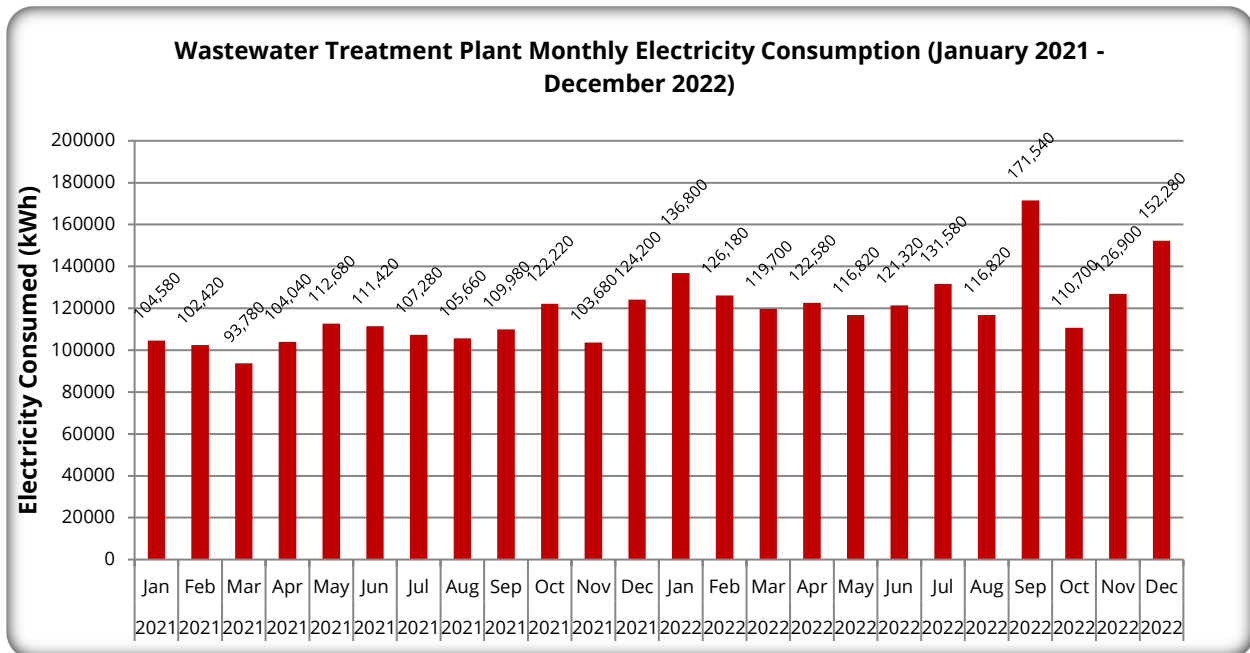


Figure 7.2: 2021/2022 Monthly Electricity Consumption

The energy consumption varies from month to month with no significant patterns or trends. Electricity consumed is directly impacted by the amount of effluent that needs to be processed.

Total electricity usage for the period of January/December 2021 was 1,301,940 kWh and 1,553,220 kWh from January/December 2022. The average annual energy consumption considering these two 12-month periods was 1,427,580 kWh.

## 7.2.2 Electricity Cost

Electricity is provided by the Antigonish Electric Utility as a “General Services above 3 kilowatts connected load” electricity rate<sup>36</sup>.

<b><u>Above 3 kilowatts connected load:</u></b>	
<u>Base Rate:</u>	\$8.75 per month per kilowatt of maximum demand.
<u>Energy Rates:</u>	\$0.15945 per kilowatt hour for the first 100 kilowatt hours per month per kilowatt of maximum demand.
	\$0.09993 per kilowatt hour for all additional consumption.
<u>Base Rate:</u>	\$8.75 per kilowatt of maximum demand.
<u>Minimum Bill:</u>	The greater of the Base Rate or \$10.53.
<u>Efficiency Nova Scotia Charges</u>	\$0.00 per kilowatt hour for all consumption.

**Figure 7.3: Antigonish Electric Utility Tariff Rate**

Table 7.3 and Table 7.4 present the monthly power bill cost breakdown for both meters for the January 2021 to December 2022, 24-month period for the Wastewater Treatment Plant.

**Table 7.3: Monthly Power Bill Cost Breakdown for the January 2021 to December 2022  
Meter 1**

Month-Year	Consumption (kWh)	Consumption Cost	Demand (kW)	Demand Cost	Invoice Amount
January 2021	16,560	\$2,113.38	77.04	\$661.77	\$2,775.15
February 2021	21,780	\$2,681.09	84.78	\$728.26	\$3,409.35
March 2021	20,880	\$2,425.09	56.88	\$488.6	\$2,913.69
April 2021	20,520	\$2,390.18	57.06	\$490.15	\$2,880.33
May 2021	30,420	\$3,595.90	93.42	\$802.48	\$4,398.38
June 2021	16,560	\$1,915.18	43.74	\$375.73	\$2,290.91

<sup>36</sup> Source [file.html\(townofantigonish.ca\)](file.html(townofantigonish.ca)). Retrieved: 2023-11-20

Month-Year	Consumption (kWh)	Consumption Cost	Demand (kW)	Demand Cost	Invoice Amount
July 2021	15,300	\$1,856.76	55.08	\$473.14	\$2,329.90
August 2021	16,380	\$2,016.12	63.72	\$547.35	\$2,563.47
September 2021	15,120	\$1,816.28	51.3	\$440.67	\$2,256.95
October 2021	17,280	\$2,089.98	61.02	\$524.16	\$2,614.14
November 2021	15,840	\$2,036.07	76.14	\$654.04	\$2,690.11
December 2021	34,380	\$4,003.41	95.4	\$819.49	\$4,822.90
January 2022	39,780	\$4,591.25	103.5	\$889.07	\$5,480.32
February 2022	36,360	\$4,251.63	103.86	\$892.16	\$5,143.79
March 2022	29,520	\$3,535.96	98.46	\$845.77	\$4,381.73
April 2022	28,080	\$3,343.86	90.36	\$776.19	\$4,120.05
May 2022	18,540	\$2,111.97	43.56	\$374.18	\$2,486.15
June 2022	19,620	\$2,527.37	95.22	\$817.94	\$3,345.31
July 2022	18,540	\$2,132.33	46.98	\$403.56	\$2,535.89
August 2022	16,380	\$2,126.47	82.26	\$706.61	\$2,833.08
September 2022	27,540	\$3,265.26	86.22	\$740.63	\$4,005.89
October 2022	17,820	\$2,295.01	86.4	\$742.18	\$3,037.19
November 2022	25,380	\$2,931.56	66.42	\$570.55	\$3,502.11
December 2022	33,660	\$3,740.77	63.36	\$544.26	\$4,285.03

**Table 7.4: Monthly Power Bill Cost Breakdown for the January 2021 to December 2022 Meter 2**

Month-Year	Consumption (kWh)	Consumption Cost	Demand (kW)	Demand Cost	Lighting Cost	Total Cost
January 2021	88,020	\$9,544.72	125.82	\$1,080.79	\$48.43	\$10,799.76
February 2021	80,640	\$8,782.60	121.68	\$1,045.23	\$48.43	\$9,997.94
March 2021	72,900	\$8,017.71	123.12	\$1,057.60	\$48.43	\$9,246.86
April 2021	83,520	\$9,067.18	121.14	\$1,040.59	\$48.43	\$10,277.34
May 2021	82,260	\$9,043.05	138.24	\$1,187.48	\$48.43	\$10,417.20
June 2021	94,860	\$10,298.95	137.7	\$1,182.84	\$48.43	\$11,667.92
July 2021	91,980	\$9,998.30	135.54	\$1,164.29	\$48.43	\$11,346.56
August 2021	89,280	\$9,680.27	127.44	\$1,094.71	\$48.43	\$10,950.85
September 2021	94,860	\$10,260.38	131.22	\$1,127.18	\$48.43	\$11,567.21
October 2021	104,940	\$11,307.32	137.88	\$1,184.39	\$56.50	\$12,686.09
November 2021	87,840	\$9,606.02	139.14	\$1,195.21	\$40.36	\$10,980.73
December 2021	89,820	\$9,792.09	137.16	\$1,178.20	\$48.43	\$11,155.88
January 2022	97,020	\$10,520.16	138.6	\$1,190.57	\$58.12	\$11,907.45
February 2022	89,820	\$9,812.45	140.58	\$1,207.58	\$48.43	\$11,209.04
March 2022	90,180	\$9,907.34	150.48	\$1,292.62	\$48.43	\$11,398.87
April 2022	94,500	\$10,286.55	141.66	\$1,216.86	\$48.43	\$11,693.50

Month-Year	Consumption (kWh)	Consumption Cost	Demand (kW)	Demand Cost	Lighting Cost	Total Cost
May 2022	98,280	\$10,711.42	149.58	\$1,284.89	\$48.43	\$12,194.32
June 2022	101,700	\$11,048.89	148.86	\$1,278.71	\$48.43	\$12,524.89
July 2022	113,040	\$12,188.53	149.94	\$1,287.98	\$48.43	\$13,674.88
August 2022	100,440	\$10,928.34	149.76	\$1,286.44	\$48.43	\$12,412.97
September 2022	144,000	\$15,294.14	151.92	\$1,304.99	\$64.58	\$16,815.63
October 2022	92,880	\$10,183.58	151.56	\$1,301.90	\$48.43	\$11,685.47
November 2022	101,520	\$11,078.05	156.78	\$1,346.74	\$48.43	\$12,630.00
December 2022	118,620	\$12,740.78	149.04	\$1,280.25	\$61.34	\$14,231.41

## 7.2.3 Total Energy Use Summary

Antigonish WWTP – Area: 167 m <sup>2</sup>	2021	2022
<b>Electricity</b>		
Annual Electricity and Demand Cost (\$)	\$165,463.54	\$195,756.21
Annual Electricity Consumption (kWh)	1,301,940	1,553,220
Annual Electricity Consumption (GJ)	4,687	5,592
Cost per GJ (\$/GJ)	\$35.3	\$35.0
Percentage of Total Energy (%)	100%	100%

The baseline energy usage for this study was determined using the January/December 2022 year. This year was selected for the baseline as it was determined that this would more accurately depict each facility's regular operations and energy usage after the COVID-19 pandemic.

## 7.2.4 Benchmarking

The energy use per area or energy use intensity (EUI) for this facility is 0.62 GJ/ average daily flow in m<sup>3</sup>. According to the Energy Star Portfolio Manager for Canada<sup>37</sup>, the average EUI for wastewater treatment plant is 0.80 GJ/ average daily flow in m<sup>3</sup>. Currently, this facility sits approximately 25% lower than the average.

## 7.2.5 End-use Breakdown

The energy use breakdown for this building was estimated by assuming the hours of operation for the process equipment, lighting, and average electrical loads for the space type. For the purpose of the energy breakdown, pumps with VFDs were estimated to be operating at 70% of full load on average. The remaining energy was estimated to be

<sup>37</sup> Source: [Canadian Energy Use Intensity by Property Type – Technical Reference \(canada.ca\)](https://www.canada.ca/en/energy/118779). Retrieved: 2023-01-23

heating. This energy use breakdown is an estimation based on information collected during the site visit and from the drawings. This information can only be confirmed with dedicated submetering of the different electrical subpanels and appliances in the facility. The review of this data allowed us to identify the following:

- ▶ The figure depicts that the majority of the energy consumption of the building, 97.2%, can be attributed to the process equipment.
- ▶ The second largest source of energy usage is space heating at approximately 2.7%.
- ▶ Electrical equipment and lighting both comprise 0.1% of the energy usage.

**Table 7.5: Energy Use Breakdown**

End-use	Energy Use Breakdown (%)	Site Energy (GJ)
Process Equipment	97.2%	5434.5
Lighting	0.07%	4.1
Heating	2.7%	149.3
Electrical Equipment	0.07%	3.7
<b>Total</b>	<b>100.0%</b>	<b>5,591.6</b>

## 7.3 Energy and GHG Reduction Pathway

### 7.3.1 Pathway Components

#### 7.3.1.1 Filter Building: Upgrade Existing Lighting to LEDs

The interior lighting for the facility is a combination of LED and fluorescent lighting fixtures. LEDs can provide the same level of light as other types of fixtures while consuming less energy. Therefore, considering the difference between the consumption levels of the current lamps and LED lamps, the implementation of this recommendation could result in energy savings.

Based on the age of the building, it is expected that the lighting fixtures in this facility will have reached the end of their expected useful life by the end of Phase 1, 2033. Therefore, the recommendation is to replace the existing lighting fixtures with LED fixtures.

When calculating the input power of the existing lighting, we prepared estimates of the quantity and type of lamps (bulbs) based on visual observation of the fixtures. Since it is difficult to know what type of ballast is used in each fixture without disassembly, the analysis team considered a minimum factor of 1.1 for fluorescent fixtures and 1.2 for HID.

The implementation of LED lighting will result in reduced maintenance costs over the following years. This is due to LEDs having a longer lifespan than the existing lighting fixtures. It is estimated that a non-LED lighting fixture has a maintenance cost of \$4/yr,

while LEDs have an estimated maintenance cost of \$2/yr. This leads to a savings of \$2/yr in maintenance per fixture.

### 7.3.1.2 Filter Building and Pumping Station: Install Occupancy Sensors for Intermittently Used Spaces

Lights within the facility are currently controlled by manual ON/OFF switches. To reduce the amount of time the lights are left on (or forgotten ON) with spaces unoccupied, it is recommended that occupancy sensors be installed. Occupancy sensors come in a wide range of configurations and characteristics. They can be installed on walls, ceilings, or at the switch location. Detection can be based on sound, infrared heat, or both. The sensor has a relay that interrupts the voltage to the fixtures in the circuit, thus turning them off when no occupancy is detected. The viability for installation of an occupancy sensor depends on the cost of electricity, the size of the load (number and wattage of lights) being controlled, and the approximate number of unoccupied hours they are often being left turned on.

### 7.3.1.3 Filter Building and Pumping Station: Repair Exhaust Louvers

Exhaust louvers located on the building show some damage and do not appear to shut properly. This allows for outdoor air infiltration; this results in additional heating loads and increases the energy demand to maintain the temperature set point for heating. It is recommended that these louvers be repaired to minimize infiltration.

### 7.3.1.4 Filter Building: Repair Broken Window in Process Area

A window located in the process area shows some damage and does not appear to shut properly. This allows for outdoor air infiltration; this results in additional heating loads and increases the energy demand to maintain the temperature set point for heating. It is recommended that this window be repaired to minimize infiltration.

### 7.3.1.5 Filter Building: Install Programmable Thermostats with Nighttime Setback in Lab Space

The heating zones in the building are controlled by manual thermostats. An alternative to manual thermostats are programmable thermostats. They are set once considering temperature setpoints for occupied or unoccupied periods and will adjust the temperature. These thermostats are programmed to reduce the set point temperature during unoccupied periods. Generally, the setpoint can be decreased by 3°F to 5°F for at least eight (8) hours a day (in heating mode), which can lead to significant savings (between 3% to 5% in heating). It is recommended that a programmable thermostat with a nighttime setback be implemented in the lab.

### 7.3.1.6 Filter Building: Upgrade 25 HP Positive Displacement Blowers to Turbo Blowers

Replacing the two existing 25HP positive displacement blowers with more energy efficient models (turbo blowers) will allow for a reduction of energy use. These blowers appear to be at the end of their useful life and should be replaced during Phase 1.

Turbo blowers have a centrifugal design that enables them to deliver higher volumes of air with significantly lower power consumption compared to positive displacement blowers. Another key advantage is that variable speed control is typically incorporated into this style of blowers, allowing for blower output to match the specific aeration requirements of the plant at any given time. Turbo blowers are able to achieve up to a 30% reduction in energy usage to deliver an equal amount of air to the lagoons. Energy reductions were based on the efficiency of the turbo blowers, as well as the ability to lower air output since new blowers are equipped with VFDs.

## 7.3.2 Energy Rates and Emission Intensity Factors

The following list includes all the assumptions and variables considered for the technical and financial analysis:

▶ Cost of Electricity:	\$0.1268/kWh
▶ Antigonish Electric GHG Emission Intensity Factor 2022:	0.3387 CO <sub>2</sub> e kg/kWh
▶ Antigonish Electric GHG Emission Intensity Factor 2033:	0.1565 CO <sub>2</sub> e kg/kWh
▶ Antigonish Electric GHG Emission Intensity Factor 2043:	0.03 CO <sub>2</sub> e kg/kWh

**Table 7.6: Projected Annual Carbon Emissions, No Measures Implemented**

Energy Source	2022 Energy Usage (GJ)	2022 Emissions (tonnes)	2033 Projected Emissions (tonnes)	2043 Projected Emissions
Antigonish Electric	5591.6	526.1	243.1	46.6
<b>Total</b>	<b>5591.6</b>	<b>526.1</b>	<b>243.1</b>	<b>46.6</b>

The baseline energy consumption, January-December 2022, for the Antigonish Wastewater Treatment Plant resulted in a total energy consumption of 5591.6 GJ annually and carbon emissions of 526.1 tonnes/year based on 2022 emissions factors. The carbon emission intensity of the electric grid and fossil fuels are projected to decrease during the lifespan of this study. Table 7.6 shows the projected annual emissions without the implementation of any energy conservation measures. Compared to the baseline, emissions are expected to decrease by 53.8% and 91.1% by 2033 and 2043, respectively.

### 7.3.3 Phase 1 Measurement and Analysis

A baseline HAP was created of the lab space to be able to estimate the building's performance considering the implementation of a nighttime setback.

- ▶ The temperature setpoint in the lab space was decrease from 18°C to 15°C. between the hours of 4:00p.m -8:00am daily.

The following measures were calculated separately:

- ▶ **Upgrade Lighting to LED with Occupancy Sensors:** Lighting wattages for spaces without LEDs were compared to LED equivalent wattages. It was assumed that the lights were on from 2.5 hours per day, seven days/week year-round for the baseline to correspond with the estimated occupancy of the building; exterior lighting was assumed to be on 12 hours per day. The time on was reduced by 12.5% to account for savings from the occupancy sensor.
- ▶ **Upgrade Positive Displacement Blowers to Turbo Blowers:** Baseline energy consumption for the blowers was calculated. The two 25 hp blowers operate 24 hours/day, seven days/week year-round. Turbo blowers can offer up to a 30% savings when compared to a positive displacement blower due to the built in VFD; however, since further study would need to be conducted to ensure that the plant is meeting necessary aeration targets with a reduced flow, only the efficiency increases between the current blower and the turbo blower, estimated to be 5%, were considered.
- ▶ **Repair Exhaust Louvers:** It was assumed that the filter building and pumping station had an average air temperature of 15°C, with an average outdoor air temperature of 2°C when the building was in operation. The existing air exhaust fans were assumed to have a ¼" gap along the louver and were estimated to be ⅛" when repaired. Electric radiant heaters were assumed to be on 60% of the time during the heating season which was assumed to be eight months. The operating hours should reduce once louvers are repaired.
- ▶ **Repair the Broken Window in the Process Spaces:** It was assumed that the filter building had an average air temperature of 15°C, with an average outdoor air temperature of 2°C when the building was in operation. The 3/32" gap along the frame was estimated to be 1/64" gap when repaired. Electric radiant heaters were assumed to be on 60% of the time during the heating season which was assumed to be eight months. The operating hours should reduce once the windows are repaired.

The implementation of these measures to the Antigonish Wastewater Treatment Plant will result in a reduction of energy consumption from the baseline of 70.8 GJ. The total cost to implement Phase 1 measures is approximately \$213,780 with a cost savings of an estimated \$2,530 for a payback period of 84.5 years. These measures will have an emissions savings 3.1 tonnes/year in 2033 compared to the baseline building's emissions in the same year as presented in Table 7.7.

**Table 7.7: Antigonish Wastewater Treatment Plant Phase 1 Efficiency Measures**

ECM	CAPEX (\$)	GHG Savings (tonne)	CAPEX/ GHG Reduction (\$/tonne)	Energy Savings GJ/yr	Cost Savings \$/yr	Cost Savings/ GHG Saved (\$/tonne CO <sub>2</sub> e)	Simple Payback (yr)
<b>Pumping Station</b>							
Upgrade Lighting to LEDs	\$410	0.08	\$8,123	1.7	\$62.8	\$837	9.7
Occupancy Sensors for Lighting	\$1,000						
Repair Exhaust Louvres	\$1,400	0.15	\$9,147	3.5	\$124.0	\$810	11.3
<b>Filter Building</b>							
Upgrade Lighting to LED	\$2,600	0.10	\$23,013	2.3	\$115.0	\$1,150	20.0
Occupancy Sensors for Lighting	\$1,000						
Repair Louver for Exhaust Fans	\$7,250	0.04	\$170,316	1.0	\$32.9	\$756.0	210.2
Repair Damaged Window	\$720	0.13	\$5,368	3.1	\$103.4	\$756.0	6.6
Nighttime Setback in Lab	\$200	0.02	\$11,210	0.4	\$14.5	\$794.9	13.8
Turbo Blowers to Replace 25HP Blowers	\$200,000	2.56	\$78,254	58.8	\$1,969.5	\$756.0	96.6
<b>ECM Implementation Total</b>	<b>\$213,780</b>	<b>3.10</b>	<b>\$68,905</b>	<b>70.8</b>	<b>\$2,530</b>	<b>\$821.9</b>	<b>854.5</b>

### 7.3.4 Phase 2 Measurement and Analysis

No additional measures were considered for implementation in this facility in Phase 2.

## 8 Antigonish Town Hall

### 8.1 Facility Description

The Antigonish Town Hall was built in 1905. Later on, three spaces at the back of the building were added to the original construction. Some elements of the building were renovated in the 1980s, such as windows. The building is open Monday to Friday eight (8) hours a day from 8:30 a.m. to 4:30 p.m. Council meetings are held on the third Monday of every month for approximately two (2) hours from 6:00 p.m. to 8:00 p.m. Figure 8.1 presents a photograph of the site.

The building is equipped with a hydronic heating system with two oil-fired boilers and circulating pumps. Hydronic baseboards and radiators provide heating to most of the spaces. The council chambers and open office utilize air source heat pumps for heating and cooling. Cooling is provided to the remainder of the office and meeting room rooms by portable air-conditioning units.

Dehumidification is provided in the basement, as well as in the first-floor corridor. Interior and exterior lighting is provided by a mixture of LED, fluorescent, and CFL lighting fixtures. Electricity and heating oil are the two sources of energy consumed on site. Electricity powers the space heating/cooling, lighting, refrigeration, service water, and kitchen appliances, as well as other ancillary equipment. Heating oil is consumed by the boilers to produce heat. No mechanical ventilation is provided to the building.

The building and major existing equipment characteristics include:

- ▶ The exterior walls appear to be in poor to fair condition. The estimated R-value for the building is R-10-15 for above ground exterior walls. Basement walls have an estimated R-value of R-11



**Figure 8.1: Antigonish Town Hall**

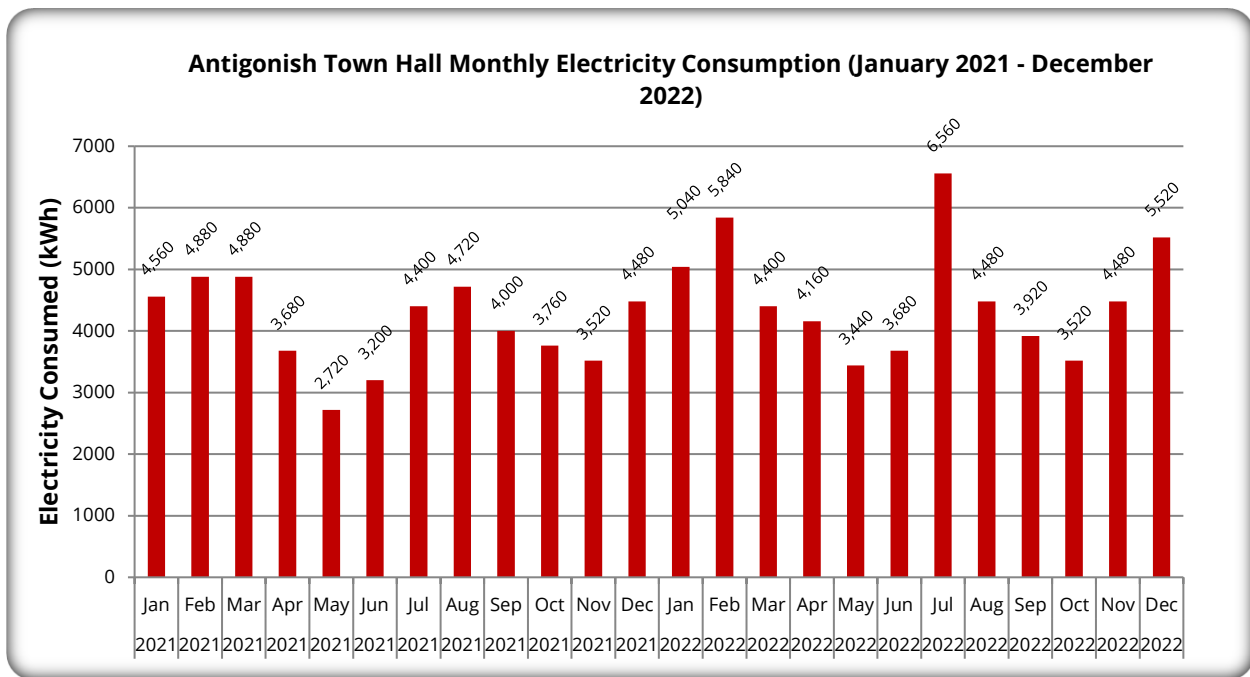
- ▶ The building roof appears to be in poor to fair condition. The estimated R-value is R-21.
- ▶ The single and double paned, wood frame windows are in poor condition and have an estimated R value of R-0.96 and R-1.7, respectively.
- ▶ The floor is slab-on-grade. The estimated R-value is R-1.4.
- ▶ The exterior doors appear in fair condition. R-values are estimated to be R-1.4.
- ▶ Weatherstripping around the man-doors appears to be in poor to fair condition with some areas showing daylight through the gaps in the weatherstripping.
- ▶ The interior lighting is a combination of LED, fluorescent, and CFL with manual ON/OFF switches.
- ▶ The exterior lighting is provided by LED lighting.
- ▶ Two oil-fired boilers provide hot water up to 82°C (180°F) for the hydronic heating system at an estimated efficiency of approximately 80-90% to the administrative spaces and the garage.
- ▶ The split system heat pumps providing heating and cooling to the council chambers and open office operate with an estimated COP of 3.3 and EER of 11.
- ▶ Portable air-conditioning units are estimated to operate with an EER of 11.
- ▶ The relative humidity setpoint for dehumidification is estimated to be 60%.
- ▶ Domestic hot water is provided by a 50-gallon electric water heater that serves the building washrooms and kitchens.
- ▶ The temperature setpoint is 21°C for heating and 23°C for cooling. All the thermostats in this space are programmable. No setback is implemented for heating and cooling is assumed to only occur during occupied hours.
- ▶ Cooking appliances are electric.

## 8.2 Review of Historic Energy Performance

Electricity bills were provided for the 24-month period between January 2021-2022. Energy consumption and demand were reviewed in annual terms to ensure that variation in seasonality was observable. With at least two periods available, a month-to-month comparison of the facility's energy performance was completed from one year to the next. Review of electricity consumption profiles, based on the information obtained from the two periods, was discussed, and is compared in this section.

### 8.2.1 Electricity Use Profiles

Figure 8.2 provides the monthly electricity usage profile which shows the 24-month period from January 2021 to December 2022.



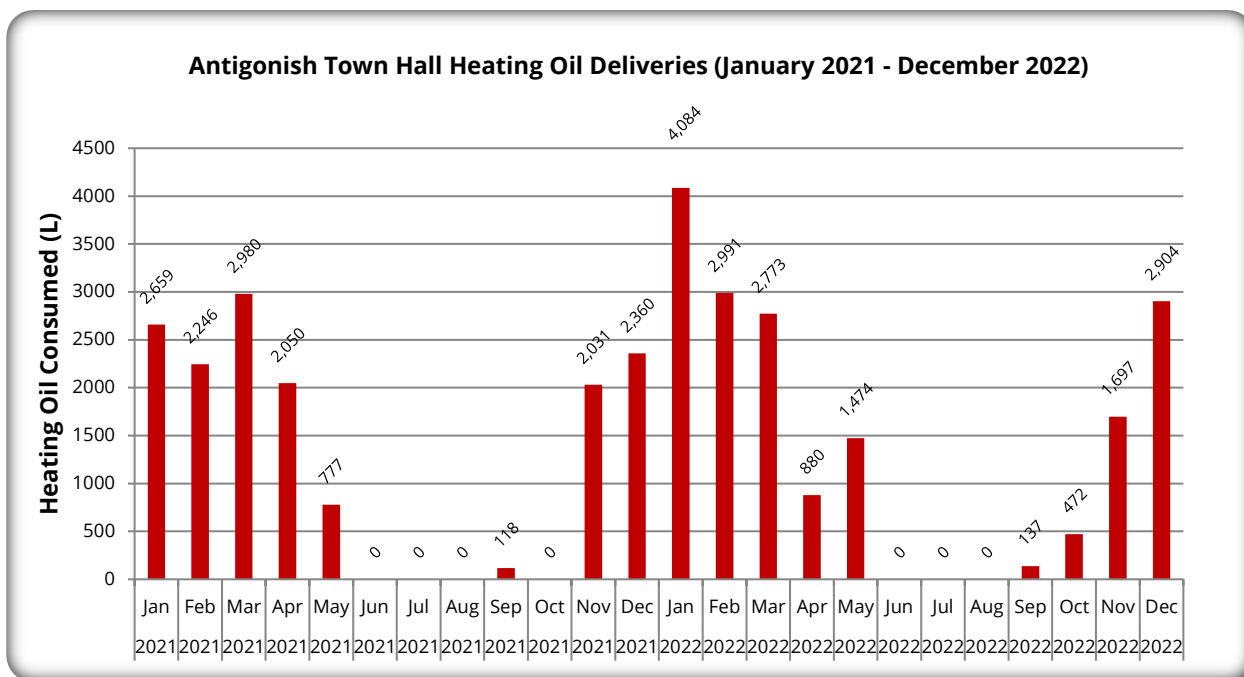
**Figure 8.2: 2021/2022 Monthly Electricity Consumption**

Figure 8.2 depicts a trend with a lower electricity consumption during the shoulder seasons in comparison to the summer and winter months. Electricity is used for heating, cooling, and dehumidification so this trend is to be expected.

Total electricity usage for the period of January/December 2021 was 48,800 kWh and 55,040 kWh from January/December 2022. The average annual energy consumption considering these two 12-month periods was 51,920 kWh.

### 8.2.2 Heating Oil Consumption

The Town of Antigonish provided the heating oil delivery records to the site for the period of January 2021 to December 2022. Total heating oil usage for the period of January/December 2021 was 15,220 L and 17,411 L from January/December 2022. The average annual fuel consumption for this period was 16,315 L. Heating oil is consumed by a boiler to provide space heating to the building. The figures are based on delivered quantities each month and do not necessarily reflect quantities consumed each month.



**Figure 8.3: 2021/2022 Monthly Heating Oil Deliveries**

### 8.2.3 Electricity Cost

Electricity is provided by the Antigonish Electric Utility as a “General Services above 3 kilowatts connected load” electricity rate<sup>38</sup>.

<b><u>Above 3 kilowatts connected load:</u></b>	
<u>Base Rate:</u>	\$8.75 per month per kilowatt of maximum demand.
<u>Energy Rates:</u>	\$0.15945 per kilowatt hour for the first 100 kilowatt hours per month per kilowatt of maximum demand.
	\$0.09993 per kilowatt hour for all additional consumption.
<u>Base Rate:</u>	\$8.75 per kilowatt of maximum demand.
<u>Minimum Bill:</u>	The greater of the Base Rate or \$10.53.
<u>Efficiency Nova Scotia Charges</u>	\$0.00 per kilowatt hour for all consumption.

**Figure 8.4: Antigonish Electric Utility Tariff Rate**

Table 8.1 presents the monthly power bill cost breakdown for the January 2021 to December 2022, 24-month period for the Antigonish Town Hall.

<sup>38</sup> Source [file.html \(townofantigonish.ca\)](file.html (townofantigonish.ca)). Retrieved: 2023-11-20

**Table 8.1: Monthly Power Bill Cost Breakdown for the January 2021 to December 2022**

Month-Year	Consumption (kWh)	Demand (kW)	Invoice Amount
January 2021	4,560	16.24	\$691.84
February 2021	4,880	19.04	\$764.53
March 2021	4,880	18.16	\$751.74
April 2021	3,680	14.56	\$579.47
May 2021	2,720	12.72	\$456.78
June 2021	3,200	19.60	\$604.79
July 2021	4,400	18.48	\$708.42
August 2021	4,720	17.68	\$728.77
September 2021	4,000	18.30	\$673.11
October 2021	3,760	14.72	\$589.79
November 2021	3,520	16.72	\$594.89
December 2021	4,480	16.48	\$687.33
January 2022	5,040	16.40	\$742.14
February 2022	5,840	17.52	\$838.37
March 2022	4,400	17.52	\$694.47
April 2022	4,160	16.40	\$654.20
May 2022	3,440	16.48	\$583.40
June 2022	3,680	17.28	\$619.03
July 2022	6,560	19.36	\$937.08
August 2022	4,480	17.36	\$700.14
September 2022	3,920	18.72	\$663.95
October 2022	3,520	15.36	\$575.12
November 2022	4,480	16.56	\$688.50
December 2022	5,520	16.16	\$786.61

## 8.2.4 Heating Oil Cost

The Town of Antigonish provided the heating oil delivery records to the site for the period of January 2021 to December 2022. The average cost during this time period was \$1.22/L. Due to the significant increase in oil prices since the billing period, the cost savings calculations have been conducted using a value more representative to current market prices of \$1.79/L<sup>39</sup>.

<sup>39</sup> Source: [Weekly Average Retail Prices for Furnace Oil in 2023 | Natural Resources Canada \(nrcan.gc.ca\)](https://www.nrcan.gc.ca/energy/11320). Retrieved: 2023-04-01.

## 8.2.5 Total Energy Use Summary

Antigonish Town Hall – Area: 899 m <sup>2</sup>	2021	2022
<b>Electricity</b>		
Annual Electricity and Demand Cost (\$)	\$7,831.46	\$8,483.01
Annual Electricity Consumption (kWh)	48,800	55,040
Annual Electricity Consumption (GJ)	176	198
Cost per GJ (\$/GJ)	\$44.6	\$42.8
Percentage of Total Energy (%)	23.1%	22.8%
<b>Heating Oil</b>		
Annual Heating Oil Cost (\$)	\$13,956.34	\$26,502.30
Annual Heating Oil Consumption (L)	15,220	17,411
Annual Heating Oil Consumption (GJ)	586.1	670.5
Cost per GJ (\$/GJ)	\$23.8	\$39.5
Percentage of Total Energy (%)	76.9%	77.2%
<b>Summary – Total</b>		
Annual Energy Costs (\$)	\$21,787.80	\$34,985.31
Annual Energy Consumption (GJ)	762	869
Cost per GJ (\$/GJ)	28.6	40.3
Percentage of Total Energy (%)	100.00%	100.00%

The baseline energy usage for this study was determined using the January/December 2022 year. This year was selected for the baseline as it was determined that this would more accurately depict each facility's regular operations and energy usage after the COVID-19 pandemic.

## 8.2.6 Benchmarking

The energy use per area or energy use intensity (EUI) for this facility is 0.91 GJ/m<sup>2</sup>. According to the Energy Star Portfolio Manager for Canada<sup>40</sup>, the average EUI for 'Other-Public Services' is 0.86 GJ/m<sup>2</sup>. Currently, this facility sits approximately 5.8% higher than the average.

## 8.2.7 End-use Breakdown

A building energy model was created in Carrier HAPV6.1 considering the information and data collected from the drawings and the site visit. The energy model was calibrated based on the actual annual energy records for this facility, which allowed us to estimate the

<sup>40</sup> Source:

<https://portfoliomanager.energystar.gov/pdf/reference/Canadian%20National%20Median%20Table.pdf>

Retrieved: 2023-01-23

energy use breakdown shown in Table 8.2. This energy use breakdown is an estimation based on information collected during the site visit and from drawings. This information can only be confirmed with dedicated submetering of the different electrical subpanels and fuel-fired equipment and appliances in the facility. The review of this data allowed us to identify the following:

- ▶ The figure depicts that the majority of the energy consumption of the building, 76.7%, can be attributed to space heating.
- ▶ The second largest source of energy usage is building lighting at approximately 9.6%.
- ▶ The third largest source of energy consumption is electrical equipment at 7.4%.
- ▶ The remaining 6.4% is comprised of mechanical equipment, space cooling, hot water, and miscellaneous equipment at 1.7%, 2.2%, 2.0% and 0.4%, respectively.

**Table 8.2: Energy Use Breakdown**

End-use	Energy Use Breakdown (%)	Site Energy (GJ)
Space Heating	76.7%	672.4
Lights	9.6%	84.1
Electrical Equipment	7.4%	64.5
Mechanical Equipment	1.7%	15.2
Hot Water	2.0%	17.8
Cooling	2.2%	19.5
Miscellaneous	0.4%	3.1
<b>Total</b>	<b>100%</b>	<b>876.7</b>

## 8.3 Energy and GHG Reduction Pathway

### 8.3.1 Pathway Components

#### 8.3.1.1 Replace Existing Oil Fired Boiler with an Electric Boiler at End of Life with Outdoor Air Temperature Reset

The majority of the building is heated by a hydronic heating system that utilizes oil-fired boilers with an estimated efficiency of 80%. An electric boiler can provide the same output at an average efficiency of 100%.

The boiler for the hydronic heating system currently heats the supply water to a constant temperature of 82°C (180°F) regardless of the air temperature outside. There is potential for energy consumption reduction in the modulation of supply water temperature for the terminal units according to the outdoor temperature. Outdoor reset control uses the heating curve to set the relationship between the outdoor temperature and the supply water temperature. The heating curve defines the amount the supply water temperature is raised for every 1° drop in outdoor air temperature. During mild outdoor temperatures, the supply water temperature will be low, while during the coldest day of the year the

supply water temperature will be at design conditions. Outdoor reset reduces indoor temperature changes by more closely matching the output of the terminal units to the load. It also increases system efficiency by minimizing distribution losses. It is recommended that this system be implemented with the installation of an electric boiler.

It is recommended that the boilers be upgraded either at the end of their lifespan or prior to the end of Phase 1 in 2032, whichever occurs first.

### 8.3.1.2 Upgrade Existing Lighting to LEDs

The interior and exterior lighting for the facility is a mixture of LED, fluorescent, and CFL fixtures. LEDs can provide the same level of light as other types of fixtures while consuming less energy. Therefore, considering the difference between the consumption levels of the current lamps and LED lamps, the implementation of this recommendation could result in significant energy savings.

Based on the findings from the building condition assessment completed in parallel to the energy study, lighting fixtures in this facility have reached the end of their expected useful life. Therefore, the recommendation is to replace the existing lighting fixtures with LED fixtures.

When calculating the input power of the existing lighting, we prepared estimates of the quantity and type of lamps (bulbs) based on visual observation of the fixtures. Since it is difficult to know what type of ballast is used in each fixture without disassembly, the analysis team considered a minimum factor of 1.1 for fluorescent fixtures and 1.2 for HID.

The implementation of LED lighting will result in reduced maintenance costs over the following years. This is due to LEDs having a longer lifespan than the existing lighting fixtures. It is estimated that a non-LED lighting fixture has a maintenance cost of \$4/yr, while LEDs have an estimated maintenance cost of \$2/yr. This leads to a savings of \$2/yr in maintenance per fixture.

### 8.3.1.3 Install Occupancy Sensors for Intermittently Used Spaces

Spaces within the facility are currently controlled by manual ON/OFF switches. To reduce the amount of time the lights are left on (or forgotten ON) with spaces unoccupied, it is recommended that occupancy sensors be installed. Occupancy sensors come in a wide range of configurations and characteristics. They can be installed on walls, ceilings, or at the switch location. Detection can be based on sound, infrared heat, or both. The sensor has a relay that interrupts the voltage to the fixtures in the circuit, thus turning them off when no occupancy is detected. The viability for installation of an occupancy sensor depends on the cost of electricity, the size of the load (number and wattage of lights) being controlled, and the approximate number of unoccupied hours they are often being left turned on.

### 8.3.1.4 Install Programmable Thermostats with Nighttime Setback

The heating zones in the building are controlled by manual thermostats. An alternative to manual thermostats is programmable thermostats. They are set once considering temperature setpoints for occupied or unoccupied periods and will adjust the temperature. These thermostats are programmed to reduce the set point temperature during unoccupied periods. Generally, the setpoint can be decreased by 3°F to 5°F for at least eight (8) hours a day (in heating mode), which can lead to significant savings (between 3% to 5% in heating).

### 8.3.1.5 Replace Weatherstripping on All Exterior Doors and Seal Exterior Openings

Some of the windows and doors in this facility exhibit gaps and cracks that will allow for outdoor air infiltration. This causes additional heating loads which impact the energy consumption from the HVAC systems. It is recommended that the envelope of conditioned spaces be inspected and caulking applied around the exterior windows, doors, and other exterior wall openings. Damaged and missing weatherstripping on the doors and windows in the facility should also be replaced.

### 8.3.1.6 Upgrade Wood Frame Windows to Thermally Insulated Vinyl Windows Minimum R-4

The building has single and double paned, wood frame windows with an estimated R value of R-0.96 and R-1.7, respectively. All wood frame windows have exceeded their expected lifespan. It is anticipated that replacing the windows with high efficiency double pane, vinyl frame windows will help reduce energy usage for the building. The implementation of this measure will lower conductive losses through the windows, as well as lower infiltration levels. It is recommended that these windows be replaced during Phase 1.

## 8.3.2 Energy Rates and Emission Intensity Factors

The following list includes all the assumptions and variables considered for the technical and financial analysis:

▶ Cost of Electricity:	\$0.1541/kWh
▶ Cost of Heating Oil:	\$1.79/L
▶ Antigonish Electric GHG Emission Intensity Factor 2022:	0.3387 CO <sub>2</sub> e kg/kWh
▶ Antigonish Electric GHG Emission Intensity Factor 2033:	0.1565 CO <sub>2</sub> e kg/kWh
▶ Antigonish Electric GHG Emission Intensity Factor 2043:	0.03 CO <sub>2</sub> e kg/kWh
▶ Heating Oil GHG Emission Intensity Factor 2022:	2.71 CO <sub>2</sub> e kg/L <sup>41</sup>
▶ Heating Oil GHG Emission Intensity Factor 2033-2043:	2.17 CO <sub>2</sub> e kg/L

<sup>41</sup> Source: [Emission Factors for Greenhouse Gas Inventories \(epa.gov\)](https://www.epa.gov/greenhouse-gas-inventories). Retrieved: 2023-04-01

**Table 8.3: Projected Annual Carbon Emissions, No Measures Implemented**

Energy Source	2022 Energy Usage (GJ)	2022 Emissions (tonnes)	2033 Projected Emissions (tonnes)	2043 Projected Emissions
Antigonish Electric	198.1	18.6	8.6	1.7
Heating Oil	650.5	47.2	47.2	47.2
<b>Total</b>	<b>868.6</b>	<b>65.8</b>	<b>55.5</b>	<b>48.8</b>

The baseline energy consumption, January-December 2022, for the Antigonish Town Hall resulted in a total energy consumption of 868.6 GJ annually and carbon emissions of 65.8 tonnes/year based on 2022 emissions factors. The carbon emission intensity of the electric grid and fossil fuels are projected to decrease during the lifespan of this study. Table 8.3 shows the projected annual emission without the implementation of any energy conservation measures. Compared to the baseline, emissions are expected to decrease by 15.2 and 38.3% by 2033 and 2043, respectively.

### 8.3.3 Phase 1 Measurement and Analysis

The baseline HAP model was modified to be able to estimate the building's performance considering the efficiency measures listed above. These modifications included:

- ▶ Replacement of the 80% efficient oil-fired boilers with 99% efficient electric boilers and an outdoor air temperature reset.
- ▶ Implement a nighttime setback of 5°F during unoccupied hours for heating.
- ▶ Lighting wattages for spaces without LEDs were modelled with LED equivalent wattages.
- ▶ The lighting in intermittently occupied spaces was reduced by 12.5% when modelled to represent the savings from occupancy sensors.
- ▶ Infiltration values were decreased by 10% to all spaces to represent weatherstripping and sealing of exterior surfaces.
- ▶ Windows were upgraded to an R-value of R-4 and in spaces with windows infiltration, was decreased by an additional 5%.

The implementation of these measures to the Antigonish Town Hall will result in a reduction of energy consumption from the baseline of 357.0 GJ. The total cost to implement Phase 1 measures is approximately \$340,410 with a cost savings of an estimated \$18.159/year for a payback period of 18.3 years. These measures will have an emissions savings 34.3 tonnes/year in 2033 compared to the baseline building's emissions in the same year as seen in Table 8.4.

**Table 8.4:Antigonish Town Hall Phase 1 Efficiency Measures**

ECM	CAPEX (\$)	GHG Savings (tonne)	CAPEX/ GHG Reduction (\$/tonne)	Energy Savings GJ/yr	Cost Savings \$/yr	Cost Savings/ GHG Saved (\$/tonne CO <sub>2</sub> e)	Simple Payback (yr)						
Install Electric Boiler Early and Implement Outdoor Air Reset	\$73,500	34.3	\$9,655	357.0	\$18,159	\$529	18.3						
Electrical Entrance Upgrades	\$90,000												
Upgrade Lighting to LED*	\$15,110												
Occupancy Sensors for Lighting Controls	\$4,600												
Install Programmable Thermostats with Nighttime Setback	\$7,200												
Upgrade Windows to a Minimum of R4	\$150,000												
Infiltration Reduction	\$2,700												
<b>ECM Implementation Total</b>	<b>\$331,610</b>							<b>34.3</b>	<b>\$9,655</b>	<b>357.0</b>	<b>\$18,159</b>	<b>\$529</b>	<b>18.3</b>

### 8.3.4 Phase 2 Measurement and Analysis

No additional measures were considered for implementation in this facility in Phase 2.

### 8.3.5 Measures Considered but Not Recommended

The following measures were considered for this building but are ultimately not currently recommended to be completed:

- **Convert Existing Oil-Fired Boiler to Propane:** The majority of the building is heated by a hydronic heating system that utilizes oil-fired boilers with an estimated efficiency of 80%. Converting the oil-fired boiler to propane will allow for the same efficiency but uses a fuel that produces less carbon emissions/GJ. This would have been implemented as a transitional step before converting to electric boilers as both oil-fired boilers had

been installed more recently in 2017. Instead, it has been recommended to replace the oil-fired boiler at the end of Phase 1, in 2032, as it would be nearing their end of life.

# 9 Antigonish Water Treatment Plant

## 9.1 Facility Description

The Antigonish Water Treatment Plant (WTP) building was built in 2006. Throughout the week, the administrative areas of the building are open for eight and a half (8.5) hours a day, seven days a week, from 8:00 a.m. to 4:30 p.m. year-round. Table 9.1 presents a photograph of the site. A roof mounted 61.6 kWdc PV array was installed in 2019.



**Figure 9.1: DNR Antigonish Office Site**

Raw water from the James River is gravity fed to the WTP, entering the plant through a 16" transmission main. The treatment system is comprised of chemical addition prior to a rapid mix tank which splits the flow into two treatment trains. Each train consists of 2-stage tapered flocculation basins and DAF clarifiers. Each flocculation tank contains top mounted, adjustable speed vertical turbine flocculators (mixers) which are designed to induce decreasing velocity gradients within the basins.

The clarifier uses dissolved air flotation (DAF) technology to separate the solid flocs from the water. Clarified water is recycled to the front of the DAF basin through a saturator tank, which forces pressurized air to mix with the recycle water to facilitate dissolution. The recycle water is injected at the entrance to the DAF basin, where the drop in pressure causes micro-bubbles to form and float to the surface of the tank. As the bubbles rise, they contact and attach to floc particles and carry them to the surface, creating a sludge blanket (or float) which is then removed via a mechanical skimmer. The DAF water is withdrawn from the bottom of the clarifier basin and flows into a common trough which feeds three dual media (anthracite/sand) rapid filters. After filtration, chlorine gas is added to the water before flowing to the chlorine contact chamber. The water is then pumped from the

clearwell to the distribution system. An average flow of 4000m<sup>3</sup> of water runs through the plant per day.

One filter is backwashed per day, where filters are drained and undergo an air scour via the blower, low flow, high flow, settling, and then rinsing. Backwashes take around 15 minutes per cycle. Backwash waste streams are first directed into onsite holding tanks and then are pumped into a series of settling lagoons located outside the WTP.

A summary of the major process equipment using electric motors, the respective motor size, estimated efficiencies, and operating schedules, is listed below in Table 9.1. Currently the rapid mixer, treatment water pumps, and service water pumps are equipped with VFDs.

**Table 9.1: Water Treatment Plant Existing Mechanical Process Equipment**

Equipment	Motor HP	Estimated Percentage of Year Operating	Motor Efficiency
Air Compressor 1	3	5.00%	86.5%
Air Compressor 2	3	0.00%	86.5%
Rapid Mixer	3	100.00%	86.5%
Blower	20	<1%	91%
Recycle Pumps	10	100.00%	90.2%
Recycle Pumps	10	50.00%	90.2%
Recycle Pump	10	50.00%	89.5%
Backwash Pumps	50	<1%	93%
Backwash Pumps	50	<1%	93%
Treated Water Pumps	15	100.00%	93%
Treated Water Pumps	15	25.00%	91%
Treated Water Pumps	15	25.00%	92.4%
Service Water Pumps 1	3	33.00%	85.5%
Service Water Pumps 2	3	33.00%	85.5%
Service Water Pumps 3	3	33.00%	85.5%

Existing motors are comprised of a mix of standard and premium efficiency units.

The building itself, is equipped with a hydronic heating system with an oil-fired boiler and circulation system. The administrative spaces utilize radiant floor heating. Process areas are equipped with hydronic unit heaters. Hydronic baseboards are in the washrooms and soda ash room. An air handling unit (AHU) provides ventilation and cooling (DX) to the administrative areas. Interior and exterior lighting are provided by a combination of LED, fluorescent, and HPS Lighting. Electricity and heating oil are the two sources of energy consumed on site. Electricity powers the space cooling, ventilation, lighting, refrigeration, kitchen appliances, and domestic hot water, as well as all process equipment. Heating oil is consumed in a boiler to produce heating to the administrative spaces and process areas.

Mechanical ventilation is provided to the administration areas by an AHU, and by roof mounted exhaust fans interlocked with fresh air dampers to the process areas. Wall mounted exhaust fans serve the chlorine storage and chemical feed room.

The building and major existing equipment characteristics include:

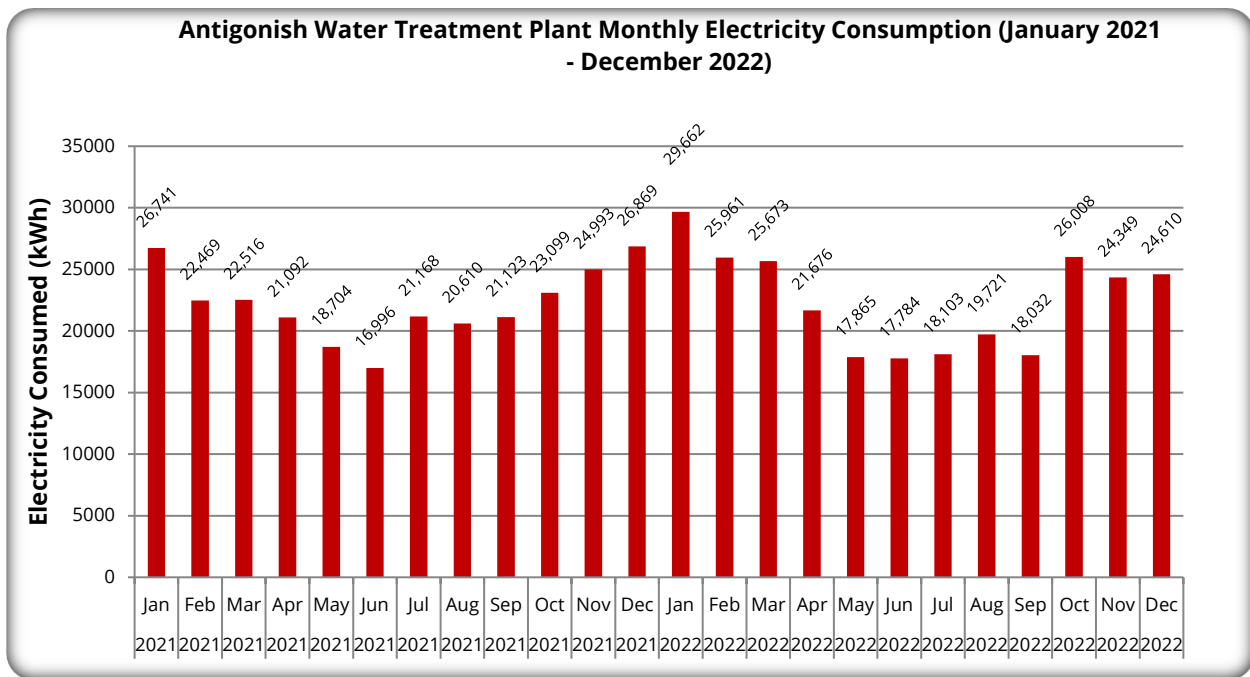
- ▶ The exterior walls appear to be in good condition. The estimated R-value for the above grade exterior walls is R-20. Below grade exterior walls are estimated to be R-11.
- ▶ The building roof appears to be in good condition. The estimated R-value for the roof is R-30.
- ▶ A 61.6 kWdc PV array is installed on the roof. This array is a part of a power purchase agreement with NSPI and does not supply electricity to the building.
- ▶ Vinyl frame, double paned windows appear in good condition with an estimated R-value of R-3.
- ▶ The floor is slab-on-grade. The estimated R-value is R-1.4.
- ▶ Exterior doors appear in good condition. R-value is estimated to be R-3.
- ▶ Weatherstripping around the man-doors appears to be in fair condition.
- ▶ The interior lighting is a combination of LED, fluorescent, and HPS with manual ON/OFF switches. Exterior light is provided by LEDs.
- ▶ One oil-fired boiler provides hot water up to 82°C (180°F), for the hydronic heating system, at an estimated efficiency of approximately 80-90% to the administrative spaces and process areas.
- ▶ The temperature setpoint is 22°C year-round for the administrative spaces with a nighttime setback of 18°C. All the thermostats in this space are programmable.
- ▶ The temperature setpoint is 15°C in the winter for the process spaces, except the soda ash room which is set to 24°C. The thermostat for this space is manual.
- ▶ Domestic hot water is provided by a 38 US Gallon electric hot water heater that serves the building washrooms and lunchroom.
- ▶ Cooking appliances are electric.

## 9.2 Review of Historic Energy Performance

Electricity bills were provided for the 24-month period between January 2021-2022. Energy consumption and demand were reviewed in annual terms to ensure that variation in seasonality was observable. With at least two periods available, a month-to-month comparison of the facility's energy performance was completed from one year to the next. Review of electricity consumption profiles, based on the information obtained from the two periods, was discussed, and is compared in this section.

### 9.2.1 Electricity Use Profiles

Figure 9.2 provides the monthly electricity usage profile which shows the 24-month period from January 2021 to December 2022.



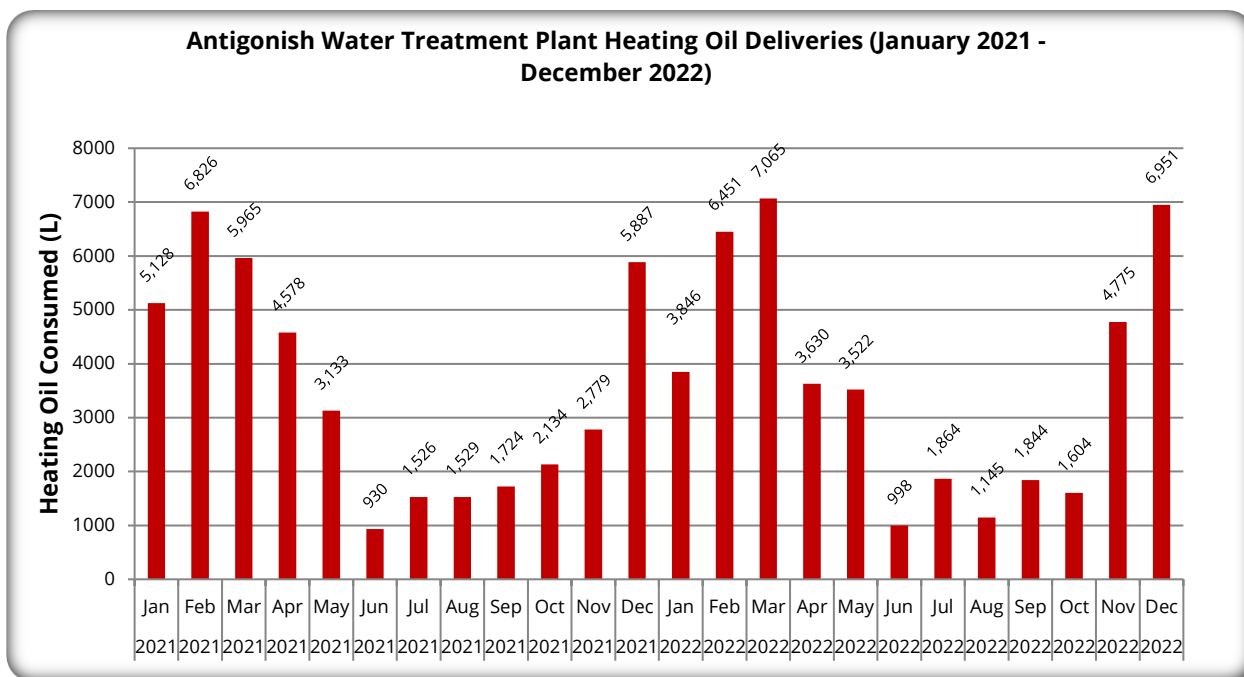
**Figure 9.2: 2021/2022 Monthly Electricity Consumption**

Figure 9.2 depicts a trend with a higher electricity consumption in the winter than in the summer. Electricity consumed is directly impacted by the amount of water that needs to be processed.

Total electricity usage in the period of January/December 2021 was 266,380 kWh and 269,444 kWh from January/December 2022. The average annual energy consumption considering these two 12-month periods was 267,912kWh.

### 9.2.2 Heating Oil Consumption

The Town of Antigonish provided the heating oil delivery records to the site for the period of January 2021 to December 2022. Total heating oil usage for the period of January/December 2021 was 42,138 L and 43,694 L from January/December 2022. The average annual fuel consumption for this period was 42,916.3 L. Heating oil is consumed by a boiler to provide space heating to the building. The figures are based on delivered quantities each month and do not necessarily reflect quantities consumed each month.



**Figure 9.3: 2021/2022 Monthly Heating Oil Deliveries**

### 9.2.3 Electricity Cost

Electricity is provided by NS Power at a “Commercial General Tariff Rate”<sup>42</sup>.

**Above 3 kilowatts connected load:**

<u>Base Rate:</u>	\$8.75 per month per kilowatt of maximum demand.
<u>Energy Rates:</u>	\$0.15945 per kilowatt hour for the first 100 kilowatt hours per month per kilowatt of maximum demand.
	\$0.09993 per kilowatt hour for all additional consumption.
<u>Base Rate:</u>	\$8.75 per kilowatt of maximum demand.
<u>Minimum Bill:</u>	The greater of the Base Rate or \$10.53.
<u>Efficiency Nova Scotia Charges</u>	\$0.00 per kilowatt hour for all consumption.

**Figure 9.4: NS Power Tariff Rate**

Table 9.2 presents the monthly power bill cost breakdown for the January 2021 to December 2022, 24-month period. Electricity consumption was provided from January 2021 to December 2022. Billing costs were provided from January 2021 to March 2022.

<sup>42</sup> Source: [General Tariff | Nova Scotia Power \(nspower.ca\)](https://www.nspower.ca). Retrieved: 2022-12-13

**Table 9.2: Monthly Power Bill Cost Breakdown for the January 2021 to December 2022**

Month-Year	Consumption (kWh)	Consumption Amount	Demand (kW)	Demand Amount	Additional Charges (\$)	HST (\$)	Invoice Amount
January 2021	26,741	\$2,759.22	71.5	\$551.55	\$65.53	\$506.45	\$3,882.75
February 2021	22,469	\$2,381.92	73.4	\$566.21	\$220.35	\$475.27	\$3,643.75
March 2021	22,516	\$2,410.48	78.5	\$605.55	\$549.58	\$534.84	\$4,100.45
April 2021	21,092	\$2,270.25	76.1	\$587.04	\$527.02	\$507.65	\$3,891.96
May 2021	18,704	\$2,040.94	73.3	\$565.44	\$688.03	\$494.16	\$3,788.57
June 2021	16,996	\$1,895.05	75.1	\$579.32	\$743.55	\$482.69	\$3,700.61
July 2021	21,168	\$2,272.37	75.1	\$579.32	\$636.59	\$523.24	\$4,011.52
August 2021	20,610	\$2,213.79	73.4	\$566.21	\$715.59	\$524.34	\$4,019.93
September 2021	21,123	\$2,270.67	75.6	\$583.18	\$471.85	\$498.86	\$3,824.56
October 2021	23,099	\$2,434.61	72.5	\$559.27	\$387.79	\$507.25	\$3,888.92
November 2021	24,993	\$2,625.92	76.7	\$591.66	\$199.87	\$512.62	\$3,930.07
December 2021	26,869	\$2,795.58	76.7	\$591.66	\$90.62	\$521.68	\$3,999.54
January 2022	29,662	\$3,121.26	76.1	\$587.04	\$29.18	\$560.62	\$4,298.10
February 2022	25,961	\$2,770.39	74.7	\$576.24	\$114.26	\$519.13	\$3,980.02
March 2022	25,673	\$2,760.77	78.3	\$604.01	\$382.98	\$562.16	\$4,309.92
April 2022	21,676	\$2,378.56	76.1	\$587.04	\$533.11	\$524.81	\$4,023.52
May 2022	17,865	\$2,016.52	74.5	\$574.69	\$899.20	\$523.56	\$4,013.97
June 2022	17,784	\$2,001.35	72.9	\$562.35	\$821.95	\$507.85	\$3,893.50
July 2022	18,103	\$2,021.49	70.9	\$546.92	\$937.51	\$525.89	\$4,031.81
August 2022	19,721	\$2,183.40	73.3	\$565.44	\$670.42	\$512.89	\$3,932.15
September 2022	18,032	\$2,026.80	73.4	\$566.21	\$471.87	\$459.73	\$3,524.61
October 2022	26,008	\$2,772.85	74.3	\$573.15	\$185.64	\$529.75	\$4,061.39
November 2022	24,349	\$2,612.85	73.1	\$563.89	\$243.92	\$513.10	\$3,933.76
December 2022	24,610	\$2,638.55	73.4	\$566.21	\$113.46	\$497.73	\$3,815.95

## 9.2.4 Heating Oil Cost

The Town of Antigonish provided the heating oil delivery records to the site for the period of January 2021 to December 2022. The average cost during this time period was \$1.26/L. Due to the significant increase in oil prices since the billing period, the cost savings calculations have been conducted using a value more representative to current market prices of \$1.79/L<sup>43</sup>.

## 9.2.5 Total Energy Use Summary

Electricity costs were incomplete for the January/December 2022 year.

<b>Antigonish Water Treatment Plant – Area: 931 m<sup>2</sup></b>	<b>2021</b>	<b>2022</b>
<b>Electricity</b>		
Annual Electricity and Demand Cost (\$)	\$46,682.62	\$47,818.70
Annual Electricity Consumption (kWh)	266,380	269,444
Annual Electricity Consumption (GJ)	959	970
Cost per GJ (\$/GJ)	\$48.7	\$49.3
Percentage of Total Energy (%)	37.1%	36.6%
<b>Heating Oil</b>		
Annual Heating Oil Cost (\$)	\$39,041.15	\$69,340.95
Annual Heating Oil Consumption (L)	42,138	43,694
Annual Heating Oil Consumption (GJ)	1,622.7	1682.64
Cost per GJ (\$/GJ)	24.1	41.2
Percentage of Total Energy (%)	62.9%	63.4%
<b>Summary – Total</b>		
Annual Energy Costs (\$)	\$85,723.77	\$117,159.65
Annual Energy Consumption (GJ)	2,582	2,653
Cost per GJ (\$/GJ)	\$33.2	\$44.2
Percentage of Total Energy (%)	100.00%	100.00%

The baseline energy usage for this study was determined using the January/December 2022 year. This year was selected for the baseline as it was determined that this would more accurately depict each facility's regular operations and energy usage after the COVID-19 pandemic.

<sup>43</sup> Source: [Weekly Average Retail Prices for Furnace Oil in 2023 | Natural Resources Canada \(nrcan.gc.ca\)](https://www.nrcan.gc.ca/energy/11327)  
Retrieved: 2023-04-01.

## 9.2.6 Benchmarking

The energy use per area or energy use intensity (EUI) for this facility is 0.66 GJ/average daily flow in m<sup>3</sup>. According to the Energy Star Portfolio Manager for Canada<sup>44</sup>, the average EUI for a water treatment plant is 0.63 GJ/average daily flow in m<sup>3</sup>. Currently, this facility sits approximately 4.8% higher than the average.

## 9.2.7 End-use Breakdown

The energy use breakdown for this building was estimated by assuming the hours of operation for the process equipment, lighting, and average electrical loads for the space type. A model of the building was created which allowed us to estimate the energy use breakdown shown. Lighting and process equipment were estimated separately from information obtained during the site visit. This energy use breakdown is an estimation based on the information collected during the site visit and from the drawings. This information can only be confirmed with dedicated submetering of the different electrical subpanels and appliances in the facility. The review of this data allowed us to identify the following:

- ▶ The figure depicts that the majority of the energy consumption of the building, 64.4%, can be attributed to space heating.
- ▶ The second largest source of energy usage is the process equipment at approximately 30.6%.
- ▶ The third largest source of energy consumption is lighting at 2.8%.
- ▶ The remaining 2.2% is comprised of electrical equipment, mechanical equipment, and fans at 0.6%, 1.0%, and 0.6%, respectively.

**Table 9.3: Energy Use Breakdown**

End-use	Energy Use Breakdown (%)	Site Energy (GJ)
Space Heating	64.4%	1682.2
Process Equipment	30.6%	800.8
Lighting	2.8%	73.9
Electrical Equipment	0.6%	15.5
Air System Fans	0.6%	14.4
Pumping	1.0%	26.8
<b>Total</b>	<b>100%</b>	<b>2613.7</b>

<sup>44</sup> Source: [Canadian Energy Use Intensity by Property Type – Technical Reference \(canada.ca\)](#).

Retrieved: 2023-01-23

## 9.3 Energy and GHG Reduction Pathway

### 9.3.1 Pathway Components

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#### 9.3.1.1 Replace Existing Oil-Fired Boiler with a Propane Boiler at End of Life with Outdoor Air Temperature Reset

The building is heated by a hydronic heating system that utilizes an oil-fired boiler with an estimated efficiency of 85%. This facility is on the NSPI grid and based on the emissions projections used in this study, the emission intensity for electricity produces more greenhouse gases than propane for the entirety of the study, even when accounting for efficiency. An electric boiler will only produce less greenhouse gases when the grid reaches an emission intensity less than 0.194 kgCO<sub>2e</sub>/kWh.

For this reason, an electric boiler has not been recommended and instead a propane boiler is recommended. A propane boiler can provide the same output at the same average efficiency as the current boiler while also having a lower carbon emission intensity than heating oil per unit of energy.

The boiler for the hydronic heating system currently heats the supply water to a constant temperature of 82°C (180°F) regardless of the air temperature outside. There is potential for energy consumption reduction in the modulation of the supply water temperature for the terminal units according to the outdoor temperature. Outdoor reset control uses the heating curve to set the relationship between the outdoor temperature and the supply water temperature. The heating curve defines the amount the supply water temperature is raised for every 1° drop in outdoor air temperature. During mild outdoor temperatures, the supply water temperature will be low, while during the coldest day of the year the supply water temperature will be at design conditions. Outdoor reset reduces indoor temperature changes by more closely matching the output of the terminal units to the load. It also increases system efficiency by minimizing distribution losses. It is recommended that this system be implemented with the installation of a propane boiler.

#### 9.3.1.2 Upgrade Existing Lighting to LEDs

The interior and exterior lighting for the facility is a mixture of LED, fluorescent, and HPS fixtures. LEDs can provide the same level of light as other types of fixtures while consuming less energy. Therefore, considering the difference between the consumption levels of the current lamps and LED lamps, the implementation of this recommendation could result in significant energy savings.

Based on the findings from the building condition assessment completed in parallel to the energy study, lighting fixtures in this facility have reached the end of their expected useful

life. Therefore, the recommendation is to replace the existing lighting fixture with LED fixtures.

When calculating the input power of the existing lighting, we prepared estimates of the quantity and type of lamps (bulbs) based on visual observation of the fixtures. Since it is difficult to know what type of ballast is used in each fixture without disassembly, the analysis team considered a minimum factor of 1.1 for fluorescent fixtures and 1.2 for HID.

The implementation of LED lighting will result in reduced maintenance costs over the following years. This is due to LEDs having a longer lifespan than the existing lighting fixtures. It is estimated that a non-LED lighting fixture has a maintenance cost of \$4/yr, while LEDs have an estimated maintenance cost of \$2/yr. This leads to a savings of \$2/yr in maintenance per fixture.

### 9.3.1.3 Install Occupancy Sensors for Intermittently Used Spaces

Spaces within the facility are currently controlled by manual ON/OFF switches. To reduce the amount of time the lights are left on (or forgotten ON) with spaces unoccupied, it is recommended that occupancy sensors be installed. Occupancy sensors come in a wide range of configurations and characteristics. They can be installed on walls, ceilings, or at the switch location. Detection can be based on sound, infrared heat, or both. The sensor has a relay that interrupts the voltage to the fixtures in the circuit, thus turning them off when no occupancy is detected. The viability for installation of an occupancy sensor depends on the cost of electricity, the size of the load (number and wattage of lights) being controlled, and the approximate number of unoccupied hours they are often being left turned on.

### 9.3.1.4 Repair Exhaust Louvers

Exhaust louvers located on the building show some damage and do not appear to shut properly. This allows for outdoor air infiltration, which causes additional heating loads and results in higher energy demand to heat spaces. It is recommended that these louvers be repaired to minimize infiltration.

### 9.3.1.5 Replace Weatherstripping on All Exterior Doors and Seal Exterior Openings

Some of the windows and doors in this facility exhibit gaps and cracks that will allow for outdoor air infiltration. This causes additional heating loads which impact the energy consumption from the HVAC systems. It is recommended that the envelope of conditioned spaces be inspected and caulking applied around the exterior windows, doors, and other exterior wall openings. Damaged and missing weatherstripping on the doors and windows in the facility should also be replaced.

### 9.3.1.6 Variable Frequency Drive on Recycling Pumps

The recycle system consists of three recycle pumps (normally in a duty/duty/standby arrangement when two clarifiers are in operation). The recycle pumps are not equipped with VFDs. In normal operations, the two pumps together produce a total flow of 26 m<sup>3</sup>/h. During normal operation, the pump discharge pressure is 79 psi and the saturator tank is maintained at a pressure of 56 psi. This pressure drop of 23 psi is primarily induced by the saturator tank inlet valve. Since pumps are not equipped with VFDs, two pumps are run at full speed to supply enough recycle water to maintain flow and pressure. The addition of VFDs on the pumps will allow for lower speeds of the pumps to deliver the required flow to the saturator tank, instead of using the inlet valve to control flow. The addition of VFDs will allow modulation of the pumps' speed and output, ensuring that energy is used only when necessary.

### 9.3.1.7 Install Ground Mounted PV System

The installation of a ground mounted solar PV system facing south could provide a fraction of the power consumed in the building. PV systems will help to improve the energy supply reliability, reduce energy costs, lower facility carbon footprint, and reduce the environmental impact of operating the building. The estimated size of the additional PV is 26.3 kWp DC.

## 9.3.2 Energy Rates and Emission Intensity Factors

The following list includes all the assumptions and variables considered for the technical and financial analysis:

▶ Cost of Electricity 2022 (Estimated):	\$0.1775/kWh
▶ Cost of Electricity PV:	\$0.10521/kWh
▶ Cost of Propane:	\$0.64/L
▶ NSPI GHG Emission Intensity Factor 2022:	0.5572 CO <sub>2</sub> e kg/kWh <sup>45</sup>
▶ NSPI GHG Emission Intensity Factor 2033:	0.3164 CO <sub>2</sub> e kg/kWh
▶ NSPI Electric GHG Emission Intensity Factor 2043:	0.1760 CO <sub>2</sub> e kg/kWh
▶ PV Electricity GHG Emission Intensity <sup>46</sup> :	0.046 CO <sub>2</sub> e kg/kWh
▶ Heating Oil GHG Emission Intensity Factor:	2.71 CO <sub>2</sub> e kg/L <sup>47</sup>
▶ Propane GHG Emission Intensity Factor:	1.52 CO <sub>2</sub> e kg/L <sup>47</sup>

**Table 9.4: Projected Annual Carbon Emissions, No Measures Implemented**

Energy Source	2022 Energy Usage (GJ)	2022 Emissions (tonnes)	2033 Projected Emissions (tonnes)	2043 Projected Emissions
NSPI	970.0	150.1	85.3	47.4
Heating Oil	1682.6	118.4	118.4	118.4
<b>Total</b>	<b>2652.6</b>	<b>268.5</b>	<b>203.6</b>	<b>165.8</b>

<sup>45</sup> Source: [Air Emissions Reporting | Nova Scotia Power \(nspower.ca\)](https://www.nspower.ca). Retrieved: 2023-09-01

<sup>46</sup> Source: [Life Cycle Greenhouse Gas Emissions from Solar Photovoltaics \(Fact Sheet\), NREL \(National Renewable Energy Laboratory\)](https://www.nrel.gov). Retrieved 2023-11-20

<sup>47</sup> Source: [Emission Factors for Greenhouse Gas Inventories \(epa.gov\)](https://www.epa.gov). Retrieved: 2023-04-01

The baseline energy consumption, January-December 2022, for the Antigonish Water Treatment Plant is 2652.6 GJ annually and results in carbon emissions of 268.5 tonnes/year based on 2022 emissions factors. The carbon emission intensity of the electric grid and fossil fuels are projected to decrease during the lifespan of this study. Table 9.4 shows the projected annual emission without the implementation of any energy conservation measures. Compared to the baseline, emissions are expected to decrease by 24.2% and 38.3% by 2033 and 2043, respectively.

### 9.3.3 Phase 1 Measurement and Analysis

A simplified HAP model of the building was created, and the model was calibrated to have the annual heating oil usage of the facility within +/- 5%. To simulate the heating load for the process space the cold-water sensible load was input, the load size was estimated by using an average ground water temperature of 8°C and an estimated exposed area for the processing tanks. This allowed for a more accurate assessment of how the HVAC system provided energy to each space. This model was modified to estimate the savings on the building's performance and considering the efficiency measures listed below. The percent savings was then applied to the building's overall energy usage. These modifications included:

- ▶ Replacement of the 85% efficient oil-fired boiler with an 85% efficient propane boiler and an outdoor air temperature reset.
- ▶ Infiltration values were decreased by 10% in the office spaces and 5% for all process areas to represent weatherstripping and sealing of exterior surfaces.

The following measures were calculated separately:

- ▶ **Variable Frequency Drive for Recycling Pumps:** The baseline for the recycling pumps was determined by calculating the energy usage of one 10 hp pump running at the rated capacity 24 hours per day every day and two additional 10 hp pumps operating 12 hours per day everyday. The savings were determined by assuming two pumps will operate at 62.5% of their rated rpm 24 hours per day all year.
- ▶ **Repair Louvers for Exhaust Fans:** It was assumed that the process area had an average air temperature of 15°C, with an average outdoor air temperature of 2°C when the building was in operation. The existing air exhaust fans were assumed to have a ¼" gap along the louver and was estimated to be ⅛" when repaired. The oil-fired boiler was assumed to have an efficiency of 85%.
- ▶ **Upgrade Lighting to LED with Occupancy Sensors:** Lighting wattages for spaces without LEDs were compared to LED equivalent wattages. It was assumed that the lights were on from 6.4 hours per day, seven days/week year-round in all spaces, with the exception of the mechanical/electrical rooms which were estimated to be on three hours per week on average, as well as the chlorine storage room and Tankage room (florescent fixtures), which were estimated to be on 24 hours per day for the baseline to correspond with the estimated occupancy of the building. The operating hours of then lighting systems was reduced by 12.5% to account for savings if occupancy sensors are installed.

► **Ground Mounted PV System:** The PV System energy production was estimated by determining an area on-site that would be suitable for the installation of the system. Assuming that the system was facing due south with panels at a slope of between 40-45°, a production rate of 0.6 kW/m<sup>2</sup> was used with an estimated ground area of 4725 ft<sup>2</sup> was assumed, based on this a 26.3 kWp DC system could be installed. An annual output of 1250 kWh/kWp DC install was estimated.

The implementation of these measures to the Antigonish Water Treatment Plant will result in a reduction of energy consumption from the baseline of 436.6GJ. The total cost to implement Phase 1 measures is approximately \$210,565 with a cost savings of an estimated \$59,129/year for a payback period of 3.6 years. These measures will have an emissions savings of 65.1 tonnes/year in 2033 compared to the baseline building's emissions in the same year as presented in Table 9.5.

**Table 9.5: Antigonish Water Treatment Plant Phase 1 Energy Efficiency Measures**

ECM	CAPEX (\$)	GHG Savings (tonne)	CAPEX/ GHG Reduction (\$/tonne)	Energy Savings GJ/yr	Cost Savings \$/yr	Cost Savings/ GHG Saved (\$/tonne CO <sub>2</sub> e)	Simple Payback (yr)
Upgrade Lighting to LED*	\$25,020	4.9	\$5,534	56	\$2,926	\$595	9.3
Occupancy Sensors for Lighting Controls	\$2,200						
Propane Boiler with Outdoor Air Temperature Reset*	\$60,000	18.7	\$3,565	19	\$35,581	\$1,903	1.9
Concrete Pad for Propane Tank	\$5,000						
Infiltration Reduction	\$1,650						
Add VFD to Recycle Pumps	\$50,000	31.2	\$1,600	355.5	\$17,528	\$561	2.9
Repair Louvers for Exhaust Fans	\$14,000	0.4	\$38,143	6.1	\$155	\$422	90.3
PV Systems	\$52,695	8.9	\$3,283	0.0	\$2,938	\$330	17.9
<b>ECM Implementation Total</b>	<b>\$210,565</b>	<b>64.1</b>	<b>\$3,283</b>	<b>436.6</b>	<b>\$59,129</b>	<b>\$922</b>	<b>3.6</b>

## 9.3.4 Phase 2 Measurement and Analysis

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No additional measures were considered for implementation in this facility in Phase 2.

# 10 Energy and GHG Reduction Pathway for Eight Buildings

## 10.1 Energy Rates & Emission Intensity Factors

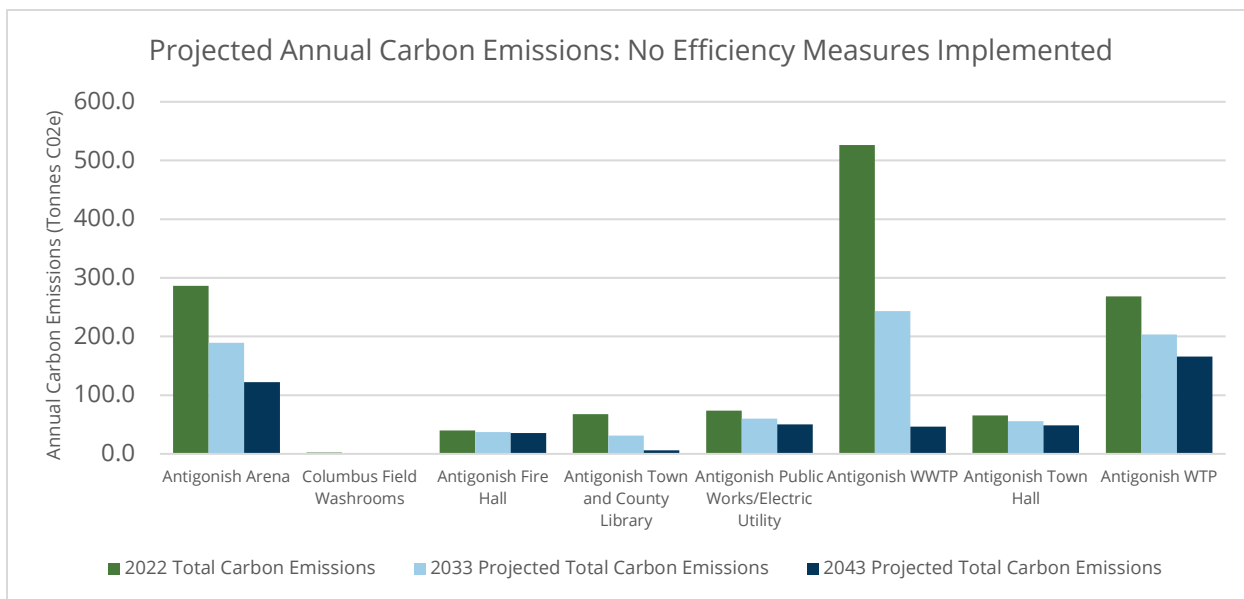
The scope of this study is to present a pathway for the TOA to reduce cumulative carbon emissions by 50% by 2033, Phase 1, and by 80% by 2043, Phase 2. The study is comprised of eight buildings, which are listed in no particular order in Table 10.1, as well as their baseline energy usage. The baseline energy usage was determined using the January/December 2022 year. This year was selected for the baseline as it was determined that this would more accurately depict each facility’s regular operations and energy usage after the COVID-19 pandemic.

**Table 10.1: Baseline Energy Consumption January/December 2022 for each of the Eight Facilities**

Facility	Electricity Consumption (kWh)	Heating Oil Consumption (L)	Propane Consumption (L)
Antigonish Arena	532,800	36,775	4,310
Columbus Field Washrooms	7,111	0	0
Antigonish Fire Hall	14,685	12,925	0
Antigonish Town and County Library	202,490	0	0
Antigonish Public Works/Electric Utility	74,927	17,777	0
Antigonish WWTP	1,553,220	0	0
Antigonish Town Hall	55,040	17,411	0
Antigonish WTP	269,444	43,694	0

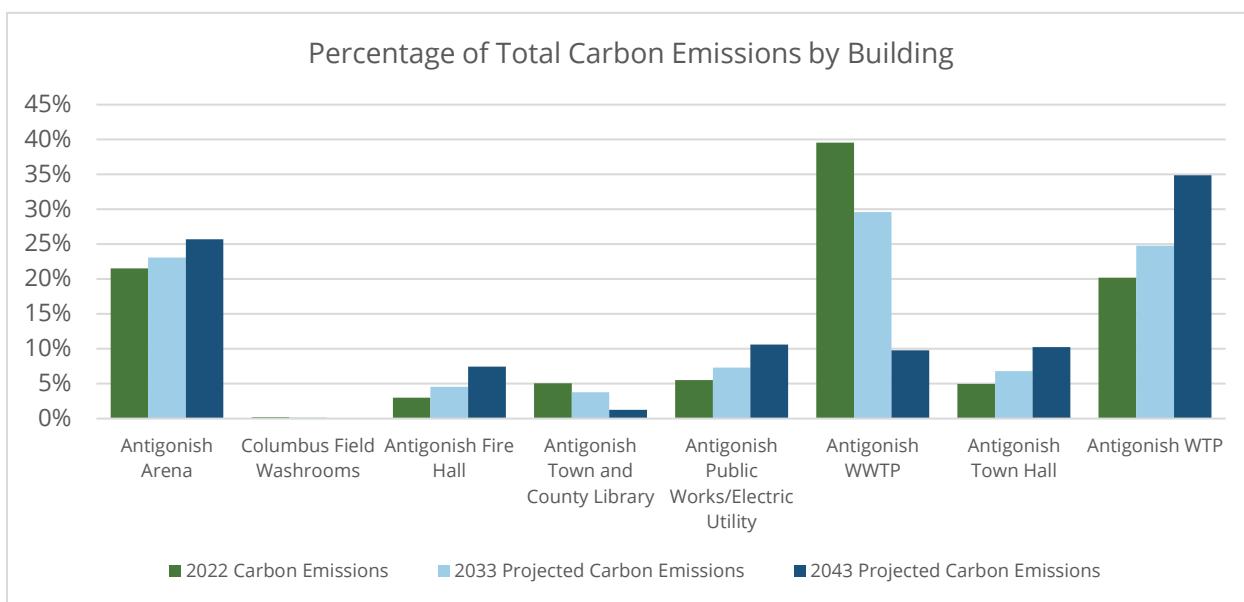
All electricity is provided by the Antigonish Electric Utility with the exception of the Antigonish Water Treatment Plant, which uses NSPI, and the Antigonish Town and County library which has a solar array with an estimated production of 3,690 kWh per year.

The annual carbon emissions for each building and the natural decarbonization of the facilities as both electric grid’s emission intensities reduce over time are presented in Figure 10.1.



**Figure 10.1: Baseline and Projected Annual Carbon Emissions for each of the Eight Facilities**

A breakdown of the percentage of the total carbon emissions each building contributes to the overall total emissions and a projection of how percentages will change over time is presented in Figure 10.2.



**Figure 10.2: Baseline and Projected Percentage of Total Carbon Emissions for each of the Eight Facilities**

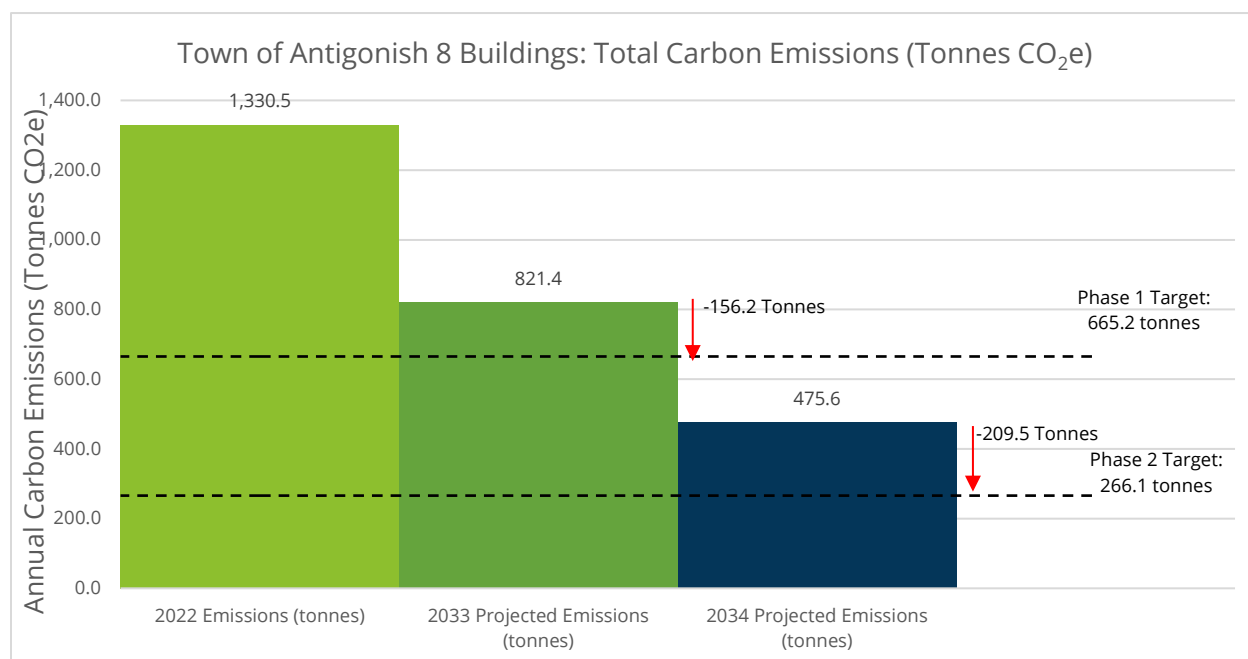
The total baseline carbon emissions for the Town of Antigonish, for the facilities included in this study, as well as how they decrease by the end of Phase 1 and Phase 2 are presented in Table 10.2.

**Table 10.2: Total Emissions by Source for all Eight Buildings**

Energy Source	2022 Energy Usage (GJ)	2022 Emissions (tonnes)	2033 Projected Emissions (tonnes)	2043 Projected Emissions
Antigonish Electric	8771.7	825.3	381.3	73.1
NSPI	970.0	150.1	85.3	47.4
PV System	13.3	0.17	0.17	0.17
Heating Oil	4951.6	348.3	348.3	348.3
Propane	109.7	6.6	6.6	6.6
<b>Total</b>	<b>14,816.3</b>	<b>1,330.5</b>	<b>821.4</b>	<b>475.6</b>

The total baseline energy consumption, January-December 2022, is 14,816.3 GJ annually and results in carbon emissions of 1330.5 tonnes per year based on 2022 emissions factors. The carbon emission intensity of the electric grid and fossil fuels are projected to decrease during the lifespan of this study. Table 10.2 shows the projected annual emission without the implementation of any energy conservation measures. Compared to the baseline, emissions are expected to decrease by 38.3% and 64.3% by 2033 and 2043, respectively.

The emission targets for the end of Phases 1 and 2 are a 50% and 80% reduction from 2022 values. This will be an annual emission of 665.3 and 266.1 tonnes CO<sub>2</sub>e by 2033 and 2043, respectively. Considering the natural reduction that will occur over this time period, the implementation of energy efficiency measures will need to reduce carbon emissions by 156.3 tonnes in Phase 1 and 209.4 tonnes in Phase 2 to meet emissions targets as shown in Figure 10.3.



**Figure 10.3: Eight Buildings Total Annual Carbon Emissions compared to Phase 1 and 2 Targets**

The following list includes all the assumptions and variables considered for the technical and financial analysis:

▶ Cost of Electricity:	
o Antigonish Arena:	\$0.1258/kWh
o Columbus Field Washrooms:	\$0.2667/kWh
o Antigonish Fire Hall:	\$0.1745/kWh
o Antigonish Town and County Library:	\$0.1467/kWh
o Antigonish Public Works/Electric Utility:	\$0.1476/kWh
o Antigonish WWTP:	\$0.1268/kWh
o Antigonish Town Hall:	\$0.1541/kWh
o Antigonish WTP:	\$0.1775/kWh
▶ Cost of Heating Oil:	\$1.79/L
▶ Cost of Propane:	
o Antigonish Arena (Heating):	\$0.80/L
o Antigonish Arena (Ice Resurfacers):	\$0.97/L
o Antigonish WTP:	\$0.64/L
▶ Antigonish Electric GHG Emission Intensity Factor 2022:	0.3387 CO <sub>2</sub> e kg/kWh <sup>48</sup>
▶ Antigonish Electric GHG Emission Intensity Factor 2033:	0.1565 CO <sub>2</sub> e kg/kWh
▶ Antigonish Electric GHG Emission Intensity Factor 2043:	0.0300 CO <sub>2</sub> e kg/kWh
▶ NSPI GHG Emission Intensity Factor 2022:	0.5572 CO <sub>2</sub> e kg/kWh <sup>48</sup>
▶ NSPI Electric GHG Emission Intensity Factor 2033:	0.3164 CO <sub>2</sub> e kg/kWh <sup>48</sup>
▶ NSPI Electric GHG Emission Intensity Factor 2043:	0.1760 CO <sub>2</sub> e kg/kWh <sup>48</sup>
▶ PV Electricity GHG Emission Intensity <sup>49</sup> :	0.046 CO <sub>2</sub> e kg/kWh
▶ Heating Oil GHG Emission Intensity Factor:	2.71 CO <sub>2</sub> e kg/L
▶ Propane GHG Emission Intensity Factor:	1.52 CO <sub>2</sub> e kg/L

### 10.1.1 Phase 1 Measurement and Analysis

When considering the implementation of Phase 1 reduction measures, the total emissions for each building are presented in Table 10.3. A cumulative natural reduction of emissions of 508.9 tonnes can be observed, and an additional 211.1 tonnes can be attributed to the addition energy conservation measures implemented in Phase 1. The total annual emissions for all eight buildings are 610.5 tonnes, with an emissions reduction of 54.1% compared to the baseline.

<sup>48</sup> Source: [Air Emissions Reporting | Nova Scotia Power \(nspower.ca\)](https://www.nspower.ca). Retrieved: 2023-04-01

<sup>49</sup> Source: [Life Cycle Greenhouse Gas Emissions from Solar Photovoltaics \(Fact Sheet\), NREL \(National Renewable Energy Laboratory\)](https://www.nrel.gov/pv/life-cycle-greenhouse-gas-emissions-from-solar-photovoltaics). Retrieved 2023-11-20

**Table 10.3: Town of Antigonish Phase 1 Emission Reductions Summary**

Building	2022 Baseline Emissions (Tonnes)	Natural Emission Reductions (Tonnes) - No ECMs Implemented	Phase 1 ECM Emissions Reductions (Tonnes)	2033 Building Emissions After ECMs	Emissions Saved %
Antigonish Arena	286.7	97.1	61.8	127.8	55.4%
Columbus Field Washroom	2.4	1.3	0.6	0.6	77.1%
Antigonish Fire Hall	40.0	2.7	11.6	25.7	35.7%
Antigonish Library	67.3	36.2	8.2	22.9	66.0%
Public Works/ Electric Utility	73.6	13.7	27.4	32.5	55.7%
WW Treatment Plant	526.1	283.0	3.1	240.0	54.4%
Antigonish Town Hall	65.8	10.0	34.3	21.5	67.4%
Water Treatment Plant	268.5	64.9	64.1	139.5	48.0%
<b>Totals</b>	<b>1330.5</b>	<b>508.9</b>	<b>211.1</b>	<b>610.5</b>	<b>54.1%</b>

The total capital cost to implement Phase 1 measures, as well as cost savings is presented in Table 10.4. The total estimated capital cost to implement Phase 1 will be \$1,531,686. This will have a cost savings of approximately \$142,098 per year. Based on this, Phase 1 will have a simple payback period of 10.8 years.

**Table 10.4: Town of Antigonish Phase 1 Capital Cost and Simple Payback Summary**

Building	CAPEX	CAPEX/Phase 1 ECM GHG Reduction (\$/tonne)	Energy Savings (GJ)	Cost Savings	Simple Payback Period
Antigonish Arena	\$350,125	\$5,665	594.6	\$36,929	9.5
Columbus Field Washroom	\$2,060	\$3,668	12.9	\$973	2.1
Antigonish Fire Hall	\$195,060	\$16,820	132.4	\$6,147	31.7
Antigonish Library	\$8,000	\$991	185.7	\$5,867	1.4
Public Works/Electric Utility	\$227,822	\$8,329	218.0	\$12,363	18.4
WW Treatment Plant	\$213,780	\$69,445	70.8	\$2,530	84.5
Antigonish Town Hall	\$331,610	\$9,655	357.0	\$18,159	18.3
Water Treatment Plant	\$210,565	\$3,283	436.6	\$59,129	3.6
<b>Totals</b>	<b>\$7,240</b>	<b>2008.0</b>	<b>\$142,098</b>	<b>10.8</b>	<b>\$7,240</b>

## 10.1.2 Phase 2 Measurement and Analysis

When considering the implementation of Phase 2 reduction measures, the total emissions savings for each building are presented in Table 10.5. A cumulative natural reduction of emissions of 854.9 tonnes can be observed, and an additional 280.5 tonnes can be attributed to the addition energy conservation measures implemented in Phase 1. Phase 2 efficiency measures result in an additional savings of 4.0 tonnes. The total annual emissions for all eight buildings are 191.1 tonnes with an emissions reduction of 85.6% compared to the baseline.

Without the additional implementation of phase 2 measures, it is expected that the target emission reduction of 80% would be met. However, considering that the estimated emission intensity factors for 2033 and 2043 are based on the ability of utilities and fossil fuel emission reductions to meet emissions targets it is recommended that these measures be implemented regardless. Additionally, the measures recommended for phase 2 are the upgrade of existing equipment that will be at the end of its useful service life during this time period, it is recommend these should be upgraded to more efficient versions when replaced.

**Table 10.5: Town of Antigonish Phase 2 Emission Reductions Summary**

Building	2022 Baseline Emissions (Tonnes)	Natural Emission Reductions (Tonnes) – No ECMs Implemented	Phase 1 ECM Emissions Reductions (Tonnes)	Phase 2 ECM Emissions Reductions (Tonnes)	2043 Building Emissions After ECMs	Emissions Saved %
Antigonish Arena	286.7	164.5	87.3	3.8	31.1	89.2%
Columbus Field Washrooms	2.4	2.2	0.1	0.01	0.1	96.1%
Antigonish Fire Hall	40.0	4.5	14.6	0.0	20.8	47.9%
Antigonish Library	67.4	61.4	1.5	0.0	4.4	93.4%
Public Works/ Electric Utility	73.6	23.1	43.1	0.2	7.2	90.2%
WW Treatment Plant	526.1	479.5	0.6	0.0	46.0	91.3%
Antigonish Town Hall	65.8	17.0	46.4	0.0	2.4	96.3%
Water Treatment Plant	268.5	102.7	86.9	0.0	79.0	70.6%
<b>Totals</b>	<b>1330.5</b>	<b>854.9</b>	<b>280.5</b>	<b>4.0</b>	<b>191.1</b>	<b>85.6%</b>

The total capital cost and cost savings for each building are presented in Table 10.6. The total estimated capital cost to implement Phase 2 will be \$243,500. This will have a cost savings of approximately \$2,245/year. Based on this, Phase 2 will have a simple payback period of 108.5 years.

**Table 10.6: Town of Antigonish Phase 2 Capital Cost and Simple Payback Summary**

Building	CAPEX	CAPEX/Phase 2 ECM GHG Reduction (\$/tonne)	Energy Savings (GJ)	Cost Savings	Simple Payback Period
Antigonish Arena	\$190,000	\$49,906	29.8	\$1,254	152
Columbus Field Washroom	\$6,000	\$547,945	1.3	\$97	\$62
Antigonish Fire Hall	\$34,500	\$936,980	2.1	102.4	336.8
Antigonish Library	\$0	\$0	0.0	0.0	0.0
Public Works/ Electric Utility	\$13,000	\$80,846	19.3	791.1	16.4
WW Treatment Plant	\$0	\$0	0.0	0.0	0.0
Antigonish Town Hall	\$0	\$0	0.0	0.0	0.0
Water Treatment Plant	\$0	\$0	0.0	0.0	0.0
<b>Totals</b>	<b>\$243,500</b>	<b>\$60,636</b>	<b>52.5</b>	<b>2245</b>	<b>108.5</b>

# 11 Life Cycle Cost Assessment

The life cycle cost analysis (LCCA) includes annual O&M costs and replacement costs for major building components and equipment over a 30-year assessment horizon. The analysis parameters considered in the LCCA development are presented below:

▶ LCCA Term (Years):	30 Years
▶ Debt (%):	100%
▶ Equity (%):	0%
▶ Loan Term (Years):	30 Years
▶ Loan Amortization Every Month:	1
▶ Interest Rate:	4.5%
▶ Discount Rate:	3.75%
▶ Inflation Rate (Operation and Maintenance Cost):	2.0%
▶ Construction Cost Inflation:	3.5%
▶ Antigonish Electric Utility Inflation	4.1%
▶ NSPI Electric Utility Inflation	4.1%
▶ Heating Oil Inflation	10.9%
▶ Propane Inflation	10.9%
▶ Carbon Tax: \$50/ton in 2022, increased by \$15/ton/yr until 2030. Then, assuming \$300/ton in 2050. Lineal increased is assumed.	
▶ Cost of Electricity:	
o Antigonish Arena:	\$0.1258/kWh
o Columbus Field Washrooms:	\$0.2667/kWh
o Antigonish Fire Hall:	\$0.1745/kWh
o Antigonish Town and County Library:	\$0.1467/kWh
o Antigonish Public Works/Electric Utility:	\$0.1476/kWh
o Antigonish WWTP:	\$0.1268/kWh
o Antigonish Town Hall:	\$0.1541/kWh
o Antigonish WTP:	\$0.1775/kWh
o NSPI Electricity PV:	\$0.10521/kWh
▶ Cost of Heating Oil:	\$1.79/L
▶ Cost of Propane:	
o Antigonish Arena (Heating):	\$0.8/L
o Antigonish Arena (Ice Resurfacer):	\$0.97/L
o Antigonish WTP:	\$0.64

▶ Antigonish Electric GHG Emission Intensity Factor 2022:	0.3387 CO <sub>2</sub> e kg/kWh <sup>50</sup>
▶ Antigonish Electric GHG Emission Intensity Factor 2033:	0.1565 CO <sub>2</sub> e kg/kWh
▶ Antigonish Electric GHG Emission Intensity Factor 2043:	0.0300 CO <sub>2</sub> e kg/kWh
▶ NSPI GHG Emission Intensity Factor 2022:	0.5572 CO <sub>2</sub> e kg/kWh <sup>50</sup>
▶ NSPI GHG Emission Intensity Factor 2033:	0.3164 CO <sub>2</sub> e kg/kWh <sup>50</sup>
▶ NSPI GHG Emission Intensity Factor 2043:	0.1760 CO <sub>2</sub> e kg/kWh
▶ PV Electricity GHG Emission Intensity <sup>51</sup> :	0.040 CO <sub>2</sub> e kg/kWh
▶ Heating Oil GHG Emission Intensity Factor:	2.71 CO <sub>2</sub> e kg/L <sup>52</sup>
▶ Propane GHG Emission Intensity Factor:	1.52 CO <sub>2</sub> e kg/L <sup>52</sup>

A list of the equipment that was considered in the LCCA, as well as its estimated lifespan and replacement costs can be found in Appendix C. The estimated implementation timeline for the efficiency measures listed for Phase 1 and Phase 2 is also presented in Appendix A. This timeline is an estimate and corresponds to when the majority of equipment reaches its end of life. If the equipment fails earlier than expected it is recommended that the implementation of the measure occurs prior to the estimated schedule.

The 30-year LCCA for each of the facilities, as well as the total of all eight buildings included in this study is presented in Table 11.1.

**Table 11.1: 30-Year LCCA for each of the Eight Facilities**

Building	Baseline (W/O Energy Efficiency Measures)	With Energy Efficiency Measures
Antigonish Arena	\$9,670,125	\$4,221,784
Columbus Field Washrooms	\$69,765	\$37,918
Antigonish Fire Hall	\$2,471,512	\$1,903,751
Antigonish Town and County Library	\$984,459	\$778,060
Antigonish Public Works/Electric Utility	\$5,348,272	\$3,103,804
Antigonish Wastewater Treatment Plant	\$6,644,684	\$6,688,173
Antigonish Town Hall	\$3,778,343	\$1,352,517
Antigonish Water Treatment Plant	\$9,408,296	\$5,306,300
<b>Totals for the Eight Facilities</b>	<b>\$38,375,455</b>	<b>\$23,392,306</b>

<sup>50</sup> Source: [Air Emissions Reporting | Nova Scotia Power \(nspower.ca\)](https://www.nspower.ca). Retrieved: 2023-04-01

<sup>51</sup> Source: [Life Cycle Greenhouse Gas Emissions from Solar Photovoltaics \(Fact Sheet\), NREL \(National Renewable Energy Laboratory\)](https://www.nrel.gov). Retrieved 2023-11-20

<sup>52</sup> Source: [Emission Factors for Greenhouse Gas Inventories \(epa.gov\)](https://www.epa.gov). Retrieved: 2023-04-01

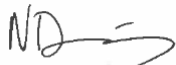
With the exception of the library and the WTP, the remainder of the facilities show a lower LCC over a 30-year-period, compared to the same building without the implementation of EEMs. Also, for the group of eight buildings with EEMs, the LCC is lower than the baseline LCC. This indicates that the implementation of the recommended EEM/phases will result in a lower operational cost over a 30-year-period.

Differences in the life cycle cost assessments between the baseline and proposed facilities are higher in buildings where switching from to a lower carbon emitting energy source was recommended. This is due to a combination of the inflation rate for fossil fuels being higher than that of electricity, as well as the increase in the carbon tax on building emissions over time.

## 12 Closing

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The opinion of probable costs for this study is presented on the basis of experience, qualifications, and best judgement. It has been prepared in accordance with acceptable principles and practices. Sudden market trends, non-competitive bidding situations, unforeseen labour and material adjustments, and the like, are beyond the control of our professional cost estimators. As such, we cannot warrant or guarantee that actual costs and/or savings will not significantly vary from the opinion provided in the preceding sections.



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# APPENDIX A

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## Energy Modelling Reports

## Annual Cost Summary

Project: 237554.00 - Antigonish - Arena Calibrated Model  
 Prepared by: CBCL Limited

02/02/2024  
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**Table 1. Annual Costs**

Component	Antigonish Arena: Baseline Building (\$)	Antigonish Arena:Pathway ECMs (\$)
Air System Fans	793	793
Cooling	30,255	30,245
Heating	69,983	41,241
Pumps	19,007	19,005
Heat Rejection Fans	1,560	1,560
<b>HVAC Sub-Total</b>	<b>121,597</b>	<b>92,843</b>
Lights	8,992	5,099
Electric Equipment	3,389	3,389
Misc. Electric	165	165
Misc. Fuel Use	0	0
<b>Non-HVAC Sub-Total</b>	<b>12,547</b>	<b>8,654</b>
<b>Grand Total</b>	<b>134,143</b>	<b>101,497</b>

**Table 2. Annual Cost per Unit Floor Area**

Component	Antigonish Arena: Baseline Building (\$/sqft)	Antigonish Arena:Pathway ECMs (\$/sqft)
Air System Fans	0.015	0.015
Cooling	0.553	0.552
Heating	1.278	0.753
Pumps	0.347	0.347
Heat Rejection Fans	0.029	0.029
<b>HVAC Sub-Total</b>	<b>2.221</b>	<b>1.696</b>
Lights	0.164	0.093
Electric Equipment	0.062	0.062
Misc. Electric	0.003	0.003
Misc. Fuel Use	0.000	0.000
<b>Non-HVAC Sub-Total</b>	<b>0.229</b>	<b>0.158</b>
<b>Grand Total</b>	<b>2.450</b>	<b>1.854</b>
Gross Floor Area (sqft)	54753.7	54753.7
Modeled Floor Area (sqft)	54753.7	54753.7

Note: Values in this table are calculated using the Gross Floor Area.

# Annual Cost Summary

Project: 237554.00 - Antigonish - Arena Calibrated Model  
Prepared by: CBCL Limited

02/02/2024  
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**Table 3. Component Cost as a Percentage of Total Cost**

<b>Component</b>	<b>Antigonish Arena: Baseline Building (%)</b>	<b>Antigonish Arena: Pathway ECMs (%)</b>
Air System Fans	0.6	0.8
Cooling	22.6	29.8
Heating	52.2	40.6
Pumps	14.2	18.7
Heat Rejection Fans	1.2	1.5
<b>HVAC Sub-Total</b>	<b>90.6</b>	<b>91.5</b>
Lights	6.7	5.0
Electric Equipment	2.5	3.3
Misc. Electric	0.1	0.2
Misc. Fuel Use	0.0	0.0
<b>Non-HVAC Sub-Total</b>	<b>9.4</b>	<b>8.5</b>
<b>Grand Total</b>	<b>100.0</b>	<b>100.0</b>

# Annual Energy and Emissions Summary

Project: 237554.00 - Antigonish - Arena Calibrated Model  
 Prepared by: CBCL Limited

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**Table 1. Annual Costs**

Component	Antigonish Arena: Baseline Building (\$)	Antigonish Arena: Pathway ECMs (\$)
<b>HVAC Components</b>		
Electric	54,324	91,217
Natural Gas	0	0
Fuel Oil	65,504	0
Propane	1,768	1,627
Remote HW	0	0
Remote Steam	0	0
Remote CW	0	0
<b>HVAC Sub-Total</b>	<b>121,596</b>	<b>92,844</b>
<b>Non-HVAC Components</b>		
Electric	12,547	8,654
Natural Gas	0	0
Fuel Oil	0	0
Propane	0	0
Remote HW	0	0
Remote Steam	0	0
<b>Non-HVAC Sub-Total</b>	<b>12,547</b>	<b>8,654</b>
<b>Grand Total</b>	<b>134,143</b>	<b>101,498</b>

# Annual Energy and Emissions Summary

Project: 237554.00 - Antigonish - Arena Calibrated Model  
 Prepared by: CBCL Limited

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**Table 2. Annual Energy Consumption**

Component	Antigonish Arena: Baseline Building	Antigonish Arena: Pathway ECMs
<b>HVAC Components</b>		
Electric (kWh)	431,825	725,097
Natural Gas (na)	0	0
Fuel Oil (*)	36,595	0
Propane (L)	1,668	1,535
Remote HW (na)	0	0
Remote Steam (na)	0	0
Remote CW (na)	0	0
<b>Non-HVAC Components</b>		
Electric (kWh)	99,736	68,791
Natural Gas (na)	0	0
Fuel Oil (*)	0	0
Propane (L)	0	0
Remote HW (na)	0	0
Remote Steam (na)	0	0
<b>Totals</b>		
Electric (kWh)	531,561	793,889
Natural Gas (na)	0	0
Fuel Oil (*)	36,595	0
Propane (L)	1,668	1,535
Remote HW (na)	0	0
Remote Steam (na)	0	0
Remote CW (na)	0	0

(\*) Energy Units differ among Buildings.

**Table 3. Annual Emissions**

Component	Antigonish Arena: Baseline Building	Antigonish Arena: Pathway ECMs
CO2 Equivalent (lb)	0	0

# Annual Energy and Emissions Summary

Project: 237554.00 - Antigonish - Arena Calibrated Model  
 Prepared by: CBCL Limited

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**Table 4. Annual Cost per Unit Floor Area**

Component	Antigonish Arena: Baseline Building (\$/sqft)	Antigonish Arena: Pathway ECMs (\$/sqft)
<b>HVAC Components</b>		
Electric	0.992	1.666
Natural Gas	0.000	0.000
Fuel Oil	1.196	0.000
Propane	0.032	0.030
Remote HW	0.000	0.000
Remote Steam	0.000	0.000
Remote CW	0.000	0.000
<b>HVAC Sub-Total</b>	<b>2.221</b>	<b>1.696</b>
<b>Non-HVAC Components</b>		
Electric	0.229	0.158
Natural Gas	0.000	0.000
Fuel Oil	0.000	0.000
Propane	0.000	0.000
Remote HW	0.000	0.000
Remote Steam	0.000	0.000
<b>Non-HVAC Sub-Total</b>	<b>0.229</b>	<b>0.158</b>
<b>Grand Total</b>	<b>2.450</b>	<b>1.854</b>
Gross Floor Area (sqft)	54753.7	54753.7
Modeled Floor Area (sqft)	54753.7	54753.7

Note: Values in this table are calculated using the Gross Floor Area.

**Table 5. Component Cost as a Percentage of Total Cost**

Component	Antigonish Arena: Baseline Building (%)	Antigonish Arena: Pathway ECMs (%)
<b>HVAC Components</b>		
Electric	40.5	89.9
Natural Gas	0.0	0.0
Fuel Oil	48.8	0.0
Propane	1.3	1.6
Remote HW	0.0	0.0
Remote Steam	0.0	0.0
Remote CW	0.0	0.0
<b>HVAC Sub-Total</b>	<b>90.6</b>	<b>91.5</b>
<b>Non-HVAC Components</b>		
Electric	9.4	8.5
Natural Gas	0.0	0.0
Fuel Oil	0.0	0.0
Propane	0.0	0.0
Remote HW	0.0	0.0
Remote Steam	0.0	0.0
<b>Non-HVAC Sub-Total</b>	<b>9.4</b>	<b>8.5</b>
<b>Grand Total</b>	<b>100.0</b>	<b>100.0</b>

## Annual Cost Summary

Project: Antigonish- Columbus Field Washrooms  
 Prepared by: CBCL Limited

02/02/2024  
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**Table 1. Annual Costs**

Component	Columbus Field Washrooms Baseline (\$)	Columbus Field Washrooms ECM Heat Off (\$)
Air System Fans	0	0
Cooling	0	0
Heating	2,294	940
Pumps	0	0
Heat Rejection Fans	0	0
<b>HVAC Sub-Total</b>	<b>2,294</b>	<b>940</b>
Lights	486	486
Electric Equipment	52	52
Misc. Electric	0	0
Misc. Fuel Use	0	0
<b>Non-HVAC Sub-Total</b>	<b>538</b>	<b>538</b>
<b>Grand Total</b>	<b>2,832</b>	<b>1,478</b>

**Table 2. Annual Cost per Unit Floor Area**

Component	Columbus Field Washrooms Baseline (\$/sqft)	Columbus Field Washrooms ECM Heat Off (\$/sqft)
Air System Fans	0.000	0.000
Cooling	0.000	0.000
Heating	1.896	0.777
Pumps	0.000	0.000
Heat Rejection Fans	0.000	0.000
<b>HVAC Sub-Total</b>	<b>1.896</b>	<b>0.777</b>
Lights	0.402	0.402
Electric Equipment	0.043	0.043
Misc. Electric	0.000	0.000
Misc. Fuel Use	0.000	0.000
<b>Non-HVAC Sub-Total</b>	<b>0.445</b>	<b>0.445</b>
<b>Grand Total</b>	<b>2.341</b>	<b>1.221</b>
Gross Floor Area (sqft)	1209.7	1209.7
Modeled Floor Area (sqft)	1209.7	1209.7

Note: Values in this table are calculated using the Gross Floor Area.

# Annual Cost Summary

Project: Antigonish- Columbus Field Washrooms  
Prepared by: CBCL Limited

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**Table 3. Component Cost as a Percentage of Total Cost**

<b>Component</b>	<b>Columbus Field Washrooms Baseline (%)</b>	<b>Columbus Field Washrooms ECM Heat Off (%)</b>
Air System Fans	0.0	0.0
Cooling	0.0	0.0
Heating	81.0	63.6
Pumps	0.0	0.0
Heat Rejection Fans	0.0	0.0
<b>HVAC Sub-Total</b>	<b>81.0</b>	<b>63.6</b>
Lights	17.2	32.9
Electric Equipment	1.8	3.5
Misc. Electric	0.0	0.0
Misc. Fuel Use	0.0	0.0
<b>Non-HVAC Sub-Total</b>	<b>19.0</b>	<b>36.4</b>
<b>Grand Total</b>	<b>100.0</b>	<b>100.0</b>

## Annual Energy and Emissions Summary

Project: Antigonish- Columbus Field Washrooms  
 Prepared by: CBCL Limited

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**Table 1. Annual Costs**

Component	Columbus Field Washrooms Baseline (\$)	Columbus Field Washrooms ECM Heat Off (\$)
<b>HVAC Components</b>		
Electric	2,294	940
Natural Gas	0	0
Fuel Oil	0	0
Propane	0	0
Remote HW	0	0
Remote Steam	0	0
Remote CW	0	0
<b>HVAC Sub-Total</b>	<b>2,294</b>	<b>940</b>
<b>Non-HVAC Components</b>		
Electric	538	538
Natural Gas	0	0
Fuel Oil	0	0
Propane	0	0
Remote HW	0	0
Remote Steam	0	0
<b>Non-HVAC Sub-Total</b>	<b>538</b>	<b>538</b>
<b>Grand Total</b>	<b>2,832</b>	<b>1,478</b>

## Annual Energy and Emissions Summary

Project: Antigonish- Columbus Field Washrooms  
 Prepared by: CBCL Limited

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**Table 2. Annual Energy Consumption**

Component	Columbus Field Washrooms Baseline	Columbus Field Washrooms ECM Heat Off
<b>HVAC Components</b>		
Electric (kWh)	8,600	3,523
Natural Gas (na)	0	0
Fuel Oil (na)	0	0
Propane (na)	0	0
Remote HW (na)	0	0
Remote Steam (na)	0	0
Remote CW (na)	0	0
<b>Non-HVAC Components</b>		
Electric (kWh)	2,018	2,018
Natural Gas (na)	0	0
Fuel Oil (na)	0	0
Propane (na)	0	0
Remote HW (na)	0	0
Remote Steam (na)	0	0
<b>Totals</b>		
Electric (kWh)	10,618	5,540
Natural Gas (na)	0	0
Fuel Oil (na)	0	0
Propane (na)	0	0
Remote HW (na)	0	0
Remote Steam (na)	0	0
Remote CW (na)	0	0

**Table 3. Annual Emissions**

Component	Columbus Field Washrooms Baseline	Columbus Field Washrooms ECM Heat Off
CO2 Equivalent (lb)	17,731	9,252

## Annual Energy and Emissions Summary

Project: Antigonish- Columbus Field Washrooms  
 Prepared by: CBCL Limited

02/02/2024  
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**Table 4. Annual Cost per Unit Floor Area**

Component	Columbus Field Washrooms Baseline (\$/sqft)	Columbus Field Washrooms ECM Heat Off (\$/sqft)
<b>HVAC Components</b>		
Electric	1.896	0.777
Natural Gas	0.000	0.000
Fuel Oil	0.000	0.000
Propane	0.000	0.000
Remote HW	0.000	0.000
Remote Steam	0.000	0.000
Remote CW	0.000	0.000
<b>HVAC Sub-Total</b>	<b>1.896</b>	<b>0.777</b>
<b>Non-HVAC Components</b>		
Electric	0.445	0.445
Natural Gas	0.000	0.000
Fuel Oil	0.000	0.000
Propane	0.000	0.000
Remote HW	0.000	0.000
Remote Steam	0.000	0.000
<b>Non-HVAC Sub-Total</b>	<b>0.445</b>	<b>0.445</b>
<b>Grand Total</b>	<b>2.341</b>	<b>1.221</b>
Gross Floor Area (sqft)	1209.7	1209.7
Modeled Floor Area (sqft)	1209.7	1209.7

Note: Values in this table are calculated using the Gross Floor Area.

**Table 5. Component Cost as a Percentage of Total Cost**

Component	Columbus Field Washrooms Baseline (%)	Columbus Field Washrooms ECM Heat Off (%)
<b>HVAC Components</b>		
Electric	81.0	63.6
Natural Gas	0.0	0.0
Fuel Oil	0.0	0.0
Propane	0.0	0.0
Remote HW	0.0	0.0
Remote Steam	0.0	0.0
Remote CW	0.0	0.0
<b>HVAC Sub-Total</b>	<b>81.0</b>	<b>63.6</b>
<b>Non-HVAC Components</b>		
Electric	19.0	36.4
Natural Gas	0.0	0.0
Fuel Oil	0.0	0.0
Propane	0.0	0.0
Remote HW	0.0	0.0
Remote Steam	0.0	0.0
<b>Non-HVAC Sub-Total</b>	<b>19.0</b>	<b>36.4</b>
<b>Grand Total</b>	<b>100.0</b>	<b>100.0</b>

## Annual Cost Summary

Project: Antigonish Fire Hall Model-Calibrated  
 Prepared by: CBCL Limited

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**Table 1. Annual Costs**

Component	Antigonish Firehall Baseline Model (\$)	Antigonish Firehall-Phase 1 ECMs (\$)	Antigonish Firehall-Phase 2 ECMs (\$)
Air System Fans	332	491	490
Cooling	0	140	141
Heating	22,453	16,822	16,719
Pumps	623	602	602
Heat Rejection Fans	0	0	0
<b>HVAC Sub-Total</b>	<b>23,408</b>	<b>18,055</b>	<b>17,953</b>
Lights	713	255	255
Electric Equipment	378	378	378
Misc. Electric	459	459	459
Misc. Fuel Use	0	0	0
<b>Non-HVAC Sub-Total</b>	<b>1,550</b>	<b>1,091</b>	<b>1,091</b>
<b>Grand Total</b>	<b>24,957</b>	<b>19,146</b>	<b>19,044</b>

**Table 2. Annual Cost per Unit Floor Area**

Component	Antigonish Firehall Baseline Model (\$/sqft)	Antigonish Firehall-Phase 1 ECMs (\$/sqft)	Antigonish Firehall-Phase 2 ECMs (\$/sqft)
Air System Fans	0.042	0.062	0.062
Cooling	0.000	0.018	0.018
Heating	2.826	2.117	2.104
Pumps	0.079	0.076	0.076
Heat Rejection Fans	0.000	0.000	0.000
<b>HVAC Sub-Total</b>	<b>2.946</b>	<b>2.273</b>	<b>2.260</b>
Lights	0.090	0.032	0.032
Electric Equipment	0.048	0.048	0.048
Misc. Electric	0.058	0.058	0.058
Misc. Fuel Use	0.000	0.000	0.000
<b>Non-HVAC Sub-Total</b>	<b>0.195</b>	<b>0.137</b>	<b>0.137</b>
<b>Grand Total</b>	<b>3.141</b>	<b>2.410</b>	<b>2.397</b>
Gross Floor Area (sqft)	7944.8	7944.8	7944.8
Modeled Floor Area (sqft)	7944.8	7944.8	7944.8

Note: Values in this table are calculated using the Gross Floor Area.

# Annual Cost Summary

Project: Antigonish Fire Hall Model-Calibrated  
Prepared by: CBCL Limited

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**Table 3. Component Cost as a Percentage of Total Cost**

<b>Component</b>	<b>Antigonish Firehall Baseline Model (%)</b>	<b>Antigonish Firehall-Phase 1 ECMs (%)</b>	<b>Antigonish Firehall-Phase 2 ECMs (%)</b>
Air System Fans	1.3	2.6	2.6
Cooling	0.0	0.7	0.7
Heating	90.0	87.9	87.8
Pumps	2.5	3.1	3.2
Heat Rejection Fans	0.0	0.0	0.0
<b>HVAC Sub-Total</b>	<b>93.8</b>	<b>94.3</b>	<b>94.3</b>
Lights	2.9	1.3	1.3
Electric Equipment	1.5	2.0	2.0
Misc. Electric	1.8	2.4	2.4
Misc. Fuel Use	0.0	0.0	0.0
<b>Non-HVAC Sub-Total</b>	<b>6.2</b>	<b>5.7</b>	<b>5.7</b>
<b>Grand Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

# Annual Energy and Emissions Summary

Project: Antigonish Fire Hall Model-Calibrated  
 Prepared by: CBCL Limited

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**Table 1. Annual Costs**

Component	Antigonish Firehall Baseline Model (\$)	Antigonish Firehall-Phase 1 ECMs (\$)	Antigonish Firehall-Phase 2 ECMs (\$)
<b>HVAC Components</b>			
Electric	955	5,703	5,615
Natural Gas	0	0	0
Fuel Oil	22,453	12,352	12,338
Propane	0	0	0
Remote HW	0	0	0
Remote Steam	0	0	0
Remote CW	0	0	0
<b>HVAC Sub-Total</b>	<b>23,408</b>	<b>18,055</b>	<b>17,953</b>
<b>Non-HVAC Components</b>			
Electric	1,550	1,091	1,091
Natural Gas	0	0	0
Fuel Oil	0	0	0
Propane	0	0	0
Remote HW	0	0	0
Remote Steam	0	0	0
<b>Non-HVAC Sub-Total</b>	<b>1,550</b>	<b>1,091</b>	<b>1,091</b>
<b>Grand Total</b>	<b>24,957</b>	<b>19,146</b>	<b>19,044</b>

# Annual Energy and Emissions Summary

Project: Antigonish Fire Hall Model-Calibrated  
 Prepared by: CBCL Limited

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**Table 2. Annual Energy Consumption**

Component	Antigonish Firehall Baseline Model	Antigonish Firehall-Phase 1 ECMs	Antigonish Firehall-Phase 2 ECMs
<b>HVAC Components</b>			
Electric (kWh)	5,474	32,681	32,176
Natural Gas (na)	0	0	0
Fuel Oil (Litre)	12,543	6,901	6,893
Propane (na)	0	0	0
Remote HW (na)	0	0	0
Remote Steam (na)	0	0	0
Remote CW (na)	0	0	0
<b>Non-HVAC Components</b>			
Electric (kWh)	8,880	6,255	6,255
Natural Gas (na)	0	0	0
Fuel Oil (Litre)	0	0	0
Propane (na)	0	0	0
Remote HW (na)	0	0	0
Remote Steam (na)	0	0	0
<b>Totals</b>			
Electric (kWh)	14,354	38,935	38,430
Natural Gas (na)	0	0	0
Fuel Oil (Litre)	12,543	6,901	6,893
Propane (na)	0	0	0
Remote HW (na)	0	0	0
Remote Steam (na)	0	0	0
Remote CW (na)	0	0	0

**Table 3. Annual Emissions**

Component	Antigonish Firehall Baseline Model	Antigonish Firehall-Phase 1 ECMs	Antigonish Firehall-Phase 2 ECMs
CO2 Equivalent (lb)	0	0	0

## Annual Energy and Emissions Summary

Project: Antigonish Fire Hall Model-Calibrated  
 Prepared by: CBCL Limited

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**Table 4. Annual Cost per Unit Floor Area**

Component	Antigonish Firehall Baseline Model (\$/sqft)	Antigonish Firehall-Phase 1 ECMs (\$/sqft)	Antigonish Firehall-Phase 2 ECMs (\$/sqft)
<b>HVAC Components</b>			
Electric	0.120	0.718	0.707
Natural Gas	0.000	0.000	0.000
Fuel Oil	2.826	1.555	1.553
Propane	0.000	0.000	0.000
Remote HW	0.000	0.000	0.000
Remote Steam	0.000	0.000	0.000
Remote CW	0.000	0.000	0.000
<b>HVAC Sub-Total</b>	<b>2.946</b>	<b>2.273</b>	<b>2.260</b>
<b>Non-HVAC Components</b>			
Electric	0.195	0.137	0.137
Natural Gas	0.000	0.000	0.000
Fuel Oil	0.000	0.000	0.000
Propane	0.000	0.000	0.000
Remote HW	0.000	0.000	0.000
Remote Steam	0.000	0.000	0.000
<b>Non-HVAC Sub-Total</b>	<b>0.195</b>	<b>0.137</b>	<b>0.137</b>
<b>Grand Total</b>	<b>3.141</b>	<b>2.410</b>	<b>2.397</b>
Gross Floor Area (sqft)	7944.8	7944.8	7944.8
Modeled Floor Area (sqft)	7944.8	7944.8	7944.8

Note: Values in this table are calculated using the Gross Floor Area.

**Table 5. Component Cost as a Percentage of Total Cost**

Component	Antigonish Firehall Baseline Model (%)	Antigonish Firehall-Phase 1 ECMs (%)	Antigonish Firehall-Phase 2 ECMs (%)
<b>HVAC Components</b>			
Electric	3.8	29.8	29.5
Natural Gas	0.0	0.0	0.0
Fuel Oil	90.0	64.5	64.8
Propane	0.0	0.0	0.0
Remote HW	0.0	0.0	0.0
Remote Steam	0.0	0.0	0.0
Remote CW	0.0	0.0	0.0
<b>HVAC Sub-Total</b>	<b>93.8</b>	<b>94.3</b>	<b>94.3</b>
<b>Non-HVAC Components</b>			
Electric	6.2	5.7	5.7
Natural Gas	0.0	0.0	0.0
Fuel Oil	0.0	0.0	0.0
Propane	0.0	0.0	0.0
Remote HW	0.0	0.0	0.0
Remote Steam	0.0	0.0	0.0
<b>Non-HVAC Sub-Total</b>	<b>6.2</b>	<b>5.7</b>	<b>5.7</b>
<b>Grand Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

## Annual Cost Summary

Project: 237554.00 - Antigonish - Library  
 Prepared by: CBCL Limited

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**Table 1. Annual Costs**

Component	Antigonish Library- Baseline (\$)	Antigonish Library- NTSB (\$)
Air System Fans	2,919	1,151
Cooling	1,483	1,267
Heating	9,290	6,301
Pumps	2,269	1,881
Heat Rejection Fans	0	0
<b>HVAC Sub-Total</b>	<b>15,960</b>	<b>10,600</b>
Lights	6,400	6,400
Electric Equipment	1,774	1,774
Misc. Electric	0	0
Misc. Fuel Use	0	0
<b>Non-HVAC Sub-Total</b>	<b>8,174</b>	<b>8,174</b>
<b>Grand Total</b>	<b>24,134</b>	<b>18,774</b>

**Table 2. Annual Cost per Unit Floor Area**

Component	Antigonish Library- Baseline (\$/sqft)	Antigonish Library- NTSB (\$/sqft)
Air System Fans	0.092	0.036
Cooling	0.047	0.040
Heating	0.293	0.199
Pumps	0.072	0.059
Heat Rejection Fans	0.000	0.000
<b>HVAC Sub-Total</b>	<b>0.504</b>	<b>0.334</b>
Lights	0.202	0.202
Electric Equipment	0.056	0.056
Misc. Electric	0.000	0.000
Misc. Fuel Use	0.000	0.000
<b>Non-HVAC Sub-Total</b>	<b>0.258</b>	<b>0.258</b>
<b>Grand Total</b>	<b>0.761</b>	<b>0.592</b>
Gross Floor Area (sqft)	31702.8	31702.8
Modeled Floor Area (sqft)	31702.8	31702.8

Note: Values in this table are calculated using the Gross Floor Area.

**Table 3. Component Cost as a Percentage of Total Cost**

Component	Antigonish Library- Baseline (%)	Antigonish Library- NTSB (%)
Air System Fans	12.1	6.1
Cooling	6.1	6.7
Heating	38.5	33.6
Pumps	9.4	10.0
Heat Rejection Fans	0.0	0.0
<b>HVAC Sub-Total</b>	<b>66.1</b>	<b>56.5</b>
Lights	26.5	34.1
Electric Equipment	7.3	9.4
Misc. Electric	0.0	0.0
Misc. Fuel Use	0.0	0.0
<b>Non-HVAC Sub-Total</b>	<b>33.9</b>	<b>43.5</b>
<b>Grand Total</b>	<b>100.0</b>	<b>100.0</b>

# Annual Energy and Emissions Summary

Project: 237554.00 - Antigonish - Library  
 Prepared by: CBCL Limited

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**Table 1. Annual Costs**

Component	Antigonish Library- Baseline (\$)	Antigonish Library- NTSB (\$)
<b>HVAC Components</b>		
Electric	15,961	10,600
Natural Gas	0	0
Fuel Oil	0	0
Propane	0	0
Remote HW	0	0
Remote Steam	0	0
Remote CW	0	0
<b>HVAC Sub-Total</b>	<b>15,961</b>	<b>10,600</b>
<b>Non-HVAC Components</b>		
Electric	8,174	8,174
Natural Gas	0	0
Fuel Oil	0	0
Propane	0	0
Remote HW	0	0
Remote Steam	0	0
<b>Non-HVAC Sub-Total</b>	<b>8,174</b>	<b>8,174</b>
<b>Grand Total</b>	<b>24,135</b>	<b>18,774</b>

**Table 2. Annual Energy Consumption**

Component	Antigonish Library- Baseline	Antigonish Library- NTSB
<b>HVAC Components</b>		
Electric (kWh)	108,801	72,259
Natural Gas (na)	0	0
Fuel Oil (na)	0	0
Propane (na)	0	0
Remote HW (na)	0	0
Remote Steam (na)	0	0
Remote CW (na)	0	0
<b>Non-HVAC Components</b>		
Electric (kWh)	55,720	55,720
Natural Gas (na)	0	0
Fuel Oil (na)	0	0
Propane (na)	0	0
Remote HW (na)	0	0
Remote Steam (na)	0	0
<b>Totals</b>		
Electric (kWh)	164,520	127,979
Natural Gas (na)	0	0
Fuel Oil (na)	0	0
Propane (na)	0	0
Remote HW (na)	0	0
Remote Steam (na)	0	0
Remote CW (na)	0	0

# Annual Energy and Emissions Summary

Project: 237554.00 - Antigonish - Library  
 Prepared by: CBCL Limited

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**Table 3. Annual Emissions**

Component	Antigonish Library- Baseline	Antigonish Library- NTSB
CO2 Equivalent (lb)	0	0

**Table 4. Annual Cost per Unit Floor Area**

Component	Antigonish Library- Baseline (\$/sqft)	Antigonish Library- NTSB (\$/sqft)
<b>HVAC Components</b>		
Electric	0.504	0.334
Natural Gas	0.000	0.000
Fuel Oil	0.000	0.000
Propane	0.000	0.000
Remote HW	0.000	0.000
Remote Steam	0.000	0.000
Remote CW	0.000	0.000
<b>HVAC Sub-Total</b>	<b>0.504</b>	<b>0.334</b>
<b>Non-HVAC Components</b>		
Electric	0.258	0.258
Natural Gas	0.000	0.000
Fuel Oil	0.000	0.000
Propane	0.000	0.000
Remote HW	0.000	0.000
Remote Steam	0.000	0.000
<b>Non-HVAC Sub-Total</b>	<b>0.258</b>	<b>0.258</b>
<b>Grand Total</b>	<b>0.761</b>	<b>0.592</b>
Gross Floor Area (sqft)	31702.8	31702.8
Modeled Floor Area (sqft)	31702.8	31702.8

Note: Values in this table are calculated using the Gross Floor Area.

**Table 5. Component Cost as a Percentage of Total Cost**

Component	Antigonish Library- Baseline (%)	Antigonish Library- NTSB (%)
<b>HVAC Components</b>		
Electric	66.1	56.5
Natural Gas	0.0	0.0
Fuel Oil	0.0	0.0
Propane	0.0	0.0
Remote HW	0.0	0.0
Remote Steam	0.0	0.0
Remote CW	0.0	0.0
<b>HVAC Sub-Total</b>	<b>66.1</b>	<b>56.5</b>
<b>Non-HVAC Components</b>		
Electric	33.9	43.5
Natural Gas	0.0	0.0
Fuel Oil	0.0	0.0
Propane	0.0	0.0
Remote HW	0.0	0.0
Remote Steam	0.0	0.0
<b>Non-HVAC Sub-Total</b>	<b>33.9</b>	<b>43.5</b>
<b>Grand Total</b>	<b>100.0</b>	<b>100.0</b>

## Annual Cost Summary

Project: Public Works Electric Utility Energy Model-Calibrated  
 Prepared by: CBCL Limited

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**Table 1. Annual Costs**

Component	0. Public Works/Electric Utility Baseline Model (\$)	1. Phase 1 ECMS Public Works/Electric Utility Model (\$)	2. Phase 2 ECMS Public Works/Electric Utility Model (\$)
Air System Fans	2,076	926	899
Cooling	0	6	7
Heating	34,258	22,879	22,114
Pumps	0	0	0
Heat Rejection Fans	0	0	0
<b>HVAC Sub-Total</b>	<b>36,334</b>	<b>23,812</b>	<b>23,021</b>
Lights	1,333	1,267	1,267
Electric Equipment	3,702	3,702	3,702
Misc. Electric	905	905	905
Misc. Fuel Use	0	0	0
<b>Non-HVAC Sub-Total</b>	<b>5,940</b>	<b>5,875</b>	<b>5,875</b>
<b>Grand Total</b>	<b>42,274</b>	<b>29,686</b>	<b>28,895</b>

**Table 2. Annual Cost per Unit Floor Area**

Component	0. Public Works/Electric Utility Baseline Model (\$/sqft)	1. Phase 1 ECMS Public Works/Electric Utility Model (\$/sqft)	2. Phase 2 ECMS Public Works/Electric Utility Model (\$/sqft)
Air System Fans	0.126	0.056	0.055
Cooling	0.000	0.000	0.000
Heating	2.081	1.390	1.343
Pumps	0.000	0.000	0.000
Heat Rejection Fans	0.000	0.000	0.000
<b>HVAC Sub-Total</b>	<b>2.207</b>	<b>1.446</b>	<b>1.398</b>
Lights	0.081	0.077	0.077
Electric Equipment	0.225	0.225	0.225
Misc. Electric	0.055	0.055	0.055
Misc. Fuel Use	0.000	0.000	0.000
<b>Non-HVAC Sub-Total</b>	<b>0.361</b>	<b>0.357</b>	<b>0.357</b>
<b>Grand Total</b>	<b>2.568</b>	<b>1.803</b>	<b>1.755</b>
Gross Floor Area (sqft)	16464.6	16464.6	16464.6
Modeled Floor Area (sqft)	16464.6	16464.6	16464.6

Note: Values in this table are calculated using the Gross Floor Area.

## Annual Cost Summary

Project: Public Works Electric Utility Energy Model-Calibrated  
 Prepared by: CBCL Limited

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**Table 3. Component Cost as a Percentage of Total Cost**

Component	0. Public Works/Electric Utility Baseline Model (%)	1. Phase 1 ECMS Public Works/Electric Utility Model (%)	2. Phase 2 ECMS Public Works/Electric Utility Model (%)
Air System Fans	4.9	3.1	3.1
Cooling	0.0	0.0	0.0
Heating	81.0	77.1	76.5
Pumps	0.0	0.0	0.0
Heat Rejection Fans	0.0	0.0	0.0
<b>HVAC Sub-Total</b>	<b>85.9</b>	<b>80.2</b>	<b>79.7</b>
Lights	3.2	4.3	4.4
Electric Equipment	8.8	12.5	12.8
Misc. Electric	2.1	3.0	3.1
Misc. Fuel Use	0.0	0.0	0.0
<b>Non-HVAC Sub-Total</b>	<b>14.1</b>	<b>19.8</b>	<b>20.3</b>
<b>Grand Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

## Annual Energy and Emissions Summary

Project: Public Works Electric Utility Energy Model-Calibrated  
 Prepared by: CBCL Limited

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**Table 1. Annual Costs**

Component	0. Public Works/Electric Utility Baseline Model (\$)	1. Phase 1 ECMS Public Works/Electric Utility Model (\$)	2. Phase 2 ECMS Public Works/Electric Utility Model (\$)
<b>HVAC Components</b>			
Electric	5,420	23,812	23,021
Natural Gas	0	0	0
Fuel Oil	30,914	0	0
Propane	0	0	0
Remote HW	0	0	0
Remote Steam	0	0	0
Remote CW	0	0	0
<b>HVAC Sub-Total</b>	<b>36,334</b>	<b>23,812</b>	<b>23,021</b>
<b>Non-HVAC Components</b>			
Electric	5,940	5,874	5,874
Natural Gas	0	0	0
Fuel Oil	0	0	0
Propane	0	0	0
Remote HW	0	0	0
Remote Steam	0	0	0
<b>Non-HVAC Sub-Total</b>	<b>5,940</b>	<b>5,874</b>	<b>5,874</b>
<b>Grand Total</b>	<b>42,274</b>	<b>29,686</b>	<b>28,895</b>

# Annual Energy and Emissions Summary

Project: Public Works Electric Utility Energy Model-Calibrated  
 Prepared by: CBCL Limited

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**Table 2. Annual Energy Consumption**

Component	0. Public Works/Electric Utility Baseline Model	1. Phase 1 ECMS Public Works/Electric Utility Model	2. Phase 2 ECMS Public Works/Electric Utility Model
<b>HVAC Components</b>			
Electric (kWh)	36,722	161,326	155,966
Natural Gas (na)	0	0	0
Fuel Oil (*)	17,271	0	0
Propane (na)	0	0	0
Remote HW (na)	0	0	0
Remote Steam (na)	0	0	0
Remote CW (na)	0	0	0
<b>Non-HVAC Components</b>			
Electric (kWh)	40,243	39,800	39,800
Natural Gas (na)	0	0	0
Fuel Oil (*)	0	0	0
Propane (na)	0	0	0
Remote HW (na)	0	0	0
Remote Steam (na)	0	0	0
<b>Totals</b>			
Electric (kWh)	76,965	201,126	195,766
Natural Gas (na)	0	0	0
Fuel Oil (*)	17,271	0	0
Propane (na)	0	0	0
Remote HW (na)	0	0	0
Remote Steam (na)	0	0	0
Remote CW (na)	0	0	0

(\*) Energy Units differ among Buildings.

**Table 3. Annual Emissions**

Component	0. Public Works/Electric Utility Baseline Model	1. Phase 1 ECMS Public Works/Electric Utility Model	2. Phase 2 ECMS Public Works/Electric Utility Model
CO2 Equivalent (lb)	0	0	0

## Annual Energy and Emissions Summary

Project: Public Works Electric Utility Energy Model-Calibrated  
 Prepared by: CBCL Limited

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**Table 4. Annual Cost per Unit Floor Area**

Component	0. Public Works/Electric Utility Baseline Model (\$/sqft)	1. Phase 1 ECMS Public Works/Electric Utility Model (\$/sqft)	2. Phase 2 ECMS Public Works/Electric Utility Model (\$/sqft)
<b>HVAC Components</b>			
Electric	0.329	1.446	1.398
Natural Gas	0.000	0.000	0.000
Fuel Oil	1.878	0.000	0.000
Propane	0.000	0.000	0.000
Remote HW	0.000	0.000	0.000
Remote Steam	0.000	0.000	0.000
Remote CW	0.000	0.000	0.000
<b>HVAC Sub-Total</b>	<b>2.207</b>	<b>1.446</b>	<b>1.398</b>
<b>Non-HVAC Components</b>			
Electric	0.361	0.357	0.357
Natural Gas	0.000	0.000	0.000
Fuel Oil	0.000	0.000	0.000
Propane	0.000	0.000	0.000
Remote HW	0.000	0.000	0.000
Remote Steam	0.000	0.000	0.000
<b>Non-HVAC Sub-Total</b>	<b>0.361</b>	<b>0.357</b>	<b>0.357</b>
<b>Grand Total</b>	<b>2.568</b>	<b>1.803</b>	<b>1.755</b>
Gross Floor Area (sqft)	16464.6	16464.6	16464.6
Modeled Floor Area (sqft)	16464.6	16464.6	16464.6

Note: Values in this table are calculated using the Gross Floor Area.

**Table 5. Component Cost as a Percentage of Total Cost**

Component	0. Public Works/Electric Utility Baseline Model (%)	1. Phase 1 ECMS Public Works/Electric Utility Model (%)	2. Phase 2 ECMS Public Works/Electric Utility Model (%)
<b>HVAC Components</b>			
Electric	12.8	80.2	79.7
Natural Gas	0.0	0.0	0.0
Fuel Oil	73.1	0.0	0.0
Propane	0.0	0.0	0.0
Remote HW	0.0	0.0	0.0
Remote Steam	0.0	0.0	0.0
Remote CW	0.0	0.0	0.0
<b>HVAC Sub-Total</b>	<b>85.9</b>	<b>80.2</b>	<b>79.7</b>
<b>Non-HVAC Components</b>			
Electric	14.1	19.8	20.3
Natural Gas	0.0	0.0	0.0
Fuel Oil	0.0	0.0	0.0
Propane	0.0	0.0	0.0
Remote HW	0.0	0.0	0.0
Remote Steam	0.0	0.0	0.0
<b>Non-HVAC Sub-Total</b>	<b>14.1</b>	<b>19.8</b>	<b>20.3</b>
<b>Grand Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

## Annual Cost Summary

Project: Antigonish WWTP  
Prepared by: CBCL Limited

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**Table 1. Annual Costs**

Component	Antigonish WWTP-Lab Area (\$)	Antigonish WWTP-Lab Area NTSB (\$)
Air System Fans	0	0
Cooling	0	0
Heating	4,737	4,722
Pumps	0	0
Heat Rejection Fans	0	0
<b>HVAC Sub-Total</b>	<b>4,737</b>	<b>4,722</b>
Lights	32	32
Electric Equipment	1	1
Misc. Electric	0	0
Misc. Fuel Use	0	0
<b>Non-HVAC Sub-Total</b>	<b>34</b>	<b>34</b>
<b>Grand Total</b>	<b>4,771</b>	<b>4,756</b>

**Table 2. Annual Cost per Unit Floor Area**

Component	Antigonish WWTP-Lab Area (\$/sqft)	Antigonish WWTP-Lab Area NTSB (\$/sqft)
Air System Fans	0.000	0.000
Cooling	0.000	0.000
Heating	4.381	4.368
Pumps	0.000	0.000
Heat Rejection Fans	0.000	0.000
<b>HVAC Sub-Total</b>	<b>4.381</b>	<b>4.368</b>
Lights	0.030	0.030
Electric Equipment	0.001	0.001
Misc. Electric	0.000	0.000
Misc. Fuel Use	0.000	0.000
<b>Non-HVAC Sub-Total</b>	<b>0.031</b>	<b>0.031</b>
<b>Grand Total</b>	<b>4.412</b>	<b>4.399</b>
Gross Floor Area (sqft)	1081.2	1081.2
Modeled Floor Area (sqft)	1081.2	1081.2

Note: Values in this table are calculated using the Gross Floor Area.

# Annual Cost Summary

Project: Antigonish WWTP  
Prepared by: CBCL Limited

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**Table 3. Component Cost as a Percentage of Total Cost**

<b>Component</b>	<b>Antigonish WWTP-Lab Area (%)</b>	<b>Antigonish WWTP-Lab Area NTSB (%)</b>
Air System Fans	0.0	0.0
Cooling	0.0	0.0
Heating	99.3	99.3
Pumps	0.0	0.0
Heat Rejection Fans	0.0	0.0
<b>HVAC Sub-Total</b>	<b>99.3</b>	<b>99.3</b>
Lights	0.7	0.7
Electric Equipment	0.0	0.0
Misc. Electric	0.0	0.0
Misc. Fuel Use	0.0	0.0
<b>Non-HVAC Sub-Total</b>	<b>0.7</b>	<b>0.7</b>
<b>Grand Total</b>	<b>100.0</b>	<b>100.0</b>

# Annual Energy and Emissions Summary

Project: Antigonish WWTP  
 Prepared by: CBCL Limited

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**Table 1. Annual Costs**

Component	Antigonish WWTP-Lab Area (\$)	Antigonish WWTP-Lab Area NTSB (\$)
<b>HVAC Components</b>		
Electric	4,737	4,722
Natural Gas	0	0
Fuel Oil	0	0
Propane	0	0
Remote HW	0	0
Remote Steam	0	0
Remote CW	0	0
<b>HVAC Sub-Total</b>	<b>4,737</b>	<b>4,722</b>
<b>Non-HVAC Components</b>		
Electric	34	34
Natural Gas	0	0
Fuel Oil	0	0
Propane	0	0
Remote HW	0	0
Remote Steam	0	0
<b>Non-HVAC Sub-Total</b>	<b>34</b>	<b>34</b>
<b>Grand Total</b>	<b>4,771</b>	<b>4,756</b>

# Annual Energy and Emissions Summary

Project: Antigonish WWTP  
 Prepared by: CBCL Limited

02/02/2024  
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**Table 2. Annual Energy Consumption**

Component	Antigonish WWTP-Lab Area	Antigonish WWTP-Lab Area NTSB
<b>HVAC Components</b>		
Electric (kWh)	37,356	37,242
Natural Gas (na)	0	0
Fuel Oil (na)	0	0
Propane (na)	0	0
Remote HW (na)	0	0
Remote Steam (na)	0	0
Remote CW (na)	0	0
<b>Non-HVAC Components</b>		
Electric (kWh)	267	267
Natural Gas (na)	0	0
Fuel Oil (na)	0	0
Propane (na)	0	0
Remote HW (na)	0	0
Remote Steam (na)	0	0
<b>Totals</b>		
Electric (kWh)	37,622	37,508
Natural Gas (na)	0	0
Fuel Oil (na)	0	0
Propane (na)	0	0
Remote HW (na)	0	0
Remote Steam (na)	0	0
Remote CW (na)	0	0

**Table 3. Annual Emissions**

Component	Antigonish WWTP-Lab Area	Antigonish WWTP-Lab Area NTSB
CO2 Equivalent (lb)	0	0

# Annual Energy and Emissions Summary

Project: Antigonish WWTP  
 Prepared by: CBCL Limited

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**Table 4. Annual Cost per Unit Floor Area**

Component	Antigonish WWTP-Lab Area (\$/sqft)	Antigonish WWTP-Lab Area NTSB (\$/sqft)
<b>HVAC Components</b>		
Electric	4.381	4.368
Natural Gas	0.000	0.000
Fuel Oil	0.000	0.000
Propane	0.000	0.000
Remote HW	0.000	0.000
Remote Steam	0.000	0.000
Remote CW	0.000	0.000
<b>HVAC Sub-Total</b>	<b>4.381</b>	<b>4.368</b>
<b>Non-HVAC Components</b>		
Electric	0.031	0.031
Natural Gas	0.000	0.000
Fuel Oil	0.000	0.000
Propane	0.000	0.000
Remote HW	0.000	0.000
Remote Steam	0.000	0.000
<b>Non-HVAC Sub-Total</b>	<b>0.031</b>	<b>0.031</b>
<b>Grand Total</b>	<b>4.412</b>	<b>4.399</b>
Gross Floor Area (sqft)	1081.2	1081.2
Modeled Floor Area (sqft)	1081.2	1081.2

Note: Values in this table are calculated using the Gross Floor Area.

**Table 5. Component Cost as a Percentage of Total Cost**

Component	Antigonish WWTP-Lab Area (%)	Antigonish WWTP-Lab Area NTSB (%)
<b>HVAC Components</b>		
Electric	99.3	99.3
Natural Gas	0.0	0.0
Fuel Oil	0.0	0.0
Propane	0.0	0.0
Remote HW	0.0	0.0
Remote Steam	0.0	0.0
Remote CW	0.0	0.0
<b>HVAC Sub-Total</b>	<b>99.3</b>	<b>99.3</b>
<b>Non-HVAC Components</b>		
Electric	0.7	0.7
Natural Gas	0.0	0.0
Fuel Oil	0.0	0.0
Propane	0.0	0.0
Remote HW	0.0	0.0
Remote Steam	0.0	0.0
<b>Non-HVAC Sub-Total</b>	<b>0.7</b>	<b>0.7</b>
<b>Grand Total</b>	<b>100.0</b>	<b>100.0</b>

## Annual Cost Summary

Project: 237554.00 - Antigonish - Town Hall - Calibrated  
 Prepared by: CBCL Limited

02/02/2024  
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**Table 1. Annual Costs**

Component	Antigonish Town Hall-Baseline (\$)	Antigonish-Town Hall- Phase 1 ECMs (\$)
Air System Fans	0	0
Cooling	837	787
Heating	32,713	16,876
Pumps	657	504
Heat Rejection Fans	0	0
<b>HVAC Sub-Total</b>	<b>34,207</b>	<b>18,168</b>
Lights	3,603	2,090
Electric Equipment	2,761	2,760
Misc. Electric	135	135
Misc. Fuel Use	0	0
<b>Non-HVAC Sub-Total</b>	<b>6,499</b>	<b>4,986</b>
<b>Grand Total</b>	<b>40,706</b>	<b>23,153</b>

**Table 2. Annual Cost per Unit Floor Area**

Component	Antigonish Town Hall-Baseline (\$/sqft)	Antigonish-Town Hall- Phase 1 ECMs (\$/sqft)
Air System Fans	0.000	0.000
Cooling	0.058	0.055
Heating	2.270	1.171
Pumps	0.046	0.035
Heat Rejection Fans	0.000	0.000
<b>HVAC Sub-Total</b>	<b>2.374</b>	<b>1.261</b>
Lights	0.250	0.145
Electric Equipment	0.192	0.192
Misc. Electric	0.009	0.009
Misc. Fuel Use	0.000	0.000
<b>Non-HVAC Sub-Total</b>	<b>0.451</b>	<b>0.346</b>
<b>Grand Total</b>	<b>2.825</b>	<b>1.607</b>
Gross Floor Area (sqft)	14408.6	14408.6
Modeled Floor Area (sqft)	14408.6	14408.6

Note: Values in this table are calculated using the Gross Floor Area.

# Annual Cost Summary

Project: 237554.00 - Antigonish - Town Hall - Calibrated  
Prepared by: CBCL Limited

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**Table 3. Component Cost as a Percentage of Total Cost**

<b>Component</b>	<b>Antigonish Town Hall-Baseline (%)</b>	<b>Antigonish-Town Hall- Phase 1 ECMs (%)</b>
Air System Fans	0.0	0.0
Cooling	2.1	3.4
Heating	80.4	72.9
Pumps	1.6	2.2
Heat Rejection Fans	0.0	0.0
<b>HVAC Sub-Total</b>	<b>84.0</b>	<b>78.5</b>
Lights	8.9	9.0
Electric Equipment	6.8	11.9
Misc. Electric	0.3	0.6
Misc. Fuel Use	0.0	0.0
<b>Non-HVAC Sub-Total</b>	<b>16.0</b>	<b>21.5</b>
<b>Grand Total</b>	<b>100.0</b>	<b>100.0</b>

# Annual Energy and Emissions Summary

Project: 237554.00 - Antigonish - Town Hall - Calibrated  
 Prepared by: CBCL Limited

02/02/2024  
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**Table 1. Annual Costs**

Component	Antigonish Town Hall-Baseline (\$)	Antigonish-Town Hall- Phase 1 ECMs (\$)
<b>HVAC Components</b>		
Electric	2,273	18,168
Natural Gas	0	0
Fuel Oil	31,934	0
Propane	0	0
Remote HW	0	0
Remote Steam	0	0
Remote CW	0	0
<b>HVAC Sub-Total</b>	<b>34,207</b>	<b>18,168</b>
<b>Non-HVAC Components</b>		
Electric	6,498	4,986
Natural Gas	0	0
Fuel Oil	0	0
Propane	0	0
Remote HW	0	0
Remote Steam	0	0
<b>Non-HVAC Sub-Total</b>	<b>6,498</b>	<b>4,986</b>
<b>Grand Total</b>	<b>40,706</b>	<b>23,153</b>

# Annual Energy and Emissions Summary

Project: 237554.00 - Antigonish - Town Hall - Calibrated  
 Prepared by: CBCL Limited

02/02/2024  
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**Table 2. Annual Energy Consumption**

Component	Antigonish Town Hall-Baseline	Antigonish-Town Hall- Phase 1 ECMs
<b>HVAC Components</b>		
Electric (kWh)	14,747	117,887
Natural Gas (na)	0	0
Fuel Oil (*)	17,915	0
Propane (na)	0	0
Remote HW (na)	0	0
Remote Steam (na)	0	0
Remote CW (na)	0	0
<b>Non-HVAC Components</b>		
Electric (kWh)	42,162	32,349
Natural Gas (na)	0	0
Fuel Oil (*)	0	0
Propane (na)	0	0
Remote HW (na)	0	0
Remote Steam (na)	0	0
<b>Totals</b>		
Electric (kWh)	56,909	150,236
Natural Gas (na)	0	0
Fuel Oil (*)	17,915	0
Propane (na)	0	0
Remote HW (na)	0	0
Remote Steam (na)	0	0
Remote CW (na)	0	0

(\*) Energy Units differ among Buildings.

**Table 3. Annual Emissions**

Component	Antigonish Town Hall-Baseline	Antigonish-Town Hall- Phase 1 ECMs
CO2 Equivalent (lb)	0	0

# Annual Energy and Emissions Summary

Project: 237554.00 - Antigonish - Town Hall - Calibrated  
 Prepared by: CBCL Limited

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**Table 4. Annual Cost per Unit Floor Area**

Component	Antigonish Town Hall-Baseline (\$/sqft)	Antigonish-Town Hall- Phase 1 ECMs (\$/sqft)
<b>HVAC Components</b>		
Electric	0.158	1.261
Natural Gas	0.000	0.000
Fuel Oil	2.216	0.000
Propane	0.000	0.000
Remote HW	0.000	0.000
Remote Steam	0.000	0.000
Remote CW	0.000	0.000
<b>HVAC Sub-Total</b>	<b>2.374</b>	<b>1.261</b>
<b>Non-HVAC Components</b>		
Electric	0.451	0.346
Natural Gas	0.000	0.000
Fuel Oil	0.000	0.000
Propane	0.000	0.000
Remote HW	0.000	0.000
Remote Steam	0.000	0.000
<b>Non-HVAC Sub-Total</b>	<b>0.451</b>	<b>0.346</b>
<b>Grand Total</b>	<b>2.825</b>	<b>1.607</b>
Gross Floor Area (sqft)	14408.6	14408.6
Modeled Floor Area (sqft)	14408.6	14408.6

Note: Values in this table are calculated using the Gross Floor Area.

**Table 5. Component Cost as a Percentage of Total Cost**

Component	Antigonish Town Hall-Baseline (%)	Antigonish-Town Hall- Phase 1 ECMs (%)
<b>HVAC Components</b>		
Electric	5.6	78.5
Natural Gas	0.0	0.0
Fuel Oil	78.5	0.0
Propane	0.0	0.0
Remote HW	0.0	0.0
Remote Steam	0.0	0.0
Remote CW	0.0	0.0
<b>HVAC Sub-Total</b>	<b>84.0</b>	<b>78.5</b>
<b>Non-HVAC Components</b>		
Electric	16.0	21.5
Natural Gas	0.0	0.0
Fuel Oil	0.0	0.0
Propane	0.0	0.0
Remote HW	0.0	0.0
Remote Steam	0.0	0.0
<b>Non-HVAC Sub-Total</b>	<b>16.0</b>	<b>21.5</b>
<b>Grand Total</b>	<b>100.0</b>	<b>100.0</b>

## Annual Cost Summary

Project: Antigonish WTP  
Prepared by: CBCL Limited

02/02/2024  
2:00 PM

**Table 1. Annual Costs**

Component	0.Antigonish WTP Baseline Building (\$)	1 Antigonish WTP ECM Propane Boiler (\$)
Air System Fans	712	701
Cooling	33	33
Heating	76,678	40,934
Pumps	1,323	1,297
Heat Rejection Fans	0	0
<b>HVAC Sub-Total</b>	<b>78,746</b>	<b>42,965</b>
Lights	3,974	3,974
Electric Equipment	764	764
Misc. Electric	0	0
Misc. Fuel Use	0	0
<b>Non-HVAC Sub-Total</b>	<b>4,738</b>	<b>4,738</b>
<b>Grand Total</b>	<b>83,484</b>	<b>47,703</b>

**Table 2. Annual Cost per Unit Floor Area**

Component	0.Antigonish WTP Baseline Building (\$/sqft)	1 Antigonish WTP ECM Propane Boiler (\$/sqft)
Air System Fans	0.073	0.072
Cooling	0.003	0.003
Heating	7.855	4.194
Pumps	0.136	0.133
Heat Rejection Fans	0.000	0.000
<b>HVAC Sub-Total</b>	<b>8.067</b>	<b>4.402</b>
Lights	0.407	0.407
Electric Equipment	0.078	0.078
Misc. Electric	0.000	0.000
Misc. Fuel Use	0.000	0.000
<b>Non-HVAC Sub-Total</b>	<b>0.485</b>	<b>0.485</b>
<b>Grand Total</b>	<b>8.553</b>	<b>4.887</b>
Gross Floor Area (sqft)	9761.2	9761.2
Modeled Floor Area (sqft)	9761.2	9761.2

Note: Values in this table are calculated using the Gross Floor Area.

# Annual Cost Summary

Project: Antigonish WTP  
Prepared by: CBCL Limited

02/02/2024  
2:00 PM

**Table 3. Component Cost as a Percentage of Total Cost**

<b>Component</b>	<b>0.Antigonish WTP Baseline Building (%)</b>	<b>1 Antigonish WTP ECM Propane Boiler (%)</b>
Air System Fans	0.9	1.5
Cooling	0.0	0.1
Heating	91.8	85.8
Pumps	1.6	2.7
Heat Rejection Fans	0.0	0.0
<b>HVAC Sub-Total</b>	<b>94.3</b>	<b>90.1</b>
Lights	4.8	8.3
Electric Equipment	0.9	1.6
Misc. Electric	0.0	0.0
Misc. Fuel Use	0.0	0.0
<b>Non-HVAC Sub-Total</b>	<b>5.7</b>	<b>9.9</b>
<b>Grand Total</b>	<b>100.0</b>	<b>100.0</b>

# Annual Energy and Emissions Summary

Project: Antigonish WTP  
 Prepared by: CBCL Limited

02/02/2024  
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**Table 1. Annual Costs**

Component	0.Antigonish WTP Baseline Building (\$)	1 Antigonish WTP ECM Propane Boiler (\$)
<b>HVAC Components</b>		
Electric	2,068	2,031
Natural Gas	0	0
Fuel Oil	76,678	0
Propane	0	40,934
Remote HW	0	0
Remote Steam	0	0
Remote CW	0	0
<b>HVAC Sub-Total</b>	<b>78,746</b>	<b>42,965</b>
<b>Non-HVAC Components</b>		
Electric	4,738	4,738
Natural Gas	0	0
Fuel Oil	0	0
Propane	0	0
Remote HW	0	0
Remote Steam	0	0
<b>Non-HVAC Sub-Total</b>	<b>4,738</b>	<b>4,738</b>
<b>Grand Total</b>	<b>83,484</b>	<b>47,703</b>

# Annual Energy and Emissions Summary

Project: Antigonish WTP  
 Prepared by: CBCL Limited

02/02/2024  
 2:00 PM

**Table 2. Annual Energy Consumption**

Component	0.Antigonish WTP Baseline Building	1 Antigonish WTP ECM Propane Boiler
<b>HVAC Components</b>		
Electric (kWh)	11,650	11,444
Natural Gas (na)	0	0
Fuel Oil (*)	42,837	0
Propane (*)	0	63,959
Remote HW (na)	0	0
Remote Steam (na)	0	0
Remote CW (na)	0	0
<b>Non-HVAC Components</b>		
Electric (kWh)	26,690	26,690
Natural Gas (na)	0	0
Fuel Oil (*)	0	0
Propane (*)	0	0
Remote HW (na)	0	0
Remote Steam (na)	0	0
<b>Totals</b>		
Electric (kWh)	38,341	38,134
Natural Gas (na)	0	0
Fuel Oil (*)	42,837	0
Propane (*)	0	63,959
Remote HW (na)	0	0
Remote Steam (na)	0	0
Remote CW (na)	0	0

(\*) Energy Units differ among Buildings.

**Table 3. Annual Emissions**

Component	0.Antigonish WTP Baseline Building	1 Antigonish WTP ECM Propane Boiler
CO2 Equivalent (lb)	0	0

# Annual Energy and Emissions Summary

Project: Antigonish WTP  
 Prepared by: CBCL Limited

02/02/2024  
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**Table 4. Annual Cost per Unit Floor Area**

Component	0.Antigonish WTP Baseline Building (\$/sqft)	1 Antigonish WTP ECM Propane Boiler (\$/sqft)
<b>HVAC Components</b>		
Electric	0.212	0.208
Natural Gas	0.000	0.000
Fuel Oil	7.855	0.000
Propane	0.000	4.194
Remote HW	0.000	0.000
Remote Steam	0.000	0.000
Remote CW	0.000	0.000
<b>HVAC Sub-Total</b>	<b>8.067</b>	<b>4.402</b>
<b>Non-HVAC Components</b>		
Electric	0.485	0.485
Natural Gas	0.000	0.000
Fuel Oil	0.000	0.000
Propane	0.000	0.000
Remote HW	0.000	0.000
Remote Steam	0.000	0.000
<b>Non-HVAC Sub-Total</b>	<b>0.485</b>	<b>0.485</b>
<b>Grand Total</b>	<b>8.553</b>	<b>4.887</b>
Gross Floor Area (sqft)	9761.2	9761.2
Modeled Floor Area (sqft)	9761.2	9761.2

Note: Values in this table are calculated using the Gross Floor Area.

**Table 5. Component Cost as a Percentage of Total Cost**

Component	0.Antigonish WTP Baseline Building (%)	1 Antigonish WTP ECM Propane Boiler (%)
<b>HVAC Components</b>		
Electric	2.5	4.3
Natural Gas	0.0	0.0
Fuel Oil	91.8	0.0
Propane	0.0	85.8
Remote HW	0.0	0.0
Remote Steam	0.0	0.0
Remote CW	0.0	0.0
<b>HVAC Sub-Total</b>	<b>94.3</b>	<b>90.1</b>
<b>Non-HVAC Components</b>		
Electric	5.7	9.9
Natural Gas	0.0	0.0
Fuel Oil	0.0	0.0
Propane	0.0	0.0
Remote HW	0.0	0.0
Remote Steam	0.0	0.0
<b>Non-HVAC Sub-Total</b>	<b>5.7</b>	<b>9.9</b>
<b>Grand Total</b>	<b>100.0</b>	<b>100.0</b>

# APPENDIX B

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## LED Lighting Inventory

# 1 Antigonish Arena

**Table 1.1: Spaces Considered for LED Upgrades**

Space	Fixture Qty	Fixture Type	Lamp Type	Existing Wattage /Fixture	Proposed Wattage/ Fixture
<b>First Floor</b>					
<b>001 - Exterior</b>	3	Floodlight	HID	100	25 W
<b>002 - Entrance Corridor</b>	16	2ft x 2ft Recessed Panel	2ft T12	80	27 W
	2	1ft x 4ft Recessed Panel	T12 FI	80	19 W
<b>003 - Women's Washroom</b>	1	4ft wall mount linear above sink	T12 FI	40	35 W
	1	4ft prismatic lens Wrap ceiling Surface Mount	T12 FI	80	24 W
<b>004 - Men's Washroom</b>	1	Circular Ceiling Surface	Incandescent	40	19 W
	1	4ft wall mount linear above sink	T12 FI	40	35 W
	2	4ft prismatic lens Wrap ceiling Surface Mount	T12 FI	80	27 W
<b>005 - Locker Corridor</b>	9	1ft x 4ft Recessed Panel	Fluorescent	80	19 W
<b>Trophy Case</b>	2	4ft Ceiling strip	T12 FI	40	35 W
<b>006 - Locker Room 5</b>	4	4ft prismatic lens Wrap ceiling Surface Mount	T12 FI	80	27 W
	6	1ft x 4ft Recessed Panel	Fluorescent	80	19 W
<b>007 - Janitor Closet</b>	1	Edison Base (Bare bulb socket)	Incandescent	180	35 W
<b>008 - Skate Sharpening</b>	1	4ft Wrapped Fixture Surface Mount	Fluorescent	80	35 W
<b>009 - Spare Room</b>	6	4ft Wrapped Fixture Surface Mount	Fluorescent	80	27 W

Space	Fixture Qty	Fixture Type	Lamp Type	Existing Wattage /Fixture	Proposed Wattage/ Fixture
010 - Entrance Corridor	1	1ft x 4ft Recessed Panel	T12 FI	40	35 W
011 - Canteen	3	4ft Wrapped Fixture Surface Mount	Fluorescent	80	35 W
	4	4ft Linear Fixture Surface Mount	Fluorescent	86	19 W
	1	Edison Base (Bare bulb socket)	Incandescent	0	35 W
012 - Locker Room	4	4ft Wrapped Fixture Surface Mount	Fluorescent	80	27 W
	6	1ft x 4ft Recessed Panel	Fluorescent	80	35 W
014 - Exterior Mech Room	2	Edison Base (Bare bulb socket)	Incandescent	60	35 W
017 - Mech Room	5	4ft Linear Fixture Surface Mount - Industrial	Fluorescent	80	35 W
018 - "Exit Only" Doors Alcove	1	4ft Wrapped Fixture Surface Mount	Fluorescent	80	35 W
019 - Electrical Closet	1	Edison Base (Bare bulb socket)	Incandescent	60	35 W
020 - Corridor	2	4ft Wrapped Fixture Surface Mount	Fluorescent	80	35 W
021 - Storage Closet	1	4ft Wrapped Fixture Surface Mount	Fluorescent	80	51 W
022 - Locker Room	2	2 x 4ft Recessed	Fluorescent	160	35 W
	2	4ft Wrapped Fixture Surface Mount	Fluorescent	80	37 W
023 - Corridor	6	8" Recessed Potlight	Triple Twin CFL	42	35 W
024 - Hospitality Room	2	4ft Wrapped Fixture Surface Mount	Fluorescent	80	35 W
025 - Spectating Room	1	4ft Wrapped Fixture Surface Mount	Fluorescent	80	35 W

Space	Fixture Qty	Fixture Type	Lamp Type	Existing Wattage /Fixture	Proposed Wattage/ Fixture
026 - Boardroom	4	4ft Wrapped Fixture Surface Mount	Fluorescent	80	35 W
027 - Electrical Closet	1	Edison Base (Bare bulb socket)	Incandescent	60	25 W
Rink Seating	20	Edison Base (Metal reflector pendant)	Incandescent	100	27 W

**Table 1.2: Spaces Considered for Occupancy Sensors**

Space
114 - Reception
121 - WC
117 - Locker Room
100 - Locker Room
208 - Standing Room
205 - Hospitality
201 - Radio
113 - Office
110 - Locker Room
116 - Locker Room
122 - WC
109 - Locker Room

## 2 Columbus Field Washrooms

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**Table 2.1: Spaces Considered for LED Upgrades**

Space	Fixture Qty	Lamp Type	Existing Wattage/ Fixture	Proposed Wattage/ Fixture
Men's Washroom	4	Fluorescent	64	25
Women's Washroom	4	Fluorescent	64	25

**Table 2.2: Spaces Considered for Occupancy Sensors**

Space
Men's Washroom
Women's Washroom

## 3 Antigonish Fire Hall

**Table 3.1: Spaces Considered for LED Upgrades**

Space	Fixture Qty	Fixture Type	Lamp Type	Existing Wattage /Fixture	Proposed Wattage/ Fixture
<b>First Floor</b>					
001 - Truck Bay	26	Industrial Fixture Ceiling Mount	Fluorescent	100	59 W
002 - Entrance	2	2ft x 4ft Recessed Troffer	Fluorescent	128	51 W
003 - Stair	2	4ft Wrapped Fixture Surface Mount	Fluorescent	64	19 W
004 - Dispatch	2	4ft Wrapped Fixture Surface Mount	Fluorescent	64	35 W
005 - Mechanical Room	1	4ft chain mount strip	Fluorescent	64	30 W
	1	Light Bulb	Fluorescent	60	30 W
006 - Storage	2	4ft Wrapped Fixture Surface Mount	Fluorescent	64	35 W
007 - Washroom	1	Vanity Fixture	Fluorescent	400	22 W
008 - Activity Room	6	2ft x 4ft Recessed Troffer	Fluorescent	96	51 W
	6	Decorative wall sconce	Fluorescent	100	7 W
009 - Kitchen	1	Enclosed surface mount round (est. 2 edison base)	Fluorescent	120	35 W
010 - Entrance	1	2ft x 2ft Recessed Troffer	Fluorescent	40	25 W
<b>Second Floor</b>					
011 - Rec Room	15	2ft x 4ft Recessed Troffer	Fluorescent	96	25 W
	6	Track Lighting	Incandescent	60	8 W
013 - Washroom	1	Linear Vanity Light	Fluorescent	20	22 W

Space	Fixture Qty	Fixture Type	Lamp Type	Existing Wattage /Fixture	Proposed Wattage/ Fixture
014 - Weight Room	3	2ft x 4ft Recessed Troffer	Fluorescent	96	51 W
	1	4ft strip (no lamp, not in use)	Fluorescent	32	25 W
017 - Fire Chief	2	2ft x 4ft Recessed Troffer	Fluorescent	128	51 W
<b>Exterior</b>					
020 - Exterior	3	Exterior Wall Pack	Fluorescent	200	35 W

**Table 3.2: Spaces Considered for Occupancy Sensors**

Space
Activity Room
Fire Chief's Office
Kitchen
Washroom: Truck Bay
Washrooms: Second Floor
Fire Apartment
Fire Apartment Washroom
Activity Room

# 4 Antigonish Public Works/Electric Utility

**Table 4.1: Spaces Considered for LED Upgrades**

Space	Fixture Qty	Fixture Type	Existing Lamp type	Existing Wattage /Fixture	Proposed Wattage/ Fixture
001 - Exterior	7	Wall Pack	HID	100	35W
003 - Sign Room	2	4ft Wrapped Fixture Surface Mount	Fluorescent	64	35 W
006 - Catwalk	3	4ft Linear Fixture Surface Mount	Fluorescent	64	35 W

**Table 4.2: Spaces Considered for Occupancy Sensors**

Space
Electric Utility: Kitchen
Electric Utility: Washroom
Electric Utility: Office
Public Works Washroom
Public Works: Bills Office
Public Works: Break room

# 5 Antigonish Wastewater Treatment Plant

**Table 5.1: Spaces Considered for LED Upgrades**

Space	Fixture Qty	Existing Lamp type	Existing Wattage/ Fixture	Proposed Wattage/ Fixture
<b>Pumping Station</b>				
Exterior	1	HID	100	18
<b>Filter Building</b>				
Chemical Room	4	Fluorescent	64	48
Blower Room	4	Fluorescent	64	27
Lab/Office	4	Fluorescent	64	17
	1	Under counter Fluorescent Bulb	34	16
	1	Under counter Fluorescent Bulb	40	16
Washroom	1	Fluorescent	64	32.5
	1	Fluorescent	32	32.5
Hallway	1	Fluorescent	64	32.5

**Table 5.2: Spaces Considered for Occupancy Sensors**

Space
Chemical Room
Blower Room
Lab/Office
Washroom
Hallway

## 6 Antigonish Town Hall

**Table 6.1: Spaces Considered for LED Upgrades**

Space	Fixture Qty	Fixture Type	Lamp type	Existing Wattage/ Fixture	Proposed Wattage/ Fixture
<b>First Floor</b>					
<b>004 - Men's Washroom</b>	1	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>005 - Ladies Washroom</b>	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>006 - Main Staircase</b>	3	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>007 - Storage</b>	1	2ft x 4ft Recessed Troffer	Fluorescent	112	35 W
<b>010 - Reception</b>	6	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>010 - Work Area</b>	2	4ft x 4ft Fixture Surface Mount	Fluorescent	224	34 W
	15	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>012 - Kitchen</b>	3	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>013 - Deputy Clerks Office</b>	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>014 - Office Supplies</b>	3	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>015 - Storage</b>	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>016 - Mayors Office</b>	4	2ft x 4ft Recessed Troffer	Fluorescent	112	35 W

Space	Fixture Qty	Fixture Type	Lamp type	Existing Wattage/ Fixture	Proposed Wattage/ Fixture
017 - Former Library	34	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>Second Floor</b>					
019 - Second Floor Stair Landing	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
023 - Engineering Dept	8	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
024 - Director of Engineering and Public Works	4	2ft x 4ft Recessed Troffer	Fluorescent	56	25 W
025 - Lab	4	2ft x 4ft Recessed Troffer	Fluorescent	56	25 W
026 - Vault	4	2ft x 4ft Recessed Troffer	Fluorescent	56	25 W
027 - Conference Room	4	2ft x 4ft Recessed Troffer	Fluorescent	84	25 W
028 - Stair	1	Suspended fixture	Fluorescent	56	
029 - Building Inspector	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>Third Floor</b>					
030 - Summer Rec	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
031 - Corridor	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
032 - Washroom	1	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
033 - Highland Society	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
034 - Clock Tower	6	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W

Space	Fixture Qty	Fixture Type	Lamp type	Existing Wattage/ Fixture	Proposed Wattage/ Fixture
036 - Fire Inspector/ Safety Officer	2	2ft x 4ft Recessed Troffer	Fluorescent	112	25 W
037 - Closet	1	Bare socket (Edison base)	CFL screw base	13	25 W
038 - Closet	1	Bare socket (Edison base)	CFL screw base	13	25 W
<b>Basement</b>					
Basement	16	Bare socket (Edison base)	LED screw bulb	9	25 W
	1	Bare socket (Edison base)	CFL screw base	13	25 W
	7	4ft strip	Fluorescent	56	35 W

**Table 6.2: Spaces Considered for Occupancy Sensors**

Space
200 - Office
201 - Office
308 - Office
122 - Rec. Offices
116 - Office
118 - Office
120 - Wc
302 - Office
303 - Kitchen
304 - Wc
301 - Office
207 - Wc
307 - Office
210 - Lab
106 - Office
112 - Office
107 - Wc
110 - Kitchen
108 - Wc
204 - Office
113 - Office

# 7 Antigonish Water Treatment Plant

**Table 7.1: Spaces Considered for LED Upgrades**

Space	Fixture Qty	Fixture Type	Existing Lamp Type	Existing Wattage/ Fixture	Proposed Wattage/ Fixture
101 Tankage Room	13	Circular High Bay	HPS	250	100
	8	4ft Vaportight Fixture Suspended	Fluorescent	64	45
102 Corridor	5	2x2 Recessed Troffer	U bulb	64	16
103 Soda Ash	2	4ft Vaportight Fixture Suspended	Fluorescent	64	45
104 Mechanical Room	2	4ft Vaportight Fixture Suspended	Fluorescent	64	45
105 Electrical Room	4	Wraparound	Fluorescent	64	30
106 Office	4	2x4 Recessed Troffer	Fluorescent	64	16
107 Lab	4	2x4 Recessed Troffer	Fluorescent	64	16
108 W/C	1	Linear Fixture	Fluorescent	32	27
109 Shower	1	Downlight	LED Potlight	30	8.5
	1	Downlight (Shower Proof)	Fluorescent	32	100
110 Chemical Feed Room	5	4ft Vaportight Fixture Suspended	Fluorescent	64	45

Space	Fixture Qty	Fixture Type	Existing Lamp Type	Existing Wattage/ Fixture	Proposed Wattage/ Fixture
111 Lunch Room	6	Downlight	LED Potlight	30	8.5
	2	2x4 Recessed Troffer	Fluorescent	64	16
112 Chlorine Storage	2	4ft Vaportight Fixture Suspended	Fluorescent	64	45
Tank Room(Caustic and Alum)	6	4ft Vaportight Fixture Suspended	Fluorescent	64	45
Basement	17	4ft Vaportight Fixture Suspended	Fluorescent	64	45

**Table 7.2: Spaces Considered for Occupancy Sensors**

Space
101 Tankage Room
102 Corridor
103 Soda Ash
102 Corridor
106 Office
107 Lab
108 W/C
109 Shower
110 Chemical Feed Room
111 Lunchroom
106 Office
107 Lab
108 W/C
Tank Room(Caustic and Alum)
Basement

Space	Fixture Qty	Fixture Type	Lamp Type	Existing Wattage/ Fixture	Proposed Wattage/ Fixture
<b>First Floor</b>					
004 - Men's Washroom	1	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
005 - Ladies Washroom	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
006 - Main Staircase	3	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
007 - Storage	1	2ft x 4ft Recessed Troffer	Fluorescent	112	35 W
010 - Reception	6	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
010 - Work Area	2	4ft x 4ft Fixture Surface Mount***	Fluorescent	224	34 W
	15	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
012 - Kitchen	3	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
013 - Deputy Clerks Office	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
014 - Office Supplies	3	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
015 - Storage	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
016 - Mayors Office	4	2ft x 4ft Recessed Troffer	Fluorescent	112	35 W
017 - Former Library	34	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>Second Floor</b>					
019 - Second Floor Stair Landing	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
023 - Engineering Dept	8	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W

Space	Fixture Qty	Fixture Type	Lamp Type	Existing Wattage/ Fixture	Proposed Wattage/ Fixture
024 - Director of Engineering and Public Works	4	2ft x 4ft Recessed Troffer	Fluorescent	56	25 W
025 - Lab	4	2ft x 4ft Recessed Troffer	Fluorescent	56	25 W
026 - Vault	4	2ft x 4ft Recessed Troffer	Fluorescent	56	25 W
027 - Conference Room	4	2ft x 4ft Recessed Troffer	Fluorescent	84	25 W
028 - Stair	1	Suspended fixture	Fluorescent	56	
029 - Building Inspector	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>Third Floor</b>					
030 - Summer Rec	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
031 - Corridor	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
032 - Washroom	1	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
033 - Highland Society	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
034 - Clock Tower	6	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
036 - Fire Inspector/ Safety Officer	2	2ft x 4ft Recessed Troffer	Fluorescent	112	25 W
037 - Closet	1	Bare socket (edison base)	CFL screw base	13	25 W
038 - Closet	1	Bare socket (edison base)	CFL screw base	13	25 W
<b>Basement</b>					
Basement	16	Bare socket (edison base)	LED screw bulb	9	25 W
	1	Bare socket (edison base)	CFL screw base	13	25 W

Space	Fixture Qty	Fixture Type	Lamp Type	Existing Wattage/ Fixture	Proposed Wattage/ Fixture
	7	4ft strip	Fluorescent	56	35 W

Space	Fixture Qty	Fixture Type	Lamp Type	Existing Wattage/ Fixture	Proposed Wattage/ Fixture
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**First Floor**

<b>004 - Men's Washroom</b>	1	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>005 - Ladies Washroom</b>	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>006 - Main Staircase</b>	3	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>007 - Storage</b>	1	2ft x 4ft Recessed Troffer	Fluorescent	112	35 W
<b>010 - Reception</b>	6	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>010 - Work Area</b>	2	4ft x 4ft Fixture Surface Mount***	Fluorescent	224	34 W
	15	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>012 - Kitchen</b>	3	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>013 - Deputy Clerks Office</b>	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>014 - Office Supplies</b>	3	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>015 - Storage</b>	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>016 - Mayors Office</b>	4	2ft x 4ft Recessed Troffer	Fluorescent	112	35 W
<b>017 - Former Library</b>	34	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W

**Second Floor**

<b>019 - Second Floor Stair Landing</b>	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
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Space	Fixture Qty	Fixture Type	Lamp Type	Existing Wattage/ Fixture	Proposed Wattage/ Fixture
023 - Engineering Dept	8	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
024 - Director of Engineering and Public Works	4	2ft x 4ft Recessed Troffer	Fluorescent	56	25 W
025 - Lab	4	2ft x 4ft Recessed Troffer	Fluorescent	56	25 W
026 - Vault	4	2ft x 4ft Recessed Troffer	Fluorescent	56	25 W
027 - Conference Room	4	2ft x 4ft Recessed Troffer	Fluorescent	84	25 W
028 - Stair	1	Suspended fixture	Fluorescent	56	
029 - Building Inspector	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
<b>Third Floor</b>					
030 - Summer Rec	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
031 - Corridor	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
032 - Washroom	1	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
033 - Highland Society	2	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
034 - Clock Tower	6	4ft Wrapped Fixture Surface Mount	Fluorescent	56	35 W
036 - Fire Inspector/ Safety Officer	2	2ft x 4ft Recessed Troffer	Fluorescent	112	25 W
037 - Closet	1	Bare socket (edison base)	CFL screw base	13	25 W
038 - Closet	1	Bare socket (edison base)	CFL screw base	13	25 W

Space	Fixture Qty	Fixture Type	Lamp Type	Existing Wattage/ Fixture	Proposed Wattage/ Fixture
<b>Basement</b>					
<b>Basement</b>	16	Bare socket (edison base)	LED screw bulb	9	25 W
	1	Bare socket (edison base)	CFL screw base	13	25 W
	7	4ft strip	Fluorescent	56	35 W

# APPENDIX C

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## LCCA Major Equipment and Replacement Timeline

## Major Equipment Considered in LCCA Development and Assumed Replacement Timeline

Antigonish Arena Baseline Building			
Equipment	First Year O&M Cost Estimate (\$)	Typical Equipment Lifespan	First Year Replacement Cost Estimate (\$)
932 MBH Oil Fired Boiler	\$3,078.00	20	\$43,000
Oil Tank	\$533.00	15	\$4,500
Fluorescent Lighting	\$500.00	7	\$20,840
Aluminum Framed Windows	-	20	\$17,600
Propane Radiant Heaters	\$3,270.00	15	\$77,000
Manual Light Switches	-	20	\$1,800
Propane Zamboni	\$5,000.00	20	\$100,000
Antigonish Arena Proposed Building			
Electric Boiler with Outdoor Air Temperature Reset	\$1,650.00	25	\$45,000
Electrical Entrance Upgrade	-	-	\$110,000
LED Lighting	\$250.00	10	\$41,680
Occupancy Sensors for Lighting Control	-	20	\$2,400
Upgrade Aluminum Windows to R-4	-	20	\$22,000
Electric Radiant Heaters with Pay Control System	\$1,000.00	20	\$77,000
Hydronic Heating Loop Pipe Insulation	-	50	\$75
Repair Exhaust Louvers	-	40	\$720
Air Compressor Maintenance Program	-	-	\$1,000
Cold Water Ice Resurfacing with DHW Heat Recovery	-	30	\$47,000
Electric Zamboni	\$6,000.00	20	\$190,000

<b>Columbus Field Washroom Baseline Building</b>			
<b>Equipment</b>	<b>First Year O&amp;M Cost Estimate (\$)</b>	<b>Typical Equipment Lifespan</b>	<b>First Year Replacement Cost Estimate (\$)</b>
Fluorescent Lighting	\$32.00	7	\$480
Manual Light Switches	-	20	\$300
Manual Bathroom Exhaust Switch	-	20	\$300
Electric DHW Heater Tank	\$100.00	15	\$3,000
<b>Columbus Field Washroom Proposed Building</b>			
Upgrade to LED Lighting	\$16.00	10	\$960.00
Implement Occupancy Sensors	-	20	\$400.00
Install Bathroom Exhaust Switch Timer	-	20	\$400.00
Turn Off Heat when Building is Closed	-	100	-
Infiltration Reduction	-	100	\$300.00
Install Tankless Hot Water Heater	\$100.00	20	\$3,000.00
Electrical Service Entrance Upgrade	-	100	\$3,000.00

<b>Antigonish Fire Hall Baseline Building</b>			
<b>Equipment</b>	<b>First Year O&amp;M Cost Estimate (\$)</b>	<b>Typical Equipment Lifespan</b>	<b>First Year Replacement Cost Estimate (\$)</b>
Fluorescent Lighting	\$328.00	7	\$4,105
Manual Light Switches	-	20	\$1,500
Oil Fired Boiler-430 MBH	\$2,815.00	20	\$32,000
Oil Tank	\$533.00	15	\$4,500
Original Aluminum Windows	-	20	\$17,200
Original Vinyl Windows	-	20	\$27,600
Bathroom Exhaust Switches	-	20	\$600
<b>Antigonish Fire Hall Proposed Building</b>			
LED Lighting	\$164.00	10	\$8,210
Occupancy Sensors	-	20	\$2,000
Bathroom Exhaust Timers	-	20	\$800
Oil Fired Boiler-430 MBH	\$2,815.00	25	\$35,000
Electric Radiant Heaters	\$348.00	20	\$40,000
Electrical Entrance Upgrade		100	\$80,000
Infiltration Reduction	-	100	\$1,550
Air Source Heat pumps	\$3,064.00	20	\$37,500
Aluminum Window Upgrade to R4	-	20	\$21,500
Air Compressor Maintenance System	-	-	\$1,000
Vinyl Window Upgrade to R4	-	20	\$34,500

<b>Antigonish Town and County Library Baseline Building</b>			
<b>Equipment</b>	<b>First Year O&amp;M Cost Estimate (\$)</b>	<b>Typical Equipment Lifespan</b>	<b>First Year Replacement Cost Estimate (\$)</b>
Building Automation System	-	20	\$200,000
<b>Antigonish Town and County Library Proposed Building</b>			
Building Automation System	\$1,701	20	\$200,000
Nighttime Setback	-	-	-
Reactivate Electronic Valve	-	-	\$8,000

<b>Antigonish Public Works/Electric Utility Baseline Building</b>			
<b>Equipment</b>	<b>First Year O&amp;M Cost Estimate (\$)</b>	<b>Typical Equipment Lifespan</b>	<b>First Year Replacement Cost Estimate (\$)</b>
Fluorescent Lighting	\$48.00	7	\$1,736
Manual Light Switches	-	20	\$1,200
Oil Fired Furnaces Qty 2	\$3,153.00	20	\$22,657
Oil Tank Qty 2	\$1,066.00	15	\$9,000
Original Aluminum Windows	-	20	\$4,600
Original Vinyl Windows	-	20	\$10,400
<b>Antigonish Public Works/Electric Utility Proposed Building</b>			
LED Lighting	\$24.00	10	\$3,472
Occupancy Sensors	-	20	\$1,600
Electric Baseboards & Electric Radiant Heaters	\$1,200.00	20	\$62,000
Electrical Entrance Upgrade	-	-	\$90,000
Original Aluminum Windows Upgrade	-	20	\$5,750
Infiltration Reduction	-	100	\$5,000
Air Source Heat Pumps	\$3,064.00	20	\$20,000
Air Compressor Maintenance Program	-	-	\$1,000
Vinyl Window Upgrades	-	20	\$13,000

<b>Antigonish Wastewater Treatment Plant Baseline Building</b>			
<b>Equipment</b>	<b>First Year O&amp;M Cost Estimate (\$)</b>	<b>Typical Equipment Lifespan</b>	<b>First Year Replacement Cost Estimate (\$)</b>
Pumping Station Fluorescent Lighting	\$4	7	\$203
Pumping Station Manual Light Switch	-	20	\$150
Filter Building: Fluorescent Lighting	\$68	7	\$1,300
Filter Building: Manual Light Switch	-	20	\$750
Filter Building: Manual Thermostat	-	20	\$150
Filter Building: 25HP PD Blower	\$3,679	30	\$100,000
<b>Antigonish Wastewater Treatment Plant Proposed Building</b>			
Pumping Station LED Lighting	\$2	10	\$410
Pumping Station : Occupancy Sensor	-	20	\$200
Pumping Station: Exhaust Louvers	-	40	\$1,400
Filter Building: LED Lighting	\$34	10	\$2,600
Filter Building: Occupancy Sensors	-	20	\$1,000
Filter Building: Programmable Thermostat	-	20	\$200
Filter Building: Repair Exhaust Louvers	-	40	\$7,250
Filter Building: Repair Damaged Windows	-	40	\$720
Filter Building: 25 HP Turbo Blowers	\$3,679	30	\$200,000

<b>Antigonish Town Hall Baseline Building</b>			
<b>Equipment</b>	<b>First Year O&amp;M Cost Estimate (\$)</b>	<b>Typical Equipment Lifespan</b>	<b>First Year Replacement Cost Estimate (\$)</b>
Fluorescent Lighting	\$592.00	7	\$7,555
Manual Light Switches	-	20	\$3,450
Oil Fired Boilers Qty 2	\$5,630.00	20	\$57,000
Oil Tanks Qty 2	\$1,066.00	15	\$9,000
Manual Thermostats	-	20	\$5,400
Original Windows	-	20	\$120,000
<b>Antigonish Town Hall Proposed Building</b>			
Electric Boilers with Outdoor Air Temperature Reset	\$2,907.14	25	\$73,500
Upgrade Electrical Entrance	-	-	\$90,000
Upgrade to LED Lighting	\$296.00	10	\$31,864
Occupancy Sensors	-	20	\$5,968
Programmable Thermostats with Nighttime Setback	-	20	\$5,400
Infiltration Reduction	-	100	\$2,700
Upgrade Existing Windows to R-4	-	20	\$150,000

<b>Antigonish Water Treatment Plant Baseline Building</b>			
<b>Equipment</b>	<b>First Year O&amp;M Cost Estimate (\$)</b>	<b>Typical Equipment Lifespan</b>	<b>First Year Replacement Cost Estimate (\$)</b>
Fluorescent Lighting	\$332	7	\$7,555
Manual Light Switches	-	20	\$3,450
Oil Fired Boiler	\$3,453	20	\$57,000
Oil Tank	\$533	15	\$5,968
<b>Antigonish Water Treatment Plant Proposed Building</b>			
Upgrade to LED Lighting	\$166.00	10	\$25,020
Occupancy Sensors for Lighting Control	-	20	\$2,200
Upgrade to Propane Fired Boiler	\$3,453.00	20	\$60,000
Concrete Pad, Vehicle Protection, Line, Trench, etc.	-	40	\$5,000
Infiltration Reduction	-	20	\$1,650
Implement VFD to Recycling Pumps	\$650.00	25	\$50,000
Repair Louvers for Exhaust Fans	-	40	\$14,000
Install Ground Mounted PV Array	\$527.00	25	\$52,700

Antigonish Arena: Baseline Building																																	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Salvage Value At Year 30	
Equipment	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054		
932 MBH Oil Fired Boiler	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$56,623	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$112,667	\$0	\$0	-\$101,401
Oil Tank	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$5,926	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$9,928	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$5,295	
Fluorescent Lighting	\$0	\$21,569	\$0	\$0	\$0	\$0	\$0	\$0	\$27,442	\$0	\$0	\$0	\$0	\$0	\$0	\$34,914	\$0	\$0	\$0	\$0	\$0	\$0	\$44,421	\$0	\$0	\$0	\$0	\$0	\$0	\$56,516	\$0	-\$48,442	
Aluminum Framed Windows	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$23,176	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$46,115	\$0	\$0	-\$41,504	
Propane Radiant Heaters	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$101,394	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$169,871	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$90,598	
Manual Light Switches	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$2,370	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$4,716	\$0	\$0	-\$4,245	
Propane Zamboni	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$145,997	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$7,300	

Antigonish Arena: Proposed Building																																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Salvage Value At Year 30
Equipment	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	
Electric Boiler with Outdoor Air Temperature Reset	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$59,256	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$7,111
Electrical Entrance Upgrade	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$144,849	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
LED Lighting	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$54,885	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$77,420	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$109,209	\$0	\$0	-\$87,367
Occupancy Sensors for Lighting Control	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$3,160	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$6,288	\$0	\$0	-\$5,660
Upgrade Aluminum Windows to R-4	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$28,970	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$57,644	\$0	\$0	-\$51,879
Electric Radiant Heaters with Pay Control System	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$101,394	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$201,753	\$0	\$0	-\$181,578
Hydronic Heating Loop Pipe Insulation	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$99	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$55
Repair Exhaust Louvers	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$948	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$427
Air Compressor Maintenance Program	\$1,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Cold Water Ice Resurfacing with DHW Heat Recovery	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$61,890	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$16,504
Electric Zamboni	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$277,394	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$13,870

Columbus Field Washrooms: Baseline Building																																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Salvage Value At Year 30
Equipment	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	
Fluorescent Lighting	\$480	\$0	\$0	\$0	\$0	\$0	\$0	\$611	\$0	\$0	\$0	\$0	\$0	\$0	\$777	\$0	\$0	\$0	\$0	\$0	\$0	\$989	\$0	\$0	\$0	\$0	\$0	\$0	\$1,258	\$0	\$0	-\$898
Manual Light Switches	\$300	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$597	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$298
Manual Bathroom Exhaust Switch	\$300	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$597	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$298
Electric DHW Heater Tank	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$4,232	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$7,090	\$0	\$0	\$0	\$0	\$0	-\$4,726

Columbus Field Washrooms: Proposed Building																																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Salvage Value At Year 30
Equipment	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	
Upgrade to LED Lighting	\$960	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$1,354	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$1,910	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$2,695	-\$2,695	
Implement Occupancy Sensors	\$400	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$796	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$398
Install Bathroom Exhaust Switch Timer	\$400	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$796	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$398
Turn Off Heat when Building is Closed	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Infiltration Reduction	\$300	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$210
Install Tankless Hot Water Heater	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$4,232	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$8,420	-\$8,420
Electrical Service Entrance Upgrade	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$4,232	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

Antigonish Fire Hall: Baseline Building																																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Salvage Value At Year 30
Equipment	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	
Fluorescent Lighting	\$0	\$0	\$4,397	\$0	\$0	\$0	\$0	\$0	\$0	\$5,595	\$0	\$0	\$0	\$0	\$0	\$0	\$7,118	\$0	\$0	\$0	\$0	\$0	\$0	\$9,056	\$0	\$0	\$0	\$0	\$0	\$0	\$11,522	-\$11,522
Manual Light Switches	\$0	\$0	\$1,607	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$3,197	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$1,918
Oil Fired Boiler-430 MBH	\$0	\$0	\$34,279	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$68,208	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$40,925	
Oil Tank	\$0	\$0	\$4,821	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$8,076	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$1,077	
Original Aluminum Windows	\$0	\$0	\$18,425	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$36,662	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$21,997	
Original Vinyl Windows	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$46,240	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$11,560	
Bathroom Exhaust Switches	\$0	\$0	\$643	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$1,279	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$767	

Antigonish Fire Hall: Proposed Building																																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Salvage Value At Year 30
Equipment	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	
LED Lighting	\$0	\$0	\$8,795	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$12,406	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$17,500	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$3,500	
Occupancy Sensors	\$0	\$0	\$2,142	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$4,263	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$2,558	
Bathroom Exhaust Timers	\$0	\$0	\$857	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$1,705	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$1,023	
Electric Boiler	\$0	\$0	\$37,493	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$88,605	\$0	\$0	\$0	-\$77,972
Electric Radiant Heaters	\$0	\$0	\$42,849	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$85,260	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$51,156	
Electrical Entrance Upgrade	\$0	\$0	\$85,698	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
Infiltration Reduction	\$0	\$0	\$1,660	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$1,195	
Electric DHW	\$0	\$0	\$40,171	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$79,932	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$47,959	
Aluminum Window Upgrade to R4	\$0	\$0	\$23,031	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$45,827	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$27,496	
Air Compressor Maintenance System	\$1,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
Vinyl Window Upgrade to R4	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$57,800	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$14,450	

Antigonish Town and County Library: Baseline Building																																	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Salvage Value At Year 30	
Equipment	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054		
<b>Building Automation System</b>	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$272,579	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$542,376	\$0	-\$515,257

Antigonish Town and County Library: Proposed Building																																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Salvage Value At Year 30
Equipment	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	
<b>Building Automation System</b>	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$272,579	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$542,376	\$0	-\$515,257
<b>Nighttime Setback</b>	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Reactivate Electronic Valve</b>	\$8,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	



Antigonish Wastewater Treatment Plant: Baseline Building																																				
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Salvage Value At Year 30				
Equipment	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054					
Pumping Station Fluorescent Lighting	\$203	\$0	\$0	\$0	\$0	\$0	\$0	\$258	\$0	\$0	\$0	\$0	\$0	\$0	\$328	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$417	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$531	\$0	\$0	-\$379	
Pumping Station Manual Light Switch	\$150	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$298	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$149		
Filter Building: Fluorescent Lighting	\$1,300	\$0	\$0	\$0	\$0	\$0	\$0	\$1,654	\$0	\$0	\$0	\$0	\$0	\$0	\$2,104	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$2,677	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$3,406	\$0	\$0	-\$2,433
Filter Building: Manual Light Switch	\$750	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$1,492	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$746		
Filter Building: Manual Thermostat	\$150	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$298	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$149		
Filter Building: 25HP PD Blower	\$0	\$0	\$0	\$110,872	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$11,087		

Antigonish Wastewater Treatment Plant: Proposed Building																																			
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Salvage Value At Year 30			
Equipment	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054				
Pumping Station LED Lighting	\$410	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$578	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$816	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$1,151	-\$1,151
Pumping Station: Occupancy Sensor	\$200	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$398	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$199	
Pumping Station: Exhaust Louvers	\$1,400	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$350	
Filter Building: LED Lighting	\$2,600	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$3,668	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$5,173	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$7,298	-\$7,298
Filter Building: Occupancy Sensors	\$1,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$1,990	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$995	
Filter Building: Programmable Thermostat	\$200	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$398	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$199		
Filter Building: Repair Exhaust Louvers	\$7,250	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$14,426	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$7,213	
Filter Building: Repair Damaged Windows	\$720	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$180		
Filter Building: 25 HP Turbo Blowers	\$0	\$0	\$0	\$221,744	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$22,174	

Antigonish Town Hall: Baseline Building																																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Salvage Value At Year 30
Equipment	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	
Fluorescent Lighting	\$0	\$7,819	\$0	\$0	\$0	\$0	\$0	\$0	\$9,948	\$0	\$0	\$0	\$0	\$0	\$0	\$12,657	\$0	\$0	\$0	\$0	\$0	\$0	\$16,104	\$0	\$0	\$0	\$0	\$0	\$0	\$20,488	\$0	-\$17,561
Manual Light Switches	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$4,543	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$9,040	\$0	\$0	-\$8,136
Oil Fired Boilers Qty 2	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$89,145	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$13,372	
Oil Tanks Qty 2	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$14,076	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$23,582	\$0	\$0	-\$20,437
Manual Thermostats	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$7,111	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$14,149	\$0	\$0	-\$12,734
Original Windows	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$158,017	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$314,421	\$0	\$0	-\$282,979

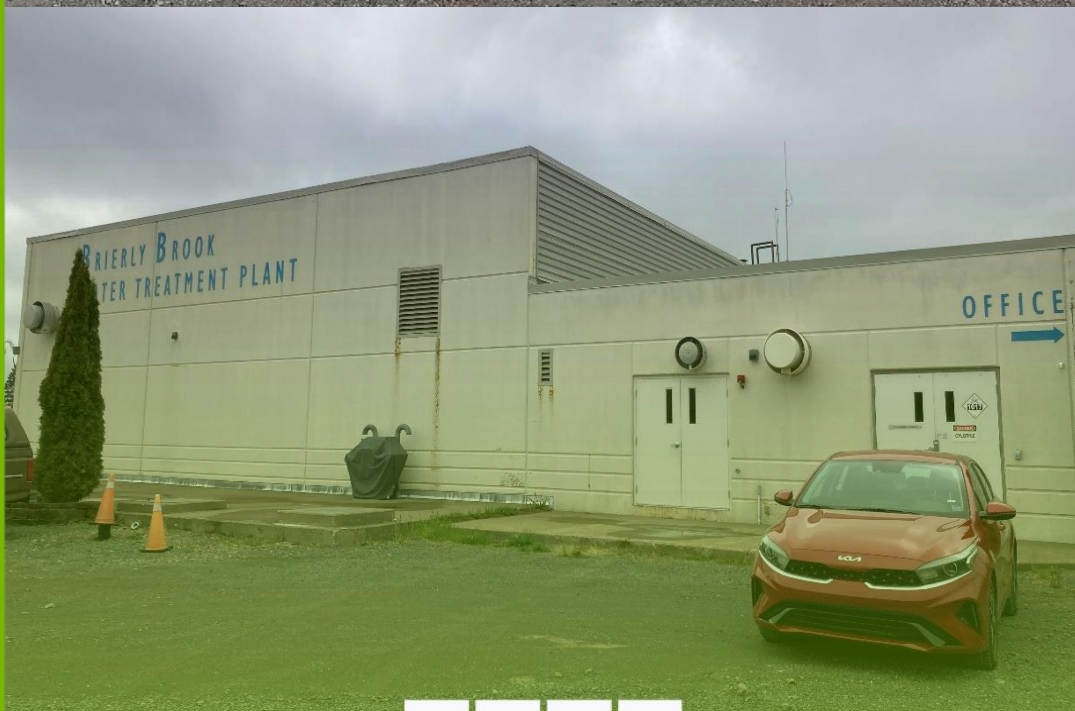
Antigonish Town Hall: Proposed Building																																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Salvage Value At Year 30
Equipment	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	
Electric Boilers with Outdoor Air Temperature Reset	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$96,785	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$11,614
Upgrade Electrical Entrance	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$118,513	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Upgrade to LED Lighting	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$19,897	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$28,067	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$39,591	\$0	\$0	-\$31,673
Occupancy Sensors	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$6,057	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$12,053	\$0	\$0	-\$10,848
Programmable Thermostats with Nighttime Setback	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$9,481	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$18,865	\$0	\$0	-\$16,979
Infiltration Reduction	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$3,555	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$2,773
Upgrade Existing Windows to R-4	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$197,521	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$393,026	\$0	\$0	-\$353,723

Antigonish Water Treatment Plant: Baseline Building																																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Salvage Value At Year 30
Equipment	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	
Fluorescent Lighting	\$0	\$0	\$8,093	\$0	\$0	\$0	\$0	\$0	\$0	\$10,297	\$0	\$0	\$0	\$0	\$0	\$0	\$13,100	\$0	\$0	\$0	\$0	\$0	\$0	\$16,667	\$0	\$0	\$0	\$0	\$0	\$0	\$21,205	-\$21,205
Manual Light Switches	\$0	\$0	\$3,696	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$7,354	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$4,412	
Oil Fired Boiler	\$0	\$0	\$61,060	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$121,496	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$72,898	
Oil Tank	\$0	\$0	\$6,393	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$10,711	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$1,428	

Antigonish Water Treatment Plant: Proposed Building																																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Salvage Value At Year 30
Equipment	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	
Upgrade to LED Lighting	\$0	\$0	\$26,802	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$37,807	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$53,330	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$10,666	
Occupancy Sensors for Lighting Control	\$0	\$0	\$2,357	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$4,689	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$2,814	
Upgrade to Propane Fired Boiler	\$0	\$0	\$64,274	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$127,891	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$76,734	
Concrete Pad, Vehicle Protection, Line Trench	\$0	\$0	\$5,356	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$1,607	
Infiltration Reduction	\$0	\$0	\$1,768	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$3,517	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$2,110	
Implement VFD to Recycling Pumps	\$50,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$118,162	\$0	\$0	\$0	\$0	-\$94,530	
Repair Louvers for Exhaust Fans	\$0	\$0	\$14,997	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$4,499	
Install Ground Mounted PV Array	\$0	\$0	\$56,454	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$133,414	\$0	\$0	\$0	-\$117,404	

Estimated Implementation Timeline																					
Building	Efficiency Measure	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	
Antigonish Arena	Electric Boiler with Outdoor Air Temperature Reset									\$59,256											
	Electrical Entrance Upgrade									\$144,849											
	LED Lighting									\$54,885											
	Occupancy Sensors for Lighting Control									\$3,160											
	Upgrade Aluminum Windows to R-4									\$28,970											
	Electric Radiant Heaters with Pay Control System									\$101,394											
	Hydronic Heating Loop Pipe Insulation									\$99											
	Repair Exhaust Louvers									\$948											
	Air Compressor Maintenance Program	\$1,000																			
Cold Water Ice Resurfacing with DHW Heat Recovery									\$61,890												
Electric Zamboni													\$277,394								
Columbus Field Washrooms	Upgrade to LED Lighting	\$960																			
	Implement Occupancy Sensors	\$400																			
	Install Bathroom Exhaust Switch Timer	\$400																			
	Turn Off Heat when Building is Closed																				
	Infiltration Reduction	\$300																			
	Install Tankless Hot Water Heater											\$4,232									
Electrical Service Entrance Upgrade											\$4,232										
Fire Hall	LED Lighting			\$8,795																	
	Occupancy Sensors			\$2,142																	
	Bathroom Exhaust Timers			\$857																	
	Oil-fired Boiler			\$37,493																	
	Electric Radiant Heaters			\$42,849																	
	Electrical Entrance Upgrade			\$85,698																	
	Infiltration Reduction			\$1,660																	
	Air Source Heat pumps			\$40,171																	
	Aluminum Window Upgrade to R4			\$23,031																	
Air Compressor Maintenance System	\$1,000																				
Vinyl Window Upgrade to R4																\$57,800					
Antigonish Town and County Library	Building Automation System																				
	Nighttime Setback																				
	Reactivate Electronic Valve	\$8,000																			
Antigonish Public Works/Electric Utility	LED Lighting		\$3,594																		
	Occupancy Sensors		\$1,656																		
	Electric Baseboards & Electric Radiant Heaters		\$64,170																		
	Electrical Entrance Upgrade		\$93,150																		
	Original Aluminum Windows Upgrade		\$5,951																		
	Infiltration Reduction		\$5,175																		
	Air Source Heat Pumps		\$20,700																		
	Air Compressor Maintenance Program																				
Vinyl Window Upgrades												\$18,338									
Antigonish Wastewater Treatment Plant	Pumping Station LED Lighting	\$410																			
	Pumping Station: Occupancy Sensor	\$200																			
	Pumping Station: Exhaust Louvers	\$1,400																			
	Filter Building: LED Lighting	\$2,600																			
	Filter Building: Occupancy Sensors	\$1,000																			
	Filter Building: Programmable Thermostat	\$200																			
	Filter Building: Repair Exhaust Louvers	\$7,250																			
	Filter Building: Repair Damaged Windows	\$720																			
Filter Building: 25 HP Turbo Blowers					\$221,744																
Antigonish Town Hall	Electric Boilers with Outdoor Air Temperature Reset									\$96,785											
	Upgrade Electrical Entrance									\$118,513											
	Upgrade to LED Lighting									\$19,897											
	Occupancy Sensors									\$6,057											
	Programmable Thermostats with Nighttime Setback									\$9,481											
	Infiltration Reduction									\$3,555											
	Upgrade Existing Windows to R-4									\$197,521											
Antigonish Water Treatment Plant	Upgrade to LED Lighting			\$26,802																	
	Occupancy Sensors for Lighting Control			\$2,357																	
	Upgrade to Propane Fired Boiler			\$64,274																	
	Concrete Pad, Vehicle Protection, Line Trench			\$5,356																	
	Infiltration Reduction			\$1,768																	
	Implement VFD to Recycling Pumps	\$50,000																			
	Repair Louvers for Exhaust Fans			\$14,997																	
Install Ground Mounted PV Array			\$56,454																		

	Phase 1									Phase 2									
	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
<b>Total</b>	\$75,840	\$195,431	\$377,746	\$221,744	\$0	\$0	\$0	\$0	\$907,262	\$0	\$26,801	\$218,995	\$0	\$0	\$0	\$57,800	\$0	\$0	\$0



Solutions today | Tomorrow  mind

