Town of Oakville
Council

ADDENDUM

Date: Monday, April 25, 2022
Time: 6:30 p.m.
Location: Virtual Meeting

Currently attendance at Town Hall is restricted and public meetings are being held by videoconference only. Live streaming video is available on oakville.ca/live or at the town's YouTube channel at youtube.com/user/townofoakvilleTV. Information regarding written submissions and requests to delegate can be found at https://www.oakville.ca/townhall/delegations-presentations.html.

Pages

7. Consent Item(s)

***7.8. Property Standards Committee, Terms of Reference and Rules of Procedure** *5 - 35*

Recommendation:

1. That the updated Property Standards Committee Terms of Reference attached as Appendix A to the report dated April 19, 2022 from the Clerk's and Legal department, be adopted.

2. That the proposed Property Standards Committee Rules of Procedure attached as Appendix B to the report dated April 19, 2022 for hearing Appeals of Property Standards Orders be endorsed and commended to the Property Standards Committee for its consideration in making rules governing its practice and procedure under section 25.1 of the *Statutory Powers Procedure Act R.S.O. 1990,c.S22* as amended.

***7.10. Reciprocal Agreement with Community Living Oakville** *36 - 45*

Recommendation:

1. That the Town enter into a reciprocal agreement with Community Living Oakville, permitting room rentals charges to be paid in equivalent Community Living Oakville staffing services.
2. That the Director of Recreation and Culture be authorized to execute renewals and amendments to the agreement, subject to such renewals and amendments having been negotiated and prepared to the satisfaction of the Town Solicitor.

***7.12. Progress Report on Reduction of Energy Use and Carbon Emissions for the Town of Oakville** *46 - 325*

Recommendation:

1. That the report entitled “Progress Report on Reduction of Energy Use and Carbon Emissions for the Town of Oakville” submitted by the Facilities and Construction Management department for the period 2014 – 2021 be received.
2. That the adoption of a Net Zero Carbon target for 2050 for all corporate activities in alignment with the federal Pan-Canadian Framework be approved.
3. That 2015 be adopted as the new baseline for energy and carbon reporting for corporate use.

9. Discussion Item(s)

*9.2. The More Homes for Everyone Act, 2022 and Implications for Oakville – April 25, 2022 *326 - 342*

Recommendation:

1. That the report titled "The *More Homes for Everyone Act,* 2022 and Implications for Oakville – April 25, 2022" be endorsed and submitted to the Province, along with the Council resolution, as the Town of Oakville's comments on the *More Homes for Everyone Act,* 2022, and related proposals under the Province's *More Homes for Everyone Plan*.

2. That the comments within this report related to the *More Homes for Everyone Act,* 2022 changes to the *Planning Act* be endorsed as the Town of Oakville's response to ERO No. 019-5284 and Proposal No. 22-MMAH006, and submitted to the Ministry of Municipal Affairs and Housing (MMAH) prior to the April 29, 2022 commenting deadline.

3. That the comments within this report related to the *More Homes for Everyone Act,* 2022 and changes to the *Development Charges Act, 1997* be endorsed as the Town of Oakville's response to Proposal No. 22-MMAH007 and submitted to the MMAH's Municipal Finance Policy Branch prior to the April 29, 2022 commenting deadline.

4. That the comments within this report related to the Province's Community Infrastructure and Housing Accelerator guidelines be endorsed as the Town of Oakville's response to ERO No. 019-5285, and submitted to the MMAH prior to the April 29, 2022 commenting deadline.

5. That the comments within this report on how to diversify housing choices within existing neighbourhoods be endorsed as the Town of Oakville's response to ERO No. 019-5286 and submitted to the MMAH by the April 29, 2022 commenting deadline.

6. That a link to this staff report, along with Council's resolution and comments, be provided for information to Halton's Members of Provincial Parliament, Halton Region, the City of Burlington, the Town of Halton Hills, the Town of Milton, Conservation Halton, Credit Valley Conservation, the Grand River Conservation Authority and the Association of Municipalities of Ontario.

***9.4. 2021 Financial Results and Surplus Disposition** *343 - 367*

Recommendation:

1. That the staff report dated April 19, 2022, entitled *2021 Financial Results and Surplus Disposition* from the Finance department, be received.
2. That the transfers to and from the Reserves and Reserve Funds and transactions contained in the report dated April 12, 2022 from the Finance department be approved.
3. That the $11.15 million surplus be transferred to the General Capital Reserve.

***9.5. Climate Action: Progress and Directions Report** *368 - 393*

Recommendation:
That the report entitled "Climate Action: Progress and Directions Report" dated April 19, 2022 be received.

11. Advisory Committee Minutes

***11.1. Accessibility Advisory Committee Minutes - March 10, 2022** *394 - 400*

18. Consideration and Reading of By-Laws

***18.6. By-law 2022-057** *401 - 401*

(Previously listed as By-law 2022-053)

A by-law to confirm the proceedings of a meeting of Council.

REPORT

Council

Meeting Date: April 25, 2022

FROM:	Clerk's Department and Legal Department
DATE:	April 19, 2022
SUBJECT:	**Property Standards Committee, Terms of Reference and Rules of Procedure**
LOCATION:	N/A
WARD:	Town-wide

RECOMMENDATION:

1. That the updated Property Standards Committee Terms of Reference attached as Appendix A to the report dated April 19, 2022 from the Clerk's and Legal department, be adopted.

2. That the proposed Property Standards Committee Rules of Procedure attached as Appendix B to the report dated April 19, 2022 for hearing Appeals of Property Standards Orders be endorsed and commended to the Property Standards Committee for its consideration in making rules governing its practice and procedure under section 25.1 of the *Statutory Powers Procedure Act R.S.O. 1990,c.S22* as amended.

KEY FACTS:

The following are key points for consideration with respect to this report:

- The Town has a Property Standards Committee appointed under the Ontario *Building Code Act* (as required) to hear appeals of Property Standards Orders under the Town's Property Standards By-law created under the Ontario *Building Code Act.*
- The Town first adopted Terms of Reference for its Property Standards Committee in 2009 and has reviewed and updated those Terms of Reference every four to five years, the last time being in 2017. Having held successful electronic hearings under the *Statutory Powers Procedure Act* during the COVID Pandemic Emergency, a review and update of the Terms of Reference, to include the opportunity to continue to hold electronic hearings outside of the emergency is appropriate at this time.

- *On* December 7, 2020 Council passed By-law 2020-140, being a by-law to allow electronic meetings and hearings of the Town of Oakville Property Standards Committee during the COVID-19 emergency.
- This by-law came into force on the day it was passed, and applied to meetings and hearings of the Committee until the COVID-19 Emergency was declared terminated.
- On March 11th, 2022, Mayor Burton declared the emergency related to the COVID-19 pandemic terminated in accordance with the provisions of the *Emergency Management and Civil Protection Act.*
- In order for the Property Standards Committee to continue to hold electronic meetings and hearings in the future, the Terms of Reference have been revised and rules governing its practice and proceedings under s. 25.1 of the Ontari*o Statutory Powers Procedure Act* made available for the Committee's consideration.
- Revised updated Terms of Reference have been prepared and are attached as Appendix A to this report for Council's consideration and if appropriate, adoption, and proposed Rules of Procedure for the Committee to consider when making rules governing its practice and procedure under s.25.1 of the *Statutory Powers Procedure Act* (SPPA) have been prepared and are attached as Appendix B to this report for Council's consideration and endorsement.

BACKGROUND:

The Mayor declared an emergency on March 24, 2020 due to the outbreak of COVID-19, which prevented the Town of Oakville Property Standards Committee meetings to be held 'in-person' as Town Hall was closed to the public due to the virus. Council passed By-law 2020-140 on March 7, 2020, which allowed the Committee to meet virtually until the emergency was ended. The Mayor ended the emergency on March 22, 2022, and in order for the Committee to continue to meet virtually and hold electronic meetings and hearings, a revised Terms of Reference allowing same must be adopted by Council and new Rules of Procedure need to be considered by the Committee under s. 25.1 of the SPPA to allow for electronic hearings. This will allow the Committee to meet and hear appeals of Property Standards Orders under the Property Standards By-law in the future in person, or virtually or, in a Hybrid manner with members and attendees being present in person or virtually.

There is an outstanding property standards appeal currently on file to be considered by the Committee and the Terms of Reference and the new Rules need to be updated in order to proceed.

COMMENT/OPTIONS:

The Terms of Reference attached as Appendix A have been revised and updated from 2017 in keeping with the make-up and practice of the Committee in 2022, and to allow for electronic meetings and hearings. The changes include:

- Reference to the 'Rules of Procedure' added throughout the document;
- 'The Appeal of an Order' being removed as it is now defined in the Rules of Procedure;
- Qualifications for Members has been further enhanced;
- Quorum has been changed to reflect that three members are required for a meeting or a hearing and that meetings or hearings cannot be held with only two members present and would need to be rescheduled;
- When holding business meetings, the Committee would abide by Council's Procedure By-law.

Council's endorsement of the proposed Rules of Procedure attached as Appendix B, is sought and if given, they will be sent to the Committee to be adopted in accordance with s.25.1 of the SPPA to govern the Committee's practice and procedure when holding Hearings for Appeals of Property Standards Orders. The proposed Rules of Procedure allow for electronic hearings as well as in person hearings and provide complete details of the appeal process including the requirements for requesting an appeal, the notice of hearing, the committee agenda and minutes, serving and filing of documents, hearing procedure, the making and issuing of decisions and the filing of Appeals to the Superior Court.

The revised Property Standards Committee Terms of Reference attached as Appendix A are recommended for adoption and the proposed new Rules of Procedure in Appendix B are recommended for endorsement and commendation to the Committee for its consideration.

CONSIDERATIONS:

(A) PUBLIC

The revised Terms of Reference will be publicly posted on the Town of Oakville website once adopted by Council and the proposed Rules of Procedure will also be posted on the Town of Oakville website, if adopted by the Committee.

(B) FINANCIAL

There are no financial implications with respect to this report.

(C) IMPACT ON OTHER DEPARTMENTS & USERS

The Legal and Municipal Enforcement departments have provided input into the Terms of Reference and the Rules of Procedure.

(D) CORPORATE STRATEGIC GOALS

This report addresses the corporate strategic goal(s) to:

- to be accountable in everything we do

(E) CLIMATE CHANGE/ACTION

N/A

APPENDICES:

Appendix A – Property Standards Committee Terms of Reference
Appendix B – Property Standards Committee Rules of Procedure

Prepared by:
Kathy Patrick
Manager of Council and Committee Services

Dennis Perlin
Assistant Town Solicitor

Submitted by:
Vicki Tytaneck
Town Clerk and

Doug Carr
Town Solicitor

APPENDIX A

Property Standards Committee

Terms of Reference

Approved by Council on

April 25, 2022

1. The Enabling Legislation

The Property Standards Committee is a quasi-judicial tribunal that hears appeals made to a Property Standards Order that was issued by a Property Standards Officer of the Town of Oakville. It is established in accordance with Section 15.6 of the *Building Code Act,* where an owner who has been served with a Property Standards Order is not satisfied with the terms and conditions of the Order, may appeal the Order to the Property Standards Committee. The Committee, operating under the provisions of the *Statutory Powers Procedure Act* and the Property Standards Committee Rules of Procedure, holds a hearing and may confirm, modify or rescind the Order or extend the time for compliance. The decision of the Property Standards Committee may be appealed to the Superior Court of Justice.

2. Mandate

The mandate of the Property Standards Committee is to hear and determine all appeals in accordance with procedures established under the provisions of the *Statutory Powers Procedure Act* and the Property Standards Committee Rules of Procedure.

Goal

The goal of the Property Standards Committee is to consider appeals to Property Standards Orders issued by Property Standards Officers. It is the responsibility of the Clerk's department, to accept all applications for processing, upon submission by the appellant.

Alignment with the Town Corporate Strategic Goals

This mandate of the Property Standards Committee shall meet with all Corporate Strategic Goals.

Interpretation

The Property Standards Committee may hold business meetings, as necessary from time to time, (choosing a Chair, or for education sessions) Business meetings shall be conducted in accordance with the Town of Oakville Procedure By-law (rules governing the procedure of Council and its Committees). For holding hearings to deal with Property Standards Orders, the Committee shall adopt Rules of Procedure in accordance with s. 25.1 of the *Statutory Powers Procedure Act* and conduct the meeting in accordance with the *Statutory Powers Procedure Act*.

3. Composition, Qualifications and Quorum and Format

Composition

The Property Standard Committee is appointed by Town Council and will be comprised of five members—three citizen appointees plus two alternate citizen appointees to fill in should vacancies arise or should one of the three citizen appointees be unable to attend a meeting or hearing . Staff representatives support the Committee but do not form part of the Committee.

The Chair of the Committee will be elected at the first business meeting or hearing of each year from amongst the three citizen appointees. The tenure for the Chair will be limited to two consecutive years unless the Committee determines otherwise with a unanimous vote of the members present. Alternate members will not have voting rights unless they are filling in for one of the citizen members.

Qualifications

Citizen and alternate members will be chosen for their expertise, experience, dedication, and commitment to the mandate of the Committee and shall have the following qualifications:

- education, experience or understanding of the Building Code or fundamentals of construction and the Property Standards By-law; or
- related education, experience or an understanding of law, legislation or law enforcement; and
- must not have been convicted of a criminal offence in which a pardon has not been granted; and
- decision making skills including:
    - Ability to make sound, practical and timely judgments
    - Ability to keep an open mind while hearing all sides of an argument
    - Ability to remain impartial.

Term

Membership is to align with the term of Council. Committee members may serve for a maximum of two consecutive four year terms only, unless permitted to serve additional terms at the discretion of Council.

A member may resign from the Committee at any time, except when hearing and deciding any appeal from a Property Standards Order, by advising of their intention in writing to the Town Clerk.

Quorum

Quorum in a business meeting will consist of three members. Should one of the three citizen appointees be unable to attend a business meeting, one of the alternate appointees will be asked to attend in their place. In keeping with the *Municipal Conflict of Interest Act,* the quorum can be two members to address any item where one member has a conflict of interest in that item.

Quorum in a hearing of an appeal will consist of three members in attendance without any conflicts of interest. Should any of the three citizen appointees be unable to attend and/or unable to participate in an appeal because of a conflict of interest then one or more of the alternate appointees without a conflict of interest will be asked to attend in their place.

The Committee must not hear an appeal with an even number of Committee members sitting.

If no quorum, without conflicts of interest, is present within 15 minutes after the time appointed for the commencement of the hearing, the Committee Coordinator shall reschedule the hearing.

Format

Business meetings and hearings may proceed in person, by conference telephone, by video-conference, or some other form of electronic technology allowing persons to hear one another, or a combination thereof, at the discretion of the Town Clerk so long as the manner of hearing does not cause a Party significant prejudice.

4. Meeting Schedule

The Property Standards Committee shall meet as required to carry on the business of the Committee and to hear appeals that have been filed with the Town Clerk.

All in person business meetings and hearings will be held at Oakville Town Hall, unless special circumstances warrant a temporary change of location.

5. Reporting Requirements and Method

Minutes and Agendas

The Committee Coordinator will give notice of each meeting to all committee members, staff representatives and the appellant(s) where there is/are hearings scheduled. Any relevant material will accompany the notice in the form of an agenda. The notice/agenda of a meeting will be sent by courier, mail or electronically to the address of each member and the appellant(s).

The decision of the Committee after any hearing will be forwarded to the appellant(s) following the meeting, and minutes of the business meeting and any hearings will be filed as part of the official record.

The Property Standards Committee decision on any hearing is the final decision at the Town, but it may be appealed to the Superior Court of Justice by notifying the Town Clerk in writing, and by applying to the Court within 14 calendar days after a copy of the Committee’s decision has been sent to the appellant(s).

6. Budget and Resources

Committees are not given a budget however, under special circumstances Council may approve one-time expenditures to help committees achieve their goals and objectives. Any budget requests should be identified in the town’s annual operating budget.

Staff will provide administrative support to the Committee through taking minutes of meetings, distribution of agenda and general administrative coordination of meetings and hearings.

7. Code of Conduct

The Town of Oakville is committed to fostering an environment where there is Respect for yourself; Respect for others; and Responsibility for your actions. All volunteers, delegates and staff will be guided by town policies and procedures including the Code of Conduct and Respectful Conduct Procedure. These policies ensure that all volunteers, delegates and staff are treated with respect and dignity. Policies and procedures can be found on the town website at www.oakville.ca.

Conflict of Interest

A member shall declare a direct or indirect pecuniary interest in accordance with the Municipal Conflict of Interest Act, and

a. prior to any consideration of the matter at a meeting or hearing, shall disclose the interest and the general nature thereof verbally and by filing a written statement of the interest with the Clerk at the meeting or hearing or as soon as possible afterwards;
b. shall not take part in the discussion of, or vote on any motion in respect of the matter at a business meeting or at a hearing, as the case may be;
c. during or after the business meeting or hearing, shall not attempt in any way to influence the voting on any such matter; and
d. shall be included in the minutes.

A copy of each written statement shall be kept in a registry which will be available on the Town of Oakville webpage.

APPENDIX A

Background

The Property Standards Committee is a statutory committee established to hear appeals of Property Standards Orders in accordance with the *Building Code Act*.

The Property Standards Committee's Terms of Reference were approved by Council on November 16, 2009, as recommended at the Administrative Services Committee meeting of November 10, 2009, as follows*: (in part)*

a) The Licensing Appeal Committee and Biting Dog Appeal Committee be combined to create an expanded appeal committee and a revised terms of reference be brought forward for approval.

b) That the Terms of Reference for the Property Standards Committee, attached as Appendix A to the report dated October 22, 2009, from the Clerk's Department, be approved.

The Property Standards Committee's Terms of Reference were revised by Council on August 30, 2010, as recommended at the Administrative Services Committee meeting of August 23, 2010, as follows*:*

That the citizen appointments to advisory committees and boards that are to expire in 2010 be extended "until their successors are appointed and not later than March 31, 2011" and that the term of all future citizen appointments include a proviso to enable the continuation of a term of appointment for no greater than 3 months into the year following an election year.

That the Terms of Reference for the Property Standards Committee be amended to increase the composition of the Committee to 5, consisting of 3 members and 2 alternate appointees to fill in should vacancies arise or one of the three appointees be unable to attend a meeting.

The Property Standards Committee's Terms of Reference were revised by Council on March 28, 2011, as recommended at the Administrative Services Committee meeting of March 22, 2011, as follows*:*

That the terms of reference for the Property Standards Committee be amended to increase the composition of the committee to 6, consisting of 3 citizen members and up to 3 alternate appointees.

The Property Standards Committee's Terms of Reference were revised by Council on February 13, 2012, as recommended at the Administrative Services Committee meeting of February 7, 2012, as follows*:*

That the current vacancy for the third alternate member to the Property Standards Committee not be filled, and the committee's Terms of Reference be amended to decrease the number of alternate members from three to two.

The Property Standards Committee's Terms of Reference were revised by Council on June 26, 2017, as recommended at the Administrative Services Committee meeting of June 19, 2017, as follows*:*

That the Terms of Reference for the Property Standards Committee attached as Appendix D to the staff report dated May 15, 2017, from the Clerk's department, be approved to include the revisions as detailed in Appendix C.

Appendix B

OAKVILLE

Property Standards Committee

Rules of Procedure

Endorsed by Council on April, 25, 2022

Adopted by the Property Standards Committee Pursuant To Section 25.1 of *The Statutory Powers Procedure Act* on Day, Month, Year

PROPERTY STANDARDS COMMITTEE
RULES OF PROCEDURE

Contents

RULE 1: INTERPRETATION

1.1 For the purposes of these rules, the following terms shall have the following meanings:

"Appeal" means an Appeal to the Property Standards Committee of a Property Standards Order;

"Appellant" means an owner or occupant that has been served with an Order and who has sent a Notice of Appeal to the Clerk within fourteen (14) days after being served with the Order;

"Appellant's Agent" means a person authorized by an Appellant to represent the Appellant; "Building Code Act" means the *Building Code Act*, 1992, S.O. 1992, c.23 as amended;

"Business Day" means a day when the Oakville Town Hall is open for business and is not a Statutory Holiday nor a Saturday nor an Easter Monday;

"By-law" means the Property Standards By-law of the Town, being By-law No.2017-007, as amended;

"Chair" means the chair of the Property Standards Committee;

"Clerk" means the Town Clerk of The Corporation of the Town of Oakville or designate;

"Committee" means the Property Standards Committee of the Town;

"Committee Coordinator" means the Committee Coordinator for the Property Standards Committee as appointed by the Clerk from time to time;

"Electronic Hearing" means a hearing held by conference telephone, video conference, or some other form of electronic technology allowing persons to hear one another. For the purposes of these rules "electronic hearing" and "virtual hearing" have the same meaning;

"Hearing" means a hearing in any proceeding of the Property Standards Committee, including an electronic hearing;

"Notice of Appeal" means the Town's prescribed form for Notices of Appeal to the Committee under these rules;

"Occupant" has the same meaning as it has in the Town's By-law;

"Officer" means a property standards officer who has been assigned the responsibility of administering and enforcing by-laws passed under section 15.1 of the *Building Code Act*;

“Owner” has the same meaning as it has in the Town’s By-law;

“Order” means a Property Standards Order made under the *Building Code Act*;

“Party” includes the Town and the Appellant;

“Proceeding” means a matter brought before the Property Standards Committee under the provisions of the By-law or the *Building Code Act*;

“Quorum” means the three members of the Property Standards Committee are in physical or virtual attendance and eligible to participate;

“Representative” means a person authorized by an Appellant to represent the Appellant;

“Statutory Holiday” means any of the following holidays:

1. Sunday
2. New Year’s Day
3. Family Day
4. Good Friday
5. Easter Monday
6. Victoria Day
7. Canada Day
8. Labour Day
9. Thanksgiving Day
10. Truth and Reconciliation Day
11. Christmas Day
12. Boxing Day
13. Any day fixed as a holiday by proclamation of the Governor General or Lieutenant Governor.

“Town” means the Corporation of the Town of Oakville.

“Vice Chair” means the Vice Chair of the Property Standards Committee.

RULE 2: GENERAL

These rules apply to all proceedings before the Committee.

2.1 These rules shall be applied in a manner consistent with the *Statutory Powers Procedure Act* (SPPA) and with other legislation governing the Committee.

2.2 The Committee may, at any time, as it deems necessary, dispense with compliance with any rules, save and except those prescribed as mandatory by the SPPA and any other legislation governing the Committee.

2.3 If these rules do not provide for a matter of procedure that arises during a Hearing, the procedure shall be determined by the Committee at the Hearing.

2.4 These rules shall be liberally construed to secure the just, most expeditious, and cost-effective determination of every proceeding on its merits.

2.5 Substantial compliance with requirements respecting the contents of forms, notices or documents under these rules is sufficient.

2.6 The Committee may exercise any of its powers under these rules on its own initiative or at the request of a Party.

2.7 (a) Three members of the Committee constitute quorum for a Hearing.

(b) If no quorum is present 15 minutes after the time appointed for the commencement of the Hearing, the Committee Coordinator shall reschedule the Hearing.

(c) The Committee must not hear an appeal with an even number of Committee members sitting.

(d) The decision of a majority of Committee members is the decision of the Committee.

(e) Despite this Rule, if, after the commencement of a Hearing, a Committee member becomes unable to act, the remaining Committee members may continue to hear the appeal and, if Committee members constituting a simple majority of the panel are in agreement on the decision that should be given,

(i) they may give that decision; and

(ii) it is the decision of the Committee.

(f) If, after a Hearing continued under Rule 2.8(e), it appears that no majority decision is possible, the remaining Committee members must order that a new hearing commence with at least two different committee members.

2.8 Hearings may proceed in person, by conference telephone, by video-conference, or some other form of electronic technology allowing persons to hear one another, or a combination thereof, in the discretion of the Clerk so long as the manner of hearing does not cause a Party significant prejudice.

2.9 Hearings will be open to the public except where the Committee is of the opinion that:

(a) matters involving public security may be disclosed; or

(b) intimate financial or personal matters or other matters may be disclosed at the hearing of such a nature, having regard to the circumstances, that the desirability of avoiding disclosure thereof in the interest of any person affected or in the public interest outweighs the desirability of adhering to the principle that hearings be open to the public; or

(c) for an electronic hearing it is not practical to hold the hearing in a manner that is open to the public, in which case the Committee may hold the hearing or parts thereof in the absence of the public.

2.10 A Party may be represented by a Representative.

RULE 3: NOTICE REQUESTING AN APPEAL

3.1 A Notice of Appeal of an Order must be received by the Clerk within fourteen (14) days after being served the Order unless specified otherwise in the Order.

3.2 A Notice of Appeal may be filed by an Owner or Occupant who has been served with a Property Standards Order.

3.3 A Notice of Appeal shall include:

(a) A completed and signed Notice of Appeal (Appendix 1) that includes the following:

- □ Address of property being appealed;
- □ Order issue date;
- □ Order compliance date;
- □ Order appeal deadline date;
- □ The name of the person(s) (specifically, the property owner, occupant, agent, and/or Representative) requesting the appeal and their address, telephone number, and email address;
- □ The grounds and/or reasons for appeal, including any documents and photographs supporting the grounds and/or reasons for the appeal;
- □ An authorization to act as agent for notice of appeal (if applicable);
- □ An authorization to act as Representative for notice of appeal (if applicable); and
- □ A property standards appeal fee, as set out in the Town of Oakville Rates and Fees Schedule, as amended. This fee is non-refundable.

(b) A copy of the Order related to the appeal.

Where Notice of Appeal is Incomplete

3.4 Where a person requests an Appeal by the Committee that is not substantially in accordance with Rule 3.3, the Committee Coordinator shall send to the Appellant, or the Appellant's Agent, if represented, an Acknowledgement (Appendix 2) within 30 days of receipt of the Notice of Appeal. The Acknowledgement shall specify what additional information is required by the Committee Coordinator in order to complete the Notice of Appeal substantially in accordance with Rule 3.3.

3.5 Any information requested in Rule 3.4 shall be sent to the Committee Coordinator within 20 days of the date of the Acknowledgment, at the address listed in the Acknowledgement, failing which the Notice of Appeal shall be considered abandoned.

Where Notice of Appeal is Complete

3.6 Where an Appellant has completed a Notice of Appeal in substantial accordance with Rules 3.3 or 3.4, the Committee Coordinator shall appoint a time and place for the Hearing of the appeal in accordance with Rule 4.

RULE 4: NOTICE OF HEARING

4.1 A Notice of Hearing shall be sent to the Appellant or Appellant's Agent or Representative by the Committee Coordinator by electronic transmission (email), registered mail or personal service to all parties affected by the order at least twenty-five (25) business days in advance of the Hearing.

4.2 A Notice of Hearing shall include:

(a) A statement of the time, place and purpose of the Hearing and details about the manner in which the Hearing will be held; and

(b) A statement that if the Appellant, or Appellant's Agent, does not attend the Hearing, the Committee may proceed in the Appellant's absence and the Appellant will not be entitled to any further notice in the proceeding; and

(c) If the Hearing is to be an electronic hearing, a statement that the party notified may, by satisfying the Committee that holding the hearing as an electronic hearing is likely to cause the party significant prejudice, require the Committee to hold the Hearing as an "in person" hearing, and an indication of the procedure to be followed for that purpose.

Effect of Non-Attendance at a Hearing

4.3 Where Notice of a Hearing has been given to a Party in accordance with these Rules and the Party does not attend at the Hearing, the Committee may proceed in the absence of the Party and the Party is not entitled to any further notice in the proceeding.

RULE 5: HEARING AGENDA

5.1 The Committee Coordinator shall prepare a Hearing Agenda (Form 3) prior to the Hearing listing the municipal addresses of the subject properties.

5.2 Copies of the Hearing Agenda along with copies of the Order(s) and any other relevant file information shall be sent to the Committee members for review prior to the Hearing. Copies of the Hearing agenda shall be available electronically before the Hearing and at an "in person" Hearing for the public and on the Oakville.ca.

5.3 If two or more Hearings before the Committee involve the same or similar questions of fact, law or policy, the Committee may,

- (a) combine the proceedings or any part of them, with the consent of the parties;
- (b) hear the proceedings at the same time, with the consent of the parties;
- (c) hear the proceedings one immediately after the other; or
- (d) stay one or more of the proceedings until after the determination of another one of them.

RULE 6: SERVING AND FILING DOCUMENTS

Documents Filed with Committee

6.1 If a Party intends to make use of any written or documentary evidence at the Hearing, that Party is required to serve one copy of the documents on all other parties and the Clerk and the Town's Legal department, no later than nine (9) business days before the Hearing date.

6.2 For the purposes of Rule 6.1, "document" includes any report, memorandum, witness statement, sound recording, videotape, file, photograph, map, plan, survey, and any information recorded or stored by any means, and any expert reports to be relied upon and a copy of the curriculum vitae of the authors of any such expert reports.

Serving Documents

6.3 "Service" means the effective delivery of the documentation to any Party or, in the case of the Appellant, the Appellant's Agent or Representative.

6.4 Service is deemed to be effective when delivered:

- (a) Personally to the Party or, in the case of the Appellant, the Appellant's Agent or Representative on same day of delivery;
- (b) By registered mail on the third day after the day of mailing;

(c) By electronic transmission (email) on the same day as the transmission.

(d) By courier, including Priority Post, on the second full day after the document was given to the courier by the Party serving; or, at the last known address, unless the Party to whom the notice is to be given establishes that he or she, acting in good faith and through absence, accident, illness or causes beyond his/her control, failed to receive the notice until a later date or at all.

6.5 Documents delivered after 4:00 p.m. shall be deemed to have been delivered on the next day that is not a weekend day or statutory holiday.

6.6 A person who serves or files a document shall include with it a statement of the person's address, telephone number, email address, if available and the name of the proceeding to which the document relates.

Filing Documents

6.7 Documents may be filed with the Clerk's and Legal departments by any of the methods of delivery in Rule 6.4.

6.8 Any Party filing documents must file, with the documents, a statement indicating who has been served and what documents have been served.

6.9 Documents must be filed with the Clerk's and Legal department at:

The Town of Oakville
Legal Department
1225 Trafalgar Road
Oakville, Ontario
L6H 0H3

The Town of Oakville
Clerk's Department
1225 Trafalgar Road
Oakville, Ontario
L6H 0H3

Failure to Serve and File Documents

6.10 If a Party fails to serve and file a document pursuant to these rules, the Party may not refer to the document in evidence at the Hearing without the Committee's consent, which may be on terms and conditions as the Committee considers just.

RULE 7: HEARING PROCEDURE

7.1 The Chair shall call the Hearing to order.

7.2 The Chair explains the purpose of the Committee and the format of the Hearing.

7.3 For each appeal heard, the Chair calls the name of the Appellant and the municipal address of the property concerned.

“In-Person” Hearings

7.4 The Town will present its case first. An opening submission may be made. The Town will then call their witness(es). Once called, a witness is seated at the witness table, and is sworn or affirmed. At the conclusion of the testimony of each Town witness(es), the Appellant and then the Committee may ask their own questions of the witness(es).

7.5 After the Town has called all of their witnesses, the Appellant may make an opening submission and call their witnesses who may be the Appellant themselves and/or other witnesses. Again, once called, a witness is seated at the witness table and sworn or affirmed. At the conclusion of the testimony of each of the Appellant’s witness(es), the Town and then the Committee may ask their own questions of the witness(es).

Electronic Hearings

7.6 The Town will present its case first. An opening submission may be made. The Town will then call their witness(es). Once called, a witness will be asked to turn on their video and unmute their microphone, and is sworn or affirmed. At the conclusion of the testimony of each Town witness(es), the Appellant and then the Committee may ask their own questions of the witness(es).

7.7 After the Town has called all of their witnesses, the Appellant may make an opening submission and call their witnesses who may be the Appellant themselves and/or other witnesses. Again, once called, a witness is asked to turn on their video and unmute their microphone, and is sworn or affirmed. At the conclusion of the testimony of each of the Appellant’s witness(es), the Town and then the Committee may ask their own questions of the witness(es).

7.8 An Electronic hearing is a hearing event and the Rules apply. The conduct of a hearing by conference telephone or videoconference and/or other technology does not change the obligations of witnesses and counsel to conduct themselves in accordance with the rules of professional conduct of their applicable professions.

Evidence

7.9 Subject to Rules 7.11 and 7.12, the Committee may admit as evidence at a Hearing, whether or not given or proven under oath or affirmation or admissible as evidence in a court,

(a) any oral testimony; and

(b) any document or other thing provided in accordance with Rule 6, relevant to the subject- matter of the proceeding and may act on such evidence, but the Committee may exclude anything unduly repetitious.

7.10 Nothing is admissible in evidence at a Hearing,

(a) that would be inadmissible in a court by reason of any privilege under the law of evidence; or

(b) that is inadmissible by the statute under which the Hearing arises or any other statute.

Nothing in Rule 7.10 overrides the provisions of any Act expressly limiting the extent to or purposes for which any oral testimony, documents or things may be admitted or used in evidence in any proceeding.

7.11 The Town and the Appellant may make their final submissions. The final submissions should include what each party is requesting of the Committee with respect to confirming, modifying or rescinding the Order and/or extending the time for complying with the Order.

7.12 The Committee may retire in person and/or electronically to deliberate in the absence of the public, the Town and the Appellant. The Committee Coordinator will retire with the Committee to record its decision.

RULE 8: THE DECISION

8.1 The Committee shall render its decision on the matter in the presence of the public, the Town and the Appellant and/or the Appellant's Agent or Representative. If the Committee determines that additional information is required to render a decision, it may adjourn the matter to a future hearing date.

8.2 In considering an Appeal, the Committee shall have all the powers and functions of the Officer who made the Order and in disposing of the matter, the Committee may,

(a) confirm the Order;
(b) modify the Order;
(c) rescind the Order;
(d) extend the time for complying with the Order;

if, in the Committee's opinion, the general intent and purpose of the By-law is maintained.

8.3 A copy of the decision including the reasons for the decision of the Committee will be sent to the Appellant by:

(a) regular letter mail to the most recent address known to the Committee and shall be deemed to be received by the Party on the fifth day after the day it is mailed; or
(b) by electronic transmission (email) to the most recent electronic mail address known to the Committee and shall be deemed to be received on the day after it was sent, unless that day is a weekend or statutory holiday, in which case

the copy shall be deemed to be received on the next day that is not a weekend or statutory holiday; or

(c) by some other method that allows proof of receipt.

Right to Appeal a Property Standards Committee Decision

8.4 The Town or any owner or occupant or person affected by a decision under subsection 15.3 (3.1) of the *Building Code Act*, may appeal to the Superior Court of Justice by notifying the Clerk of the Town and by applying to the Court within fourteen (14) days after a copy of the decision is sent.

RULE 9: DUTIES OF THE COMMITTEE COORDINATOR

9.1 The Committee Coordinator shall keep on file records of all official business of the Committee, including records of all business meetings, Notices of Appeal and Minutes of all Hearings and Decisions, including minutes of any portion of a meeting closed to the public, respecting those Notices of Appeal.

9.2 The Committee Coordinator shall prepare Minutes of the Committee's business meetings and Hearings.

9.3 The Committee Coordinator shall note the decision of the Committee on any Hearing on the form Notice of Decision (Form 5) and all voting Committee members shall sign the decision.

9.4 The Committee Coordinator shall send a copy of the Notice of Decision to the Appellant and to anyone else who has submitted a written request for the decision at the Hearing by mail, electronic submission (email) or some other method that allows proof of receipt.

RULE 10: SITE INSPECTIONS

10.1 The Committee will not as a pre-requisite or general rule, inspect subject properties prior to a Hearing, however an individual Committee member may drive by the property prior to the Hearing for information purposes. The Committee can be requested by any Party to "Take a Site Inspection" of the property as a Committee and the Committee may do so if the Committee believes such a Site Inspection would be beneficial but is not required to do so.

10.2 Notwithstanding 8.1 above, the Committee may reserve its decision to a later fixed time and place, pending a Site inspection by the Committee, where the Committee on request by a Party or on its own initiative determines such Site Inspection would be beneficial.

10.3 Where the Committee requires a Site Inspection, the Owner of the property will be notified of the date and time for the Site Inspection and if the Site Inspection involves entry into a dwelling unit, Section 16.(1) of the Ontario Building Code Act shall apply. In undertaking the Site Inspection the Committee shall have the Appellant or Appellant's Agent or Representative and one representative from the Town in attendance with the Committee.

APPENDICES

Appendix 1: Notice of Appeal

Property Location:	
Property Owner(s)	
Address if different from location	
Owner Phone #:	

Order Issue Date:		Order Deadline for appeal date:	
Order compliance date:		Order number:	

Appellant’s Name:	
Address:	
Phone Number:	
Email Address:	

Agent Name:	
Address:	
Phone Number:	
Email Address:	

- ☐ State the grounds and/or reasons for appeal, including any documents and photographs supporting the grounds and/or reasons for the appeal:

Sign: ______________________________ Date: ______________________________

Name: ______________________________

Attachments:

- ◻ Order related to the appeal
- ◻ A property standards appeal fee, as set out in the Town of Oakville Rates and Fees Schedule, as amended. This fee is non-refundable.
- ◻ An authorization to act as agent for notice of appeal (if applicable);
- ◻ An authorization to act as representative for notice of appeal (if applicable); and

Appendix 2: Acknowledgement

DATE

FIRST NAME LAST NAME
ADDRESS
CITY, PROVINCE
POSTAL CODE

SUBJECT: ACKNOWLEDGEMENT OF RECEIPT OF APPEAL

This letter is to acknowledge receipt of an appeal regarding [insert subject matter of appeal], regarding an Order to Comply with Building Maintenance By-law 035-18, Building Code Act, S.O. Chapter C23, as amended.

The subject property is known legally as LEGAL DECRIPTION and is known municipally as Municipal Address.

Town staff are processing your appeal and will notify you of the Notice of Appeal Hearing date and time and information on how to register and participate.

Name
Townclerk@oakville.ca
905-845-6601 ext. 6015

Appendix 3: Notice of Appeal Hearing

PROPERTY STANDARDS COMMITTEE NOTICE OF APPEAL HEARING

TAKE NOTICE that an appeal hearing has been scheduled by the Town of Oakville, regarding an Order to Comply with Town of Oakville Property Standards By-law 2017-007 as amended, under the *Building Code Act*, S.O. Chapter C23, as amended.

The subject property is known legally as LEGAL DESCRIPTION and is known municipally as Municipal Address.

The Appellant, First Name Last Name is seeking review and consideration from the Property Standards Committee regarding Order to Comply No. , attached as Appendix A. The Appellant's Notice of Appeal is attached as Appendix B.

The Property Standards Committee for the Town of Oakville will consider this appeal through an in person or electronic hearing on INSERT DATE AND TIME. The purpose of this hearing is to consider the Appellant's Appeal.

To participate in the hearing as the Appellant, Appellant's Agent, Witness and/or Interested Party, you must register by submitting an email Townclerk@oakville.ca or in writing to:
Town of Oakville, Clerk's Department, 1225 Trafalgar Road, Oakville, ON L6H 0H3

If the Appellant, or Appellant's Agent, does not attend the Hearing, the Committee may proceed in the Appellant's absence and the Appellant will not be entitled to any further notice in the proceeding.

Please be advised that this hearing is a formal process where parties involved will be given an opportunity to present oral, written or visual evidence related to the matter. Questions of clarification may be asked by the Committee. Those parties providing evidence will be sworn in or affirmed before they do so. The process for this hearing must comply with the Committee's Rules of Procedure and as necessary, the *Statutory Power and Procedures Act*. A copy of the Committee's Rules of Procedure are available on the Town of Oakville website.

If you wish to receive a copy of the decision of the Property Standards Committee in respect of the appeal, you must make a written request to the Clerk of the Town of Oakville by way of email or regular mail.

Accessible formats are available on request, to support participation in all aspects of the feedback process. To request an alternate format please contact at townclerk@oakville.ca

Name
townclerk@oakville.ca
905-845-6601 ext. 6015

Appendix 4: Agenda

PROPERTY STANDARDS COMMITTEE AGENDA

MEETING OF Month, Day, Year @ Time

---

1. Call to Order
2. Regrets
3. Declarations of Pecuniary Interest
4. The following appeal(s) will be heard:
5. Adjournment

Appendix 5: Notice of Decision

TAKE NOTICE that a decision has been made by the Property Standards Committee for an appeal to A Property Standards Order under the Town of Oakville Property Standards By-law 2017-007 as amended, pursuant to the *Building Code Act*, S.O. Chapter C23, as amended.

The subject property is known legally as LEGAL DESCRIPTION and is known municipally as Municipal Address.

The Appellant, First Name Last Name is seeking review and consideration from the Property Standards Committee regarding Order to Comply (Order No.), attached as Appendix A. The Appellant's Notice of Appeal is attached as Appendix B.

The Property Standards Committee has considered all written and oral submissions received before and/or during the hearing as part of their decision and renders its decision on the matter in the presence of the public, the Town and the Appellant and/or the Appellant's Agent.

□ Order Confirmed: The decision of the Property Standards Committee is that the appeal by the Appellants, (Appellants Names) be denied and that the Property Standards Order, being Order (Order No.) is confirmed.

□ Order is Rescinded: The decision of the Property Standards Committee is that the appeal of the Appellants (Appellants Names) is allowed and the Order is hereby rescinded.

□ Order is Modified: The decision of the Property Standards Committee is that the appeal of the Appellants (Appellants Names) is allowed and the Order is hereby modified in the following manner:

That the following conditions be added and/or amended:

a) ______________________________

b) ______________________________

□ AND/OR Time for Compliance is Extended: The decision of the Property Standards Committee is that the appeal of the Appellants (Appellants Names) is allowed and the Order is hereby modified by extending the time for compliance to ____ p.m. on the ____ day of ____, 202X.

FOR THE FOLLOWING REASONS:

1.
2.

DECISION DATED AT THE TOWN OF OAKVILLE this X day of Month, Year.

CIRCULATION DATE OF NOTICE OF DECISION: Month Day, Year

Name, Chair

Name, Member

Name, Member

I, Name, Committee Coordinator do hereby certify that the above is a true copy of the Decision of the Property Standards Committee rendered on the XX Day of Month, Year.

Name,
Committee Coordinator
Property Standards Committee

OAKVILLE

REPORT

Council

Meeting Date: April 25, 2022

FROM: Recreation and Culture

DATE: April 19, 2022

SUBJECT: Reciprocal Agreement with Community Living Oakville

LOCATION: 2302 Bridge Road, Town Wide
WARD: Town-wide Page 1

RECOMMENDATION:

1. That the Town enter into a reciprocal agreement with Community Living Oakville, permitting room rentals charges to be paid in equivalent Community Living Oakville staffing services.

2. That the Director of Recreation and Culture be authorized to execute renewals and amendments to the agreement, subject to such renewals and amendments having been negotiated and prepared to the satisfaction of the Town Solicitor.

KEY FACTS:

The following are key points for consideration with respect to this report:

- The Town of Oakville is currently seeking qualified support staff for our Inclusion Programs, particularly our Teen Adventure Program serving young adults aged 13-21 with developmental disabilities.
- Community Living Oakville ("CLO") has qualified support staff with expertise serving young adults in the community
- CLO is currently looking to expand their offerings in community settings and interested in space within the town's Recreation and Culture facilities to deliver the Community Connect Program.
- Weekday, daytime facility space is available and some rooms are going unused.
- Entering a reciprocal agreement where CLO utilizes an available community room September through June and reimburse the Town by providing staff to support the Teen Adventure Program in July and August would be highly beneficial for both parties involved.

- Approval of this reciprocal agreement would increase community offerings to individuals with an exceptionality in Oakville with no financial increase to the Town.
- Both parties are able to meet insurance requirements for service delivery outlined in this report.

BACKGROUND:

Community Living Oakville is a local organization providing a range of support services to children, youth, and adults who have developmental disabilities and their families. Currently, the organization offers a wide range of services including residential options, community day programs, employment services and after-school programs. CLO is seeking to rent an available community room at one or more of the Town of Oakville's community centres to better meet the needs of local residents. CLO requires a medium sized room during weekday daytime hours, for several days per week from September through to June for their Community Connect Program. The Community Connect Program re-imagines the way in which the developmental sector offers day program offerings to people with developmental disabilities. Adults with developmental disabilities participating in Community Connect will be supported to be integrated into community-based programs, promoting full inclusion of all people with varying support needs in community activities. Through Community Connect adults with developmental disabilities have the opportunity to enhance their skills to become more independent and develop community connections; strengthening their social network. The community room rental for this program would follow Council approved fees and charges, along with current allocation policies.

The Town of Oakville is seeking qualified support staff for our Inclusion portfolio. In particular, our Teen Adventure Program Summer Camp serving young adults aged 13-21 requires support staff with experience serving individuals in a low ratio setting. The Town has significant challenges recruiting staff for this program due to the seasonal nature of its delivery, along with the preferred, highly specialized qualifications and experience required. CLO staff are highly qualified (have a diploma and/or experience in Developmental Services, Social Services, Child and Youth, ECE, Behavioural Sciences, Psychology, Police Foundations, Education Assistance or similar fields) and receive specialized training in Safe Management Behaviour Intervention Training, Personal Outcome Measures, Understanding and Promoting Rights Training, Smart Meds training (medication administration training), Abuse Prevention Training and Person Centered Training. The Town's seasonal camp positions are filled by students, making it challenging to appropriately fill these roles. CLO currently employs staff with this expertise and is able to provide the number of qualified staff required to support the program participants. This program could significantly benefit from collaboration with a community partner.

COMMENT/OPTIONS:

It is recommended that the included reciprocal agreement (Appendix A) serve the needs of both parties. CLO would permit an available community room at the value identified in current rates and fees and allocation policies. In place of payment for permit fees, CLO will provide qualified staff to support town inclusion programming. The value would be essentially dollar for dollar and in the event one party cannot meet the value with agreed upon services, the cash amount would be paid. The current staffing rate for CLO is $35.00 per hour, including fringe and will be adjusted yearly to include future inflation.

This agreement would be evaluated annually. The Town would enter a contracted services agreement with CLO for the delivery of the Teen Adventure Program to ensure quality standard and insurance needs are satisfied. The agreement has significant benefit to the Town as it ensures qualified staff in our program, which is currently staffed with students. The agreement will also require fewer training resources and funds, as CLO staff are experienced and trained in working with people with exceptionalities. Lastly, the agreement will help mitigate and manage the Town’s risk and liability in this highly specialized program. These benefits will allow us to maintain quality service delivery and ensure program longevity for youth in our community. The reciprocal agreement will ensure meaningful use of under-utilized daytime space in our facilities and increases service offerings to the community without any additional financial commitments. These programs are of high community need and we only expect the community needs to continue growing in coming years. This agreement positions the Town and CLO to better serve individuals with exceptionalities in Oakville.

CONSIDERATIONS:

(A) PUBLIC

Public rental requests are reviewed on an on-going basis and granted based on facility availability and allocation policies.

(B) FINANCIAL

The value of the rental will be compensated to the Town through staffing services provided in the Teen Adventure Program (Inclusion BU). The rental contract will follow Council approved rates and fees. Staffing expense will be accepted at CLO’s current (2022) wage. In the event one party cannot meet the value of the agreement through service exchange, cash payment will be provided.

(C) IMPACT ON OTHER DEPARTMENTS & USERS

The agreement and this report have been developed in consultation with the Legal Department.

(D) CORPORATE STRATEGIC GOALS

This report addresses the corporate strategic goal(s) to:
- continuously improve our programs and services
- be fiscally sustainable

(E) CLIMATE CHANGE/ACTION

N/A

APPENDICES:

Appendix A – CLO – Teen Adventure Program Agreement
Schedule A – Permit Schedule – Oakville Community Living

Prepared by:
Brent Copeland, Acting Senior Manager, Operations

Recommended by:
Ryan Maynard, Assistant Town Solicitor

Submitted by:
Julie Mitchell, Director, Recreation and Culture

OAKVILLE

THIS SERVICES AGREEMENT made as of the 25 day of April, 2022.

BETWEEN:

THE CORPORATION OF THE TOWN OF OAKVILLE

(hereinafter the “Town”)

PARTY OF THE FIRST PART

- and -

Community Living Oakville

(Full Registered Business Name or Person’s Name)
(hereinafter the “Vendor”)

PARTY OF THE SECOND PART

In consideration of the mutual covenants, term and conditions herein contained, the Vendor and the Town agree as follows:

<u>Basic Terms</u>

1. The Vendor agrees to provide the following services to the Town on the terms set out in this Services Agreement:

Support Staff for the Teen Adventure Summer Camp Program serving youth with exceptionalities. CLO will provide 4 trained support staff each week from July 4-Sept 2, 2022. Staff will be working from 8:30 a.m. to 4:30 p.m. daily (stat holiday excluded). Staff will participate in an on-site training in June 2022. Full-time staff from CLO (Neil or designate) will participate with intake interviews throughout May and June. Note: The Town is requiring employees of contractors and their sub-contractors who will work indoors at Town facilities to be fully vaccinated against COVID-19. The Contractor acknowledges that the requirement to have its personnel fully vaccinated is in addition to applicable COVID-19 protocols and screening that would otherwise apply. For purposes of this agreement, an individual is considered "fully vaccinated" if they have received:(a) (i) the full series (e.g., two doses of a two dose vaccine series or one dose of a one dose vaccine series) of a Health Canada approved COVID-19 vaccine or any combination of such vaccines; or (ii) one or two doses of a COVID-19 vaccine not authorized by Health Canada, followed by one dose of a COVID-19 mRNA vaccine authorized by Health Canada; or (iii) three doses of a COVID-19 vaccine authorized not authorized by Health Canada and (b) they received their final dose of the COVID-19 vaccine at least 14 days ago.

(the “Program”) Program Description

In the Summer Program session, from approximately 07/04/22 to 09/02/2022.
(Spring, Summer, Fall, Winter) (Date) (Date)

2. The Vendor shall be responsible for all aspects of the delivery of the Program.

3. At any time, the Town shall have the sole right and discretion, after consultation with the Vendor to cancel the Program if minimum registration is not met or there is concern over the safety of the participants. In the event

of cancellation, this Agreement shall immediately terminate and the Town shall have no obligation to compensate the Vendor.

4. The published program fee is $71.36/day per registered program participant.
5. The Town agrees to pay the Vendor N/A of the program revenue.
6. The Vendor shall invoice the Town based on the following billing schedule:

- ☐ Monthly
- ☐ 100% following final class of the Program
- ☑ CLO will not receive program revenue, but will rather be compensated for staff time through reciprocal agreement (room permits)

All invoices are to be submitted to Accounts Payable at accountpayables@oakville.ca.

The Vendor shall determine if the Harmonized Sales Tax (HST) is applicable to the services rendered under this Services Agreement and the Vendor is responsible for his/her/its own compliance with requirements of the HST. If HST is determined to be applicable, the Vendor shall remit such HST collected from the Town to the Canada Revenue Agency and, if the Vendor fails to do so, the Vendor further agrees to indemnify the Town for all such monies and any associated costs.

Standard Terms

1. The Vendor agrees to provide the services under this Services Agreement in a professional and competent manner at all times.
2. The Vendor agrees to provide the services personally, or if that is not reasonably possible, through a properly qualified and trained sub-Vendor, who is also under a services agreement with the Town or an employee of the Vendor. The Vendor shall be fully responsible for their sub-Vendors and employees and their compensation.
3. The Vendor shall provide all necessary equipment, supplies and materials required for the Program, except as agreed upon.
4. While delivering the Program, only those persons who have registered with the Town for said Program shall be permitted to participate in or benefit from any session of the Program. The Vendor shall not permit registration in or sell spaces in the Program independent of the Town's registration system.
5. The Town is committed to the HIGH FIVE Principles that endorse healthy child development in all our recreation programs. The Vendor of children's programs shall provide activities and environments in which children feel safe, welcome, competent, connected, empowered and special. The Town reserves the right to request further information concerning the operations of the program. See attachment for more information on the HIGH FIVE Program.
6. The Town shall be responsible for advertising the programs in the Town brochures or flyers if it is included in the contract agreement.
7. The Vendor shall provide a written report to the Town with respect to any accidents and/or incidents involving participants within **1** day of the accident or incident, on forms provided by the Town.

8. The Vendor shall be required to carry general liability insurance to a limit of no less than $2,000,000 per accident or occurrence, naming the Town of Oakville as an additional insured, including provisions for cross liability in respect of named insured, severity of interest as between insured, and a waiver of subrogation over against the named insured, and shall provide an insurance certificate to the Program Supervisor and shall provide 60 days prior notice, in writing, to the Supervisor of any alteration or lapse of such insurance coverage.

9. The Vendor agrees that from time to time and at all times hereinafter, he/she/it will and truly save, defend and fully indemnify The Corporation of the Town of Oakville from and against all actions, suits, claims and demands which may be brought against or upon the Town and against loss, costs damages or expenses which the Town may sustain, suffer, incur or be liable to resulting from, arising from, or in any way incidental to the Town in conjunction with the agreed activity.

10. The Town shall not be responsible for any damage or loss of personal property brought onto the premises.

11. No changes, amendments or modifications of any terms, provisions and conditions of this agreement shall be valid, binding and enforceable unless they are in writing and have been fully executed by the parties hereto.

12. Each and every part of this agreement is severable one from the other. Should it be found by a court of competent jurisdiction that any one or more parts hereof are null and void; the validity of the remaining parts hereof shall not be affected.

13. In instances where the Town contracts with a Vendor who in turn provides staff of their own, the Vendor is considered to be an employer and is responsible to provide Workplace Safety Insurance Coverage, where applicable. It is the Vendor's responsibility to contact the Workplace Safety Insurance Board (WSIB) to determine if their business meets the exemption criteria or if Workplace Safety Insurance Coverage is required. Proof of exemption or proof of good standing with WSIB must be provided prior to the start of the program. The WSIB phone number is 1-800-263-8488.

14. The Vendor, regardless of his/her/its classification, must provide the following documents, which must be supplied prior to the start of the specific program or service:
    - Proof of insurance coverage (minimum $2,000,000)
    - Statement of HST status
    - Proof of standing with WSIB (if applicable)
    - Staff qualifications pertaining to the program (which may include, current first aid certification and HIGH FIVE training)
    - Criminal reference checks and vulnerable screening checks have been completed on all staff providing direct leadership to children and vulnerable participants

15. The Town shall not be responsible for making statutory deductions including income tax, Canada Pension Plan, Employment Insurance, Workplace Safety and Insurance Act premiums, and Employer Health Tax. The Vendor acknowledges and agrees that he/she/it is responsible for arranging and paying all applicable taxes, payments, premiums, and/or penalties under any federal or provincial legislation with respect to the payments provided under this Services Agreement. The Vendor agrees to indemnify and save harmless the Town for any failure by the Vendor to remit the appropriate payments to the respecting government agencies.

16. The Vendor agrees that the performance of the services will be in accordance with the provisions and regulations set out in the *Accessibility for Ontarians with Disabilities Act, 2005* and its associated Regulation 429/7, *Accessibility Standards for Customer Service*. The Vendor is responsible for his/her/its own training. The Town will require proof of completed training under that legislation.

The undersigned has read and on behalf of the Vendor agrees to be bound by this contract and the terms and conditions contained herein and attached hereto, and hereby warrants and represents that he/she executes this contract on behalf of the Vendor and has sufficient power, authority to bind the Vendor with his/her signature.

Dated at Oakville, Ontario this 25 day of April 2022.

THE CORPORATION OF THE TOWN OF OAKVILLE	**VENDOR:** (insert name of vendor)
Colleen Beswick	
Supervisor Signature	Vendor signature
Program Supervisor - Children, Youth & Camps	
Position	Name/Title
	(I have the authority to bind the Corporation)

<u>Additional information required for invoiced payments:</u>

HST/GST # (if applicable) ______________________

Full Business Name______________________

Mailing Address______________________

Contact Phone Number______________________

Email Address______________________

4

HIGH FIVE® Program

HIGH FIVE® was first conceived in 1994. With the input of volunteers and practitioners representing a broad spectrum of different service organizations from across Ontario, Parks and Recreation Ontario (PRO), a not-for-profit organization representing the sector in Ontario, developed the necessary tools and resources for setting new and consistent standards of quality for programs across the province.

The HIGH FIVE® program is committed to assisting children along the path of healthy development by: ensuring that recreation and sport practitioners develop a high level of knowledge and expertise in child development; helping parents to make informed choices; and providing practitioners with tools for enhancing and maintaining a high level of program quality.

The HIGH FIVE® program is a five-step process that:

- helps recreation and sport practitioners to achieve program excellence and to promote healthy child development
- helps parents to make informed choices about quality recreation and sport programs for their children

The HIGH FIVE® Program offers training in:

- Principles of Healthy Child Development – designed for people who give direct leadership to children across a broad spectrum of sectors, focusing on principles of healthy child development and how to use those principles in the planning of a quality program.

- HIGH FIVE® Quest – designed for senior managers, volunteers or board members providing information on healthy child development, how to properly use the HIGH FIVE® quality experience scanning tools and how to apply the results.

I hereby acknowledge that I have read and understand the importance of the HIGH FIVE® Program in quality recreation programs for children. As a vendor with the Town of Oakville we will strive to provide programs that promote healthy child development.

______________________________ ______________________________

Signature Date Signed

SCHEDULE “A” TO THE PERMIT BETWEEN _Community Living Oakville_ (the “Contract Holder”) AND TOWN OF OAKVILLE (the “Town”) FOR RENTAL SPACE IN _Queen Elizabeth Park Community and Cultural Centre AND Oakville Trafalgar Community Centre_ (the “Facility”)

1) To the extent there is a conflict between the terms of the Permit and the terms of this Schedule, the terms of this Schedule will prevail to the extent of such conflict.

2) The Contract Holder shall pay the fees for the use of the Facility set out in this Permit (the “Permit Fees”) by providing **4** staff for the Town’s **Teen Adventure** program on the terms in the service contract attached to this Permit as Schedule “B”.

3) The Contract Holder shall not be required to pay the Permit Fees upfront and each staff hour provided to the Town by the Contract Holder represents **$_35.00**_ (the “Staff Fees”) and will be credited towards the Permit Fees. Within a reasonable time after **_the one-year term**_ the parties shall reconcile the Permit Fees and Staff Fees. If the total amount of the Permit Fees to be paid by the Contract Holder is less than the Staff Fees provided to the Town, then the Town shall pay the difference to the Contract Holder forthwith. If the total amount of the Permit Fees to be paid by the Contract Holder is greater than the Staff Fees provided to the Town, then the Contract Holder shall pay the difference to the Town forthwith.

REPORT

Council

Meeting Date: April 25, 2022

FROM:	Facilities and Construction Management Department
DATE:	April 19, 2022
SUBJECT:	**Progress Report on Reduction of Energy Use and Carbon Emissions for the Town of Oakville**
LOCATION:	Town-wide
WARD:	Town-wide

RECOMMENDATION:

1. That the report entitled "Progress Report on Reduction of Energy Use and Carbon Emissions for the Town of Oakville" submitted by the Facilities and Construction Management department for the period 2014 – 2021 be received.
2. That the adoption of a Net Zero Carbon target for 2050 for all corporate activities in alignment with the federal Pan-Canadian Framework be approved.
3. That 2015 be adopted as the new baseline for energy and carbon reporting for corporate use.

KEY FACTS:

The following are key points for consideration with respect to this report:

- The *Canadian Net-Zero Emissions Accountability Act* came into effect on June 29, 2021, enshrining Canada's commitment to achieve net-zero emissions by 2050.
- Building on Canada's strengthened climate plan "*A Healthy Environment and a Healthy Economy",* and *Pan-Canadian Framework, Canada's 2030 Emissions Reduction Plan* outlines a roadmap for Canada to meet its enhanced Paris Agreement target to reduce emissions by 40-45% from 2005 levels by 2030.
- Adoption of a Net Zero target by 2050 for the Town of Oakville will mean more efforts will be required on the part of the town to bring corporate emissions down to zero within the next 30 years.

- As of 2021, the Town is close to meeting its 2030 interim targets (20% reduction in energy use and 30% reduction in carbon emissions). Although some of these results are derived from a reduction in facility use throughout the COVID-19 pandemic, the Town has also taken steps to reduce energy use and carbon emissions through energy conservation measures such as lighting retrofits and maximizing building automation system sequences and operations.
- The temporary impact of the COVID-19 pandemic has also allowed the Town to incorporate lessons learned to make adjustments within normal operations at our facilities.
- The Town is continuing to look at different approaches to achieve our 2050 targets. This includes feasibility studies, Net Zero deep energy retrofits, and the establishment of the Sustainable Design Standard, mandating any new construction or major renovation project to target a Net Zero carbon and low energy standard.

BACKGROUND:

In 2014, Town Council passed a motion to adopt formal corporate greenhouse gas (GHG) emission reduction targets for all operations, targeting an 80% reduction by 2050 based on 2014 levels. Since then, the Town also declared a climate emergency in 2019, strengthening its commitment to reduce the effect of corporate operations on climate.

From a regulatory perspective, the Town is required to report on its energy use on a yearly basis to the Ontario Ministry of Energy. In addition, the Town must prepare and update a Conservation and Demand Management (CDM) plan, a strategic document that outlines past performance and future projects that the Town will undertake to continue to reduce its corporate energy use and carbon emissions.

The federal government has also taken strides to combat climate change by adopting a Net Zero carbon target for the country as a whole by 2050. Other municipalities in Ontario, such as Whitby, Burlington and Halton Hills have adopted a Net Zero target already.

Corporate Energy and Carbon Reductions: Progress 2014-2021

Energy use and carbon emissions at the Town of Oakville, from a corporate perspective, include three main sources: facilities, internal fleet and our transit fleet. Main energy sources include electricity (facilities), natural gas (facilities), gasoline (internal fleet) and diesel (internal fleet, Transit fleet).

In Ontario, electricity production generates significantly less carbon emissions than other comparable fuels. This means that, from an environmental perspective, the town of Oakville needs to reduce its use of natural gas, diesel and gasoline and transition to an electrification strategy, which would help achieve the 2050 targets. From an economic perspective, electricity is the single largest utility cost for corporate operations at the Town. This creates conflicting requirements: as we look to reduce carbon emissions, the town would transition to an electrification strategy, which would in turn considerably increase operational costs. Therefore, in order to meet our targets while remaining fiscally responsible, the Town needs to rely more on electricity, while reducing the overall amount of energy used for corporate operations.

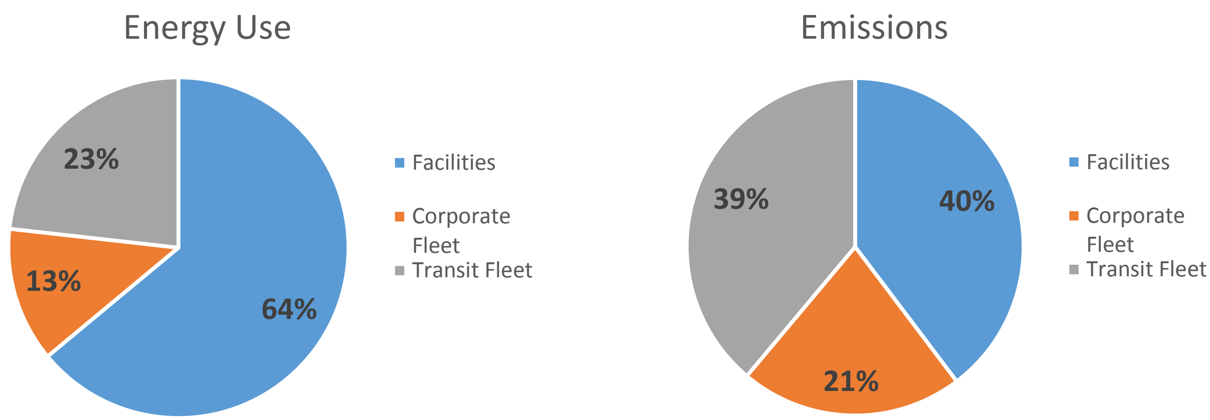
Table 1 shows a summary of energy use and associated carbon emissions for all corporate activities in 2014 (baseline year) and 2021 (last year for which full information is available). All energy use was converted to its equivalent kilowatt hours for comparison purposes. Carbon emissions were calculated for each source of energy using their respective emission factors and quantification methodologies as per the Partners for Climate Protection framework.

Table 1. Corporate energy use and carbon emissions, 2014 vs 2021

Category	Energy Source	Energy Use (ekWh)			Carbon Emissions (tonnes CO2e)		
		2014	2021	% reduction	2014	2021	% reduction
Facilities	Natural Gas and electricity	86,075,920	60,834,392	29.3%	8,714	5,773	33.7%
Corporate fleet	Diesel, Marked Diesel and Gasoline	9,134,811	12,163,535	-33.2%	2,339	3,115	-33.2%
Transit fleet	Diesel	31,079,699	22,082,200	28.9%	7,953	5,655	28.9%
TOTAL		126,290,430	95,080,127	24.7%	19,006	14,543	23.5%

Figure 1 shows the breakdown of energy use and carbon emissions per corporate activity for the 2021 year. This graph in particular showcases the importance of reducing energy use in all corporate activities to have an equivalent impact on carbon emissions.

Figure 1. Breakdown of energy use and carbon emissions per corporate activity, 2021



Together, the information provided in Table 1 and Figure 1 provide two main findings:

- The achieved reduction of 23.5% in carbon emissions in 2021 takes us more than halfway through our 2030 interim target of 30% reductions; and
- The single largest contributor for energy use and carbon emissions at a corporate level are our facilities

Although work will be performed on all fronts, the Town needs to prioritize our built infrastructure to ensure that we meet our 2050 targets. Once fully implemented, the bus electrification program currently under development will help achieve an additional 35% reduction (or more) in carbon emissions from a portfolio-wide perspective. This means that, all things equal, the bus electrification program will take the Town to a 58.5% (or more) reduction in carbon emissions by 2050.

Considerations under a COVID-19 lens

Table 1 presents the performance on energy use for corporate activities at the Town of Oakville. Several projects have been implemented over the past few years, including the lighting retrofit of our streetlights and in several of our community centres, arenas and operations centres; update to Town Hall's building automation system (BAS); capital replacement program with more efficient units. Some items that need to be considered in order to understand the performance of the Town:

1. COVID-19 impacted energy use throughout our corporation in 2020, where facility closures and reduced transit schedules meant less energy was used overall, with a similar reduction in GHG emissions.
2. COVID-19 will also increase our energy use in facilities to be able to maintain recommended levels of air ventilation for our occupants

3. The Town has opened at least three new facilities since 2014 (Trafalgar Park Community Centre/Fire Hall 3, Oakville Trafalgar Community Centre and Fire Hall 8).

Even with an absolute increase in square footage at town facilities, overall energy use and carbon emissions continued to go down. This speaks to the Town's ability to implement projects, including new construction, which can help reduce energy use and carbon emissions as a whole for the corporate portfolio.

For each main source of energy use and emissions, the Town is also committing to continue the development and implementation of projects and initiatives that enhance the energy efficiency of our facilities.

A) For our built infrastructure, the Town will continue to implement energy efficiency projects such as our lighting retrofits and capital equipment replacement. Through the renewable energy generation strategy and a low carbon roadmap, the Town will not only make our facilities more efficient, but additional low-carbon energy generation sources will be added to our facilities to help offset carbon emissions from the grid. With the development of a Sustainable Design Standard and a Deep Energy Retrofit Program, the Town will tackle both current and upcoming facilities, where Net Zero carbon and low energy will be key design principles to be included in all projects.
B) In 2020, the Town of Oakville announced a seven-year plan to purchase 60 electric buses, with the view of converting the entire Transit Fleet to electric buses by 2035. The change from diesel to electricity would have a great impact on carbon emissions, while a robust renewable energy generation strategy would help reduce the impact on costs from an increase in electricity use.
C) Several areas within the Town of Oakville are looking at developing a formal Green Fleet Strategy which would help reduce energy use and carbon emissions from our Corporate Fleet. Like the Transit fleet, using electric vehicles would greatly reduce carbon emissions; renewable energy generation would be required to offset the increase in electricity use to make the new cost of operation more sustainable in the future.

PREPARING THE CORPORATION FOR THE FUTURE:

As part of our efforts to meet our 2050 targets, the Town has developed two documents that will help guide our efforts towards more sustainable operations:

- Low Carbon Roadmap: this document identifies all corporate activities and their related energy use and carbon emissions, with proposed scenarios for carbon emissions reductions through electrification

- Renewable Energy Generation Strategy: this document outlines the framework for embedding select renewable energy generation technologies that can help offset the increase in electricity use at town facilities and other operations

As we continue our efforts moving forward, we have some decisions to make to ensure ongoing progress towards our 2050 targets. In order to prepare the Town of Oakville to be able to reach its commitment regarding carbon emission reductions, as well as ensure that we are in alignment with federal and provincial programs and regulations, it is recommended that:

- **The Town formally adopt a Net Zero carbon target**. The Federal government's climate plan adopted a Net Zero approach towards 2050. Several municipalities across Canada are moving towards a Net Zero emissions target for 2050, with an interim target of 40-45% reductions by 2030. By internally adopting a Net Zero target for 2050, the Town of Oakville would confirm its ongoing commitment towards cleaner corporate operations, and would align with the efforts being undertaken in other municipalities and organizations around the world.
- **The Town change the energy use and carbon emissions baseline from 2014 to 2015.** The province of Ontario started removing the use of coal for electricity generation in 2003, with 2014 being the last year when a coal-fired plant provided electricity to the province. Carbon emissions reductions reported for 2015 are largely due to the decarbonization of the electric grid in Ontario. Using 2015 as the baseline would represent a more appropriate challenge for the Town, as it would not account for those reductions achieved through the electrical grid.

The 2022 capital program includes funding to continue the work to better manage corporate energy and carbon use. This includes:

- Updating our Building Automation System (BAS) standards in Town facilities to ensure we have effective controls for temperature and operations;
- Initiating two feasibility studies for deep energy retrofits at our facilities. This will help us understand the level of resources and effort required to bring our buildings down to a Net Zero carbon and low energy standard;
- Development of the Town's first Sustainable Design Standard, building on the success of its Sustainable Design Guidelines; and
- Continue implementation of capital replacement programs, looking for the most energy efficient and least carbon intensive alternatives.

These studies/projects will help us understand the level of financial commitment required moving forward.

The road to 2050 (and our interim 2030 targets) will require a higher level of commitment at all levels in the organization. It is important for the Town to focus on:

- Securing appropriate resources to implement projects and initiatives derived from our low carbon roadmap, deep energy retrofit program and more;
- Securing partnerships with local, provincial and federal bodies and organizations that can help complement funding and resources requirements in order to meet our targets;
- Working closely with Finance and Asset Management to develop and implement a Life Cycle Costing framework that supports low carbon, high energy efficient projects.

In closing, the Town of Oakville has been working hard to meet its commitments towards 2050. We have accomplished much over the past 8 years and we need to build upon these successes to keep our momentum going. As a key stakeholder in the greater Oakville community under the Community Energy Strategy, the town needs to maintain its commitment to reduce our impact on the environment, maximize our investments in low carbon operations, and collaborate within and outside of Oakville to ensure we showcase our leadership as environmental stewards for the community.

CONSIDERATIONS:

(A) PUBLIC

The Town of Oakville is one of the major partners for the Community Energy Plan, and is seen as one of the leaders in implementing projects and initiatives that can help the greater community reach its goals. By updating our target, the Town would be strengthening its commitment to meet (and potentially exceed) federal and provincial requirements.

(B) FINANCIAL

The 2022 capital program includes funding to continue the work around corporate energy and carbon management. This includes:

- Updating our Building Automation System (BAS) standards in Town facilities to ensure we have effective controls for temperature and operations
- Initiating two feasibility studies for deep energy retrofits at our facilities. This will help us understand the level of resources and effort required to bring our buildings down to a Net Zero carbon and low energy standard
- Development of the Town’s first Sustainable Design Standard, building on the success of its Sustainable Design Guidelines

- Continue implementing capital replacement programs, looking for the most energy efficient and least carbon intensive alternatives

These studies/projects will help us understand the level of financial commitment required moving forward.

(C) IMPACT ON OTHER DEPARTMENTS & USERS

Energy use and carbon emissions are shared among departments and users throughout the Town. Conversations are already underway for a variety of initiatives, and will continue with a number of departments and external partners.

(D) CORPORATE STRATEGIC GOALS

This report addresses the corporate strategic goal(s) to:

- Livability: implementing energy use and carbon emissions as a main decision-making tool can help not only enhance the air quality in Oakville, but ensure that our facilities continue to be safe to visit and use, while offering appealing designs and appropriate indoor environments.
- Environment: energy use and carbon emissions have a direct impact on the environment, and are considered a strategic priority for the corporation. By adopting a new baseline and new carbon emission reduction targets, the Town would be doubling down on its commitment to reduce the impact on the environment from its corporate activities, while showcasing leadership within the greater community energy plan for Oakville.

(E) CLIMATE CHANGE/ACTION

Energy use and carbon emissions reductions have a direct effect on our climate, as they are the main drivers for climate change mitigation. By doubling down our efforts, the Town would be addressing climate change mitigation through its corporate activities.

APPENDICES:

APPENDIX A – Breakdown of Energy Use and Carbon Emissions performance per type of operation
APPENDIX B – Oakville Greenhouse Gas Reduction Roadmap and Action Plan
APPENDIX C – Phase A – Baseline Analysis – Renewable Energy Generation Strategy
APPENDIX D – Phase B – Sustainability Report – Renewable Energy Generation Strategy
APPENDIX E - Phase C – Strategic Visioning Workshop – March 2021
APPENDIX F – Phase D – Strategy Summary – Renewable Energy Generation Strategy

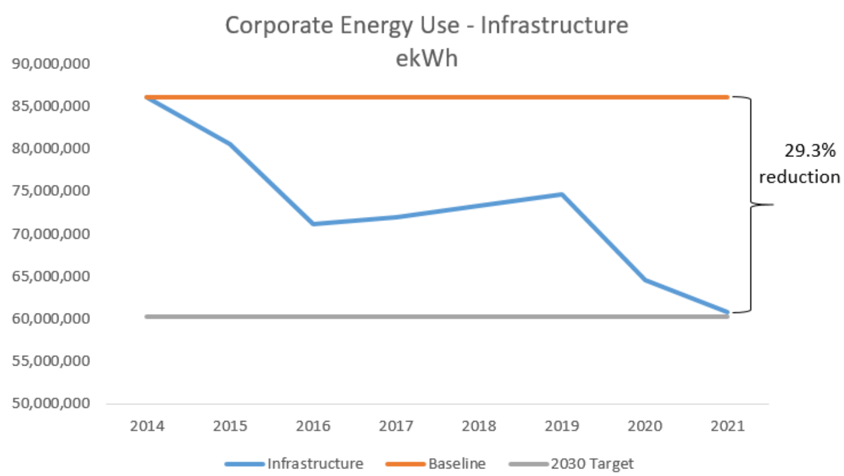
Prepared by:
Dave Cano, Energy Solutions Manager

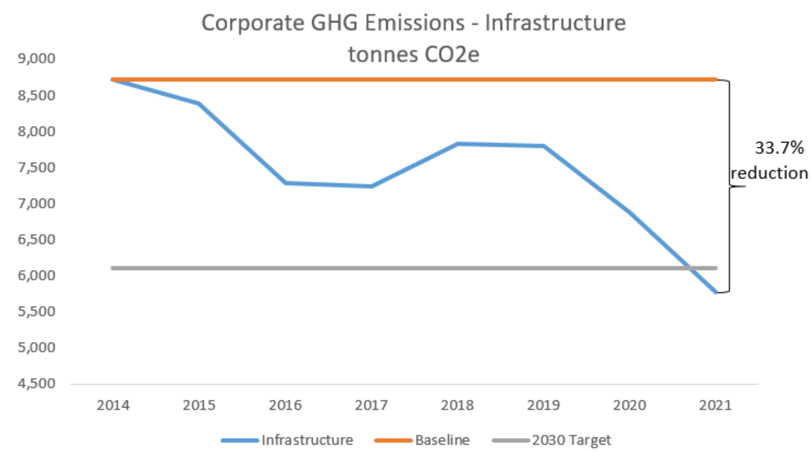
Recommended by:
Colleen Bell, Commissioner – Community Services

APPENDIX A – Breakdown of energy use and carbon emissions performance per type of operation

The following sections will provide a summary of energy and carbon emissions performance for each type of corporate activity at the Town: Facilities, Corporate Fleet and Transit Fleet.

Energy use and carbon emissions from facilities



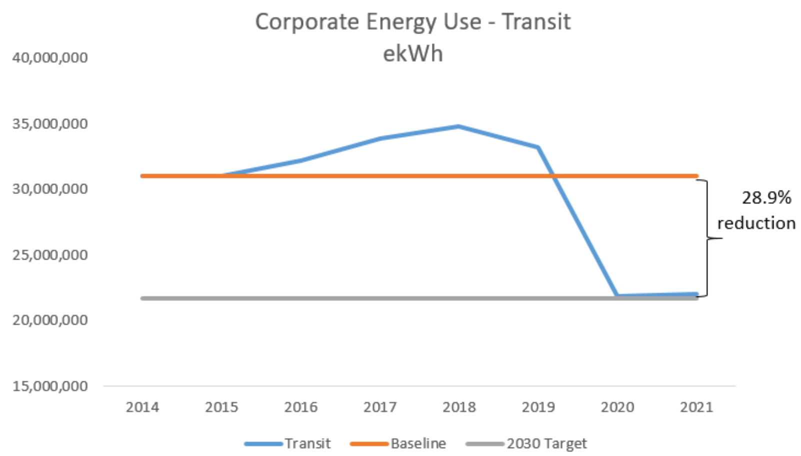


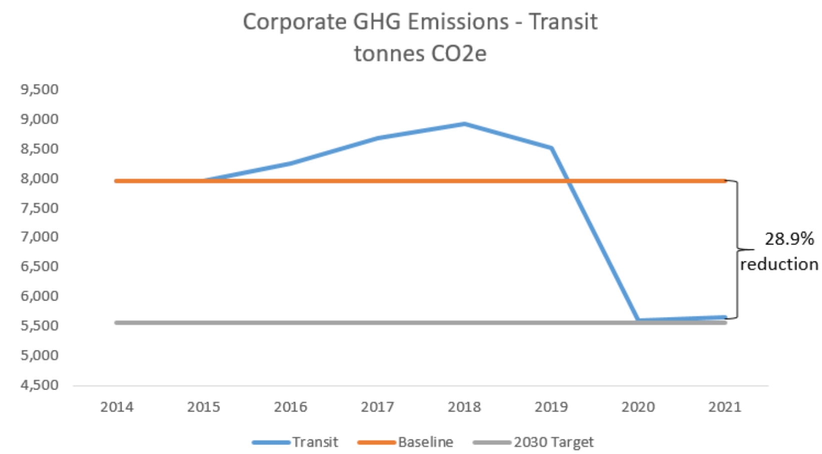
Energy use in corporate facilities has been going down since 2019. Several projects have been implemented at our facilities, including:

- Streetlight retrofit
- Lighting retrofits at several community centres, arenas and operations centres
- BAS upgrades to Town Hall
- Introduction of energy efficient equipment under the capital replacement program
- Retrocommissioning program at our largest facilities

Overall, the Town has achieved a 29.3% reduction in energy use and 33.7% reduction in carbon emissions by 2021, putting us ahead our interim target of 30% reductions by 2030.

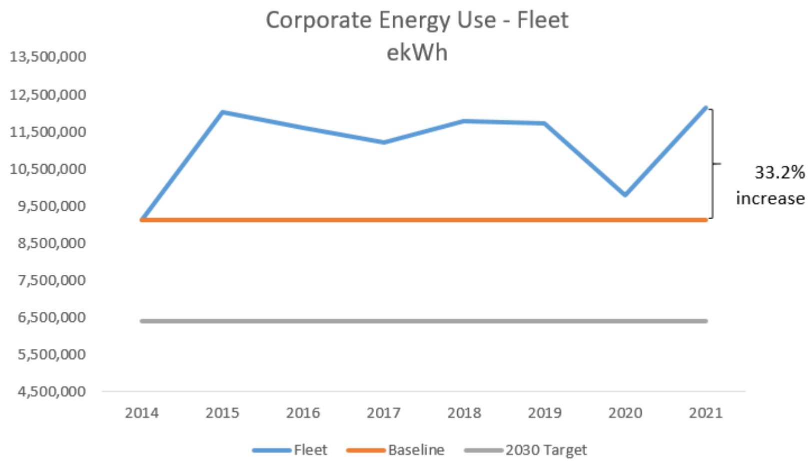
Energy use and carbon emissions from Transit fleet

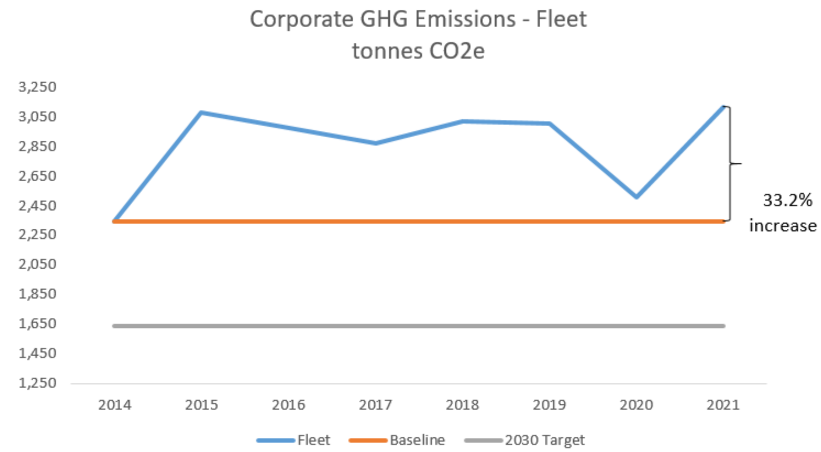




Our Transit fleet has experience an increase in energy use and carbon emissions up to 2020, where due to the COVID-19 pandemic, transit services were modified to better serve the community. That being said, the team at Oakville Transit has been working hard for the past few years (and will continue to do so) with their strategy to electrify the bus fleet. Thanks to federal and provincial funding, the Town is ready to purchase its first set of electric buses with the intent to fully electrify the fleet by 2035. With a fully electric fleet, Oakville Transit would be cutting down its carbon emissions drastically. An accompanying energy services strategy will help ensure that any increase in electricity use is managed appropriately to ensure costs are not a hinderance to this program.

Energy use and carbon emissions from Corporate Fleet





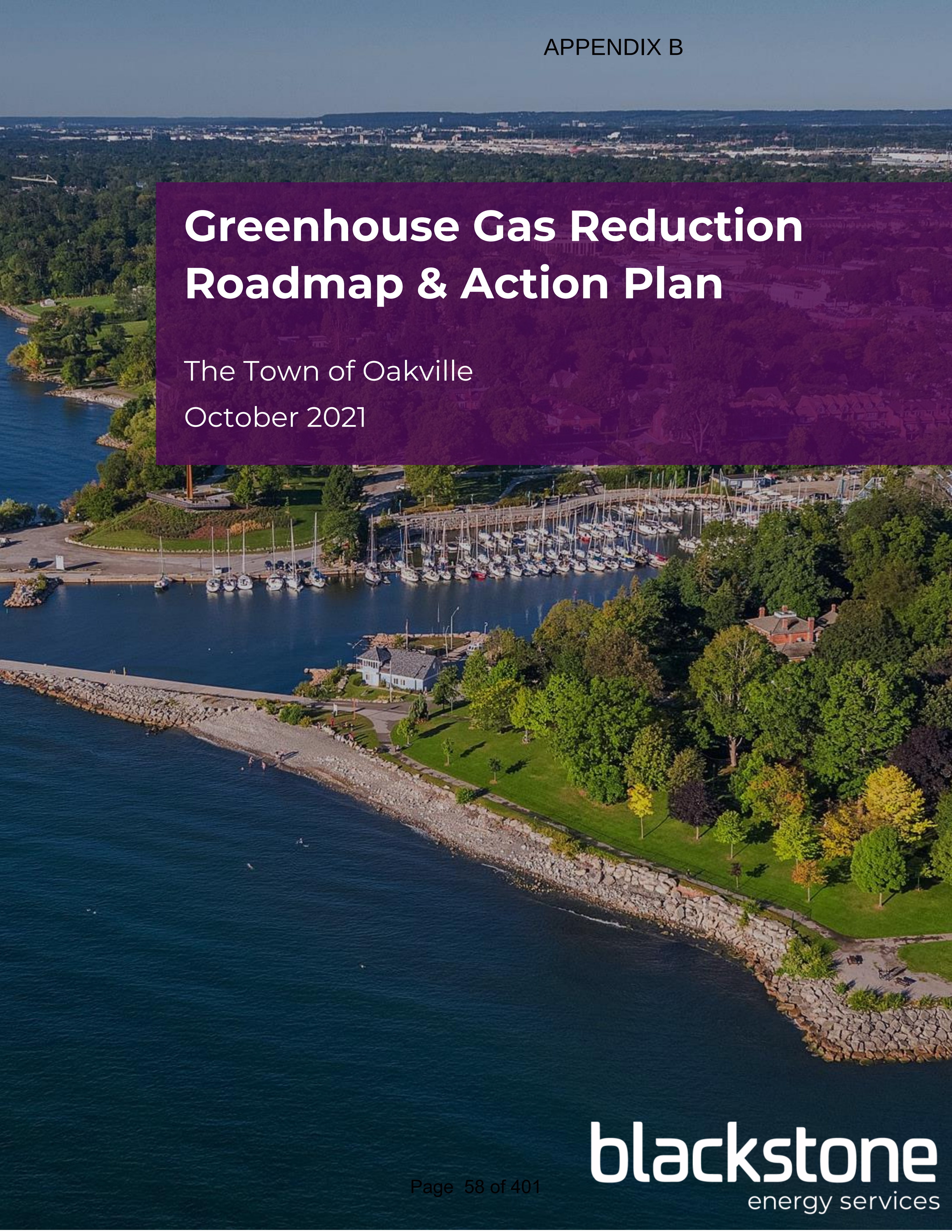
This is the only category where energy use and carbon emissions have consistently grown over the past few years. More information will be gathered to understand what could be driving this increase. Several departments within the Town are working to develop the first Green Fleet Strategy, and looking at ways to move from gasoline/diesel to fully electric vehicles. Starting in 2022, the Building Inspectors will start transitioning to a fully electric fleet, which should have a great impact in our carbon emissions. The associated increase in energy use and cost should be tackled through renewable energy generation projects that can help reduce our requirements for electricity drawn from the grid.

APPENDIX B

Greenhouse Gas Reduction Roadmap & Action Plan

The Town of Oakville

October 2021



blackstone
energy services

Introduction

The transition toward the decarbonization of your facilities and services is an opportunity for The Town of Oakville (The Town) to be a part of the growing activity around climate action initiatives. The Town has made significant strides in its sustainability standing and is on a path to significant and important actions that mitigate and prepare for the impacts of climate change. The Town's Greenhouse Gas Reduction Roadmap & Action Plan (GRRAP) includes corporate facilities and sets short-term and long-term strategies for greenhouse gas (GHG) footprint targets. It recognizes The Town's overarching sustainability goal of achieving 80% GHGs reduction from 2014 level and energy portfolio resiliency by 2050.

Compared to a baseline year of 2014, The Town has committed to:

- Reduce its GHG emissions by 20% by 2030 from 2014 level
- Achieve 80% reduction by 2050 from 2014 level

This GRRAP aims to provide strategic direction and options required to reduce emissions at The Town over the next 30 years. In order to reach its GHG emission targets, The Town's GRRAP must be reflected in its vision, planning, and financial strategies. The Town policies and plans may include those listed below which may need to be adapted to fully realize their goals:

- Municipal Master Plan
- Parking Master Plan
- Sustainability Action Plan
- Energy Management
- Five Year Strategic Plan
- Sustainability Policy

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Glossary of Terms

Word	Abbreviation	Meaning
Air Handing Unit	AHU	A device used to regulate and circulate air as part of a heating, ventilating, and air-conditioning system.
Baseline Year		A benchmark that is used as a foundation for measuring or comparing current and past values.
British Thermal Units	BTU	A standard unit of the heat content of fuels or energy sources.
Building Automation System	BAS	The automatic centralized control of a building's heating, ventilation and air conditioning, lighting, and other systems.
Business as Usual	BAU	Scenario if no actions are taken to mitigate or change.
Canada Green Building Council	CaGBC	The Town of Oakville certifies a Zero Carbon Building Standard that could be used as a guide for carbon-free construction and operations.
Carbon Dioxide	CO_2	A greenhouse gas that results, in part, from the combustion of fossil fuels.
Coefficient of Performance	COP	A ratio of useful heating or cooling provided to work is required.
Carbon Reduction Roadmap	GRRAP	Provides an in-depth look at a facility's baseline, current, and forecasted Scope 1, 2 and 3 GHG emissions relative to their targets, and provides reduction strategies.
Direct Expansion	DX	A system that uses the vapour-compression refrigeration cycle to efficiently cool a building.
Environment and Climate Change Canada	ECCC	Informs Canadians about protecting and conserving natural heritage and ensuring a clean, safe, and sustainable environment for present and future generations.
Electric Vehicle	EV	A vehicle that uses one or more electric motors for propulsion
Energy Conservation & Demand Management	ECDM	The installation of measures, or implementation of practices, to improve energy efficiency. This is a requirement of O. Reg. 507/18: Broader Public Sector: Energy Conservation and Demand Management Plans (ECDM).
Energy Storage		Typically refers to the energy stored by the battery.
Energy Usage Intensity	EUI	The amount of energy consumed relative to a building's physical size, typically measured in equivalent kWh per square foot.
Engineering, Procurement and Construction	EPC	Engineering, procurement, and construction of infrastructure projects.
Electrification		The conversion of fossil fuel-based technologies to electric alternatives.
Equivalent Carbon Dioxide	CO_2e	Measurement of greenhouse gas emissions, relative to carbon dioxide.
Equivalent kilo-watt hours	ekWh	A standard unit of energy consumption that is used to compare energy sources.
GHG Protocol		The recognized international standards used in the measurement and quantification of greenhouse gases – The Scope 1 Standard, the Scope 2 Standard, and the Scope 3 Standard.
Greenhouse Gas	GHG	A gas that contributes to the greenhouse effect by absorbing infrared radiation, e.g., carbon dioxide and chlorofluorocarbons.
Global Warming Potential	GWP	A measure of how much heat is trapped in the atmosphere by a greenhouse gas up to a specific time horizon, relative to carbon dioxide.

Global Reporting Initiative	GRI	The GRI is an international independent standards organization that helps businesses, governments and other organizations understand and communicate their impacts on issues such as climate change, human rights, and corruption.
Heating, Ventilation and Air Conditioning +Lighting	HVAC+L	A system that provides heating, cooling, ventilation, and lighting to a building.
Hourly Ontario Electricity Price	HOEP	The wholesale price of electricity as determined in the real-time market administered by the IESO.
Independent Electricity System Operator	IESO	Crown corporation responsible for operating the electricity market in the province of Ontario.
The Town of Oakville Energy Efficiency Project	EEP	The Town of Oakville's program on improving energy efficiency and promoting energy conservation.
Leadership in Energy and Environmental Design	LEED	A green building certification program that is administered by the CaGBC.
Long Term Energy Plan	LTEP	Ontario's plan that outlines the province's energy demand, supply, and commitments.
Metric Tonnes	t	A unit of measurement of mass.
Mega Tonnes	MT	A unit of measurement of mass (1 MT = 1,000,000 t).
Photovoltaic	PV	The conversion of light into electricity using semiconducting materials.
Renewable Energy	RE	Generation of energy produced from sources that do not deplete.
Renewable Natural Gas	RNG	Biogas that is captured from decomposing organic waste.
Scope 1		Direct emissions from sources owned or controlled by the municipality.
Scope 2		Indirect emissions from the consumption of purchased energy generated upstream from the municipality.
Scope 3		Indirect emissions (not included in Scope 2) that occur in the value chain of the municipality including both upstream and downstream emissions, like waste, transport, food, and procurement.
Space Optimization	SO	Maximizing the effective use of the built environment.
Natural Gas/Traditional Natural Gas	TNG	Natural gas is a naturally occurring hydrocarbon gas, or fossil fuel, mixture consisting primarily of methane.
Power Purchase Agreement	PPA	A contract between two parties, one which generates electricity (the seller) and one which purchases electricity (the buyer) for an agreed cost (including maintenance) over a defined time where typically the source of electricity generation is from a renewable power generation system.
Variable Refrigerant Flow	VRF	A system that varies the *flow* of *refrigerant* to indoor units based on demand.
Zero Carbon Building	ZCB	A highly energy-efficient building that is fully powered from on-site and/or off-site renewable energy sources and carbon offsets resulting in an annual net-zero carbon footprint.

1. Executive Summary

The Town has committed to achieving an 80% GHGs reduction from 2014 levels by 2050. The path and transition to 80% reduction by 2050 will be impacted by strategic planning, technology, implementation timelines, government incentives, utility rate structures, grid emissions and societal impacts. It is recommended that The Town prepares and follows a strategy as envisioned through this GRRAP, performs annual inventory of energy and GHGs, regularly assesses their progress, adapts to achieve, and identifies new programs that could help The Town reach 80% reduction from 2014 level by 2050.

Note that when The Town is mentioned in this report, we are referring to the corporate facilities, fleets, and transit assets. Private assets are not included.

There are **four key pillars** on the journey to achieving 80% GHGs reduction from 2014 level:

- **Pillar 1: Energy Conservation & Demand Management (ECDM)** – The Town has a documented ECDM strategy with estimated costs, benefits, and timelines. Pillar 1 supports the implementation and continued commitment to energy conservation, reduced waste, and optimum energy and GHG use intensities.
- **Pillar 2: Space Optimization (SO) & Zero Carbon Buildings (ZCB)** – Addresses how to minimize emissions from buildings by optimizing the use of existing building space and reducing emissions from renovations and new facilities through high-performance design standards and operations.
- **Pillar 3: Facility Electrification** – Focused on converting existing fossil fuel-based technologies to low carbon, electric, alternatives.
- **Pillar 4: Renewable Energy (RE) Generation** – On- and off-site renewable energy generation can support The Town's net-zero carbon targets. For The Town, renewable generation is focused on the installation of rooftop solar photovoltaics, carport solar photovoltaics, solar heated air/water, and geo-exchange technologies (i.e., inter-seasonal ground energy storage).

To achieve an 80% GHGs reduction from 2014 level, it is recommended that The Town commits to implementing the strategies outlined in the GRRAP to support each of the four pillars.

Under Pillar 1, The Town should continue to create a culture of ECDM. The Town's existing ECDM program has created a foundation for improvements to minimize energy use. ECDM technologies – including lighting, ventilation controls and upgraded building automation systems – have proven to be cost-effective mechanisms for The Town. Also, the ECDM Plan provides a short-term overview of projects, their estimated costs, and benefits. The Town should continue to fund ECDM to minimize energy usage and should review the ECDM plan on a five-year renewal schedule.

Under Pillar 2, it is recommended that The Town commits to undertaking a space use optimization study to further assess how to maximize the efficiency of existing spaces. For new buildings, The Town should commit that all new buildings and major renovations will be built to (at minimum) zero carbon standards. To build to these higher standards will cost more than building to the Ontario Building Code (approximately 4%-16% depending on the systems used). However, zero-carbon buildings have lower operational costs, are more comfortable and cost-effective over their lifespans. Blackstone also recommends that The Town develops their own high-performance standards tailored to their portfolio archetypes and include elements of existing standards/guidelines (such as LEED, Passive House, Toronto Green Standards) as a checklist for best practices sustainability and high-performance measures.

Under Pillar 3, The Town commits to the electrification of fleet and facility HVAC equipment. Internal combustion fleet vehicles should be replaced with electric vehicles. When asset renewals are considered, facility equipment should be evaluated from a life cycle cost and carbon perspective. Installing electric systems may be more expensive and operating costs may increase, though against increasingly more expensive carbon fees due to fossil fuels. These are budget considerations The Town should assess with the knowledge that the sooner the investment is made, the lower the carbon output of The Town's operations. Under Pillar 4, it is recommended that The Town installs the maximum amount of solar photovoltaics (both rooftop and carport) and geothermal systems its municipality can support to provide renewable energy. The onsite renewable potential was assessed to determine the feasibility of renewable energy projects and identify archetypes best suited for installation at The Town. Note also that a renewable energy systems (RES) report has been prepared and submitted for The Town that provides further details about RES opportunities.

The graph below depicts the combination of four scenarios, as well as the addition of aggressive renewable systems installations as recommended in the RE report. By executing all these initiatives, The Town will achieve their GHG emission reduction target which is 20% GHG emissions reduction by 2030 from 2014 levels and GHG emissions reduction of 80% by 2050 from 2014 levels, as shown in Figure 1.

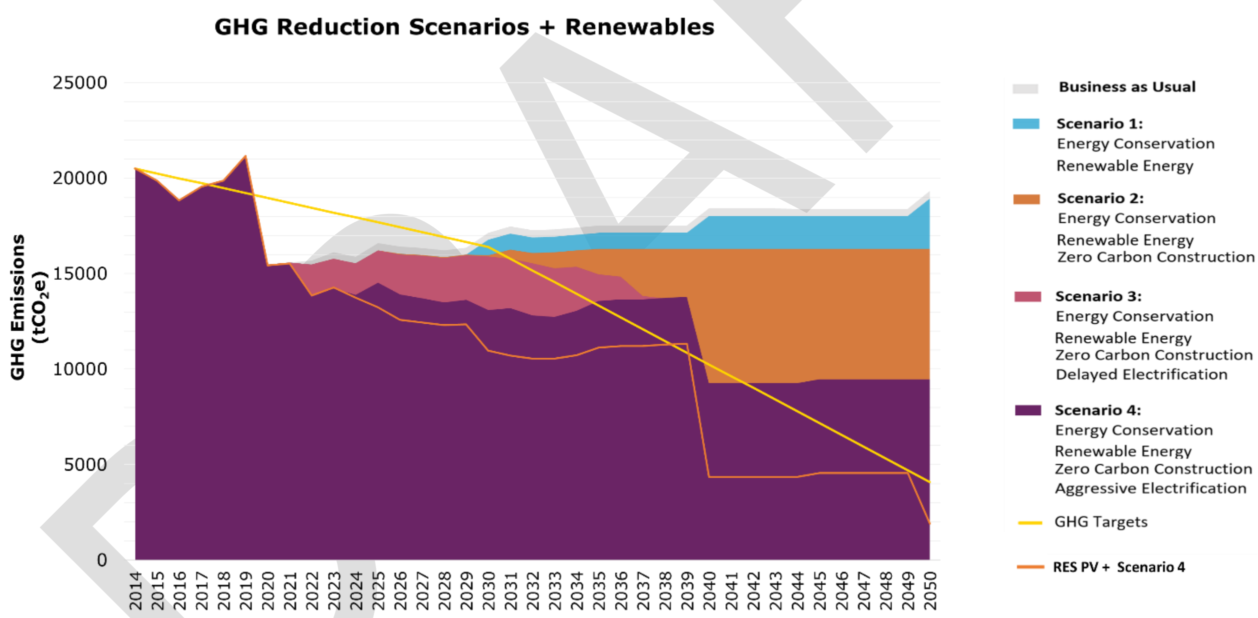


Figure 1. *GHG Reduction Scenarios + Renewables – Path to Achieve GHG Reduction Target*

2. Recommendations

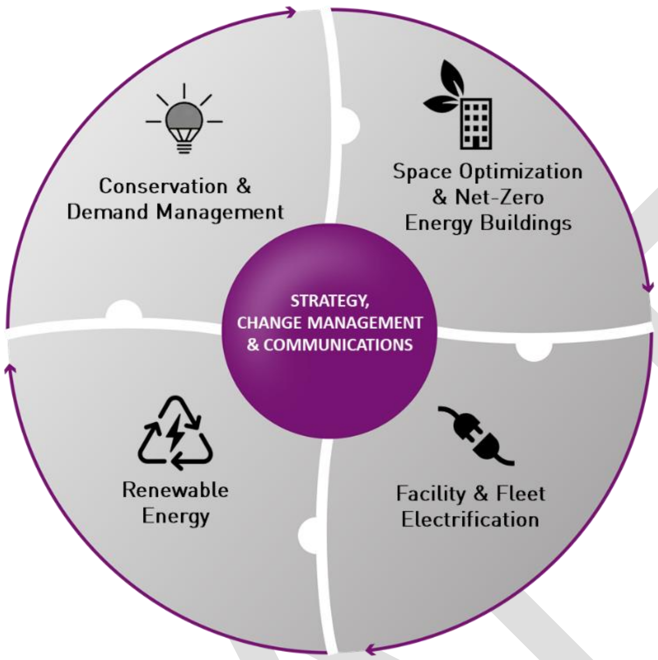


Figure 2. *Strategy, Change Management & Communications Wheel*

It is recommended that The Town moves ahead with the following actions items listed below, under all four pillars, to support the GRRAP.

Pillar 1. Energy Conservation & Demand Management

- At five-year intervals, update ECDM Plan and maintain a commitment to energy management programs (as part of O. Reg. 507/18).
- Ensure budget allocation to support the implementation of best practice ECDM standards.
- Identify opportunities for energy conservation and deep energy retrofits in alignment with deferred maintenance priorities.
- Review the state of building envelope items and facility condition reports regularly.

Pillar 2. Space Optimization & Net-Zero Carbon Buildings

- Develop design and construction standards to drive high-performance indices and ensure Net-Zero Carbon as the minimum standard for new builds and major renovations.
- Develop space use policies to minimize underused space and maximize the space utilization rate within corporate facilities.
- Develop a master plan that has space optimization as a guiding principle.
- Allocate budget for conducting space use audits and implementing space optimization measures.

Pillar 3. Facility & Fleet Electrification

- Commit to the electrification of facility equipment. Explore alternatives for fossil fuels for cooking equipment.
- Implement a Green Fleet Strategy to replace the corporate fleet with electric vehicles.
- Ensure parking lots have the infrastructure to support solar panels, electric vehicles, and geo-loops, and enhance the infrastructure for vehicle-to-grid in existing buildings.

Pillar 4. Renewable Energy

- Install maximum amount of solar photovoltaics, both rooftop and carport, and geothermal as the municipality will allow.

General Sustainability Initiatives

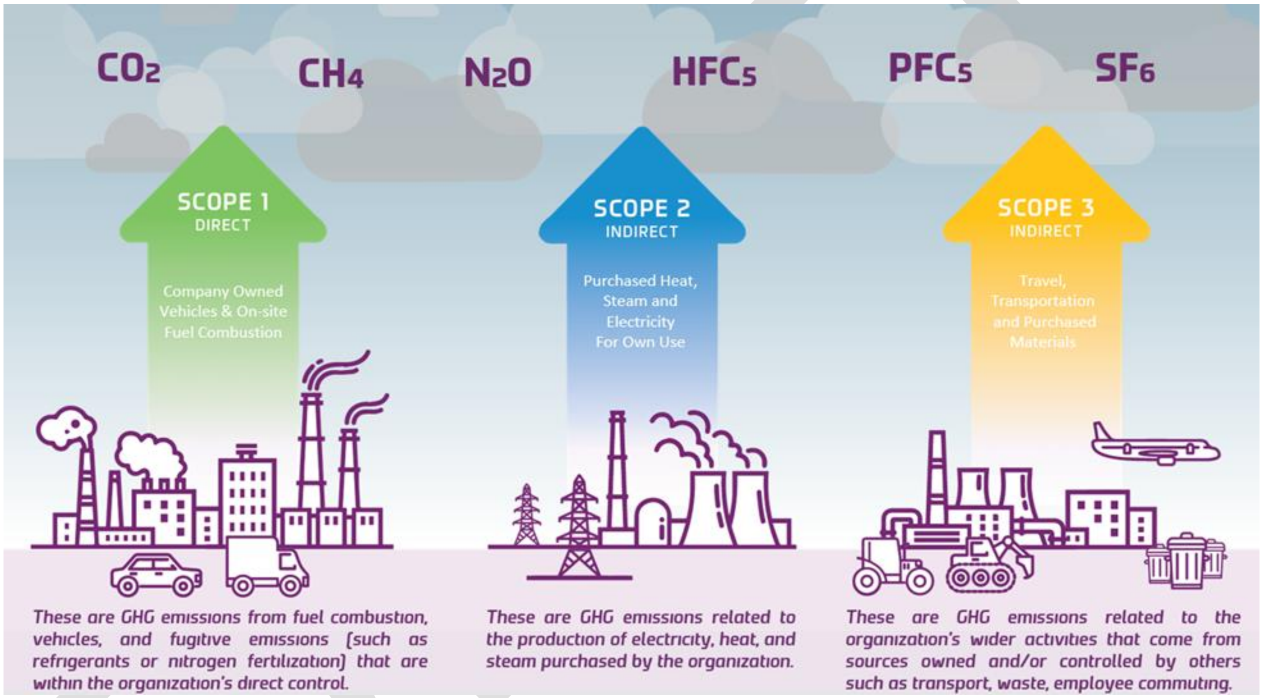
It is recommended that The Town continues to support a low carbon future and promotes sustainability at a municipality level.

- Continue to monitor and achieve alignment between the sustainability plan and The Town's GHG reduction targets.
- Ban single-use plastics within corporate facilities.
- Limit food waste generation.
- Strengthen awareness programs about energy and waste management for employees, staff, and residents.
- Expand sustainable transportation options for The Town's community.

3. The Town of Oakville's GHG Footprint

3.1. Scope of Emissions

The Town's GRRAP quantifies GHG emissions by source, outlines the scenarios for emission reduction and provides The Town with a roadmap to reach its reduction targets. GHG emissions are accounted for according to the GHG Protocol Standard, which is the global standardized framework to measure and manage greenhouse gas (GHG) emissions from private and public sector operations. GHG emissions considered for the GRRAP are categorized by three types of emissions: Scope 1, Scope 2, and Scope 3, although due to the complex nature of a spread out and multiple stakeholder corporation, scope 3 emissions are excluded from this report. Therefore, for the following sections, only scope 1 and 2 emissions are discussed, calculated, and addressed.



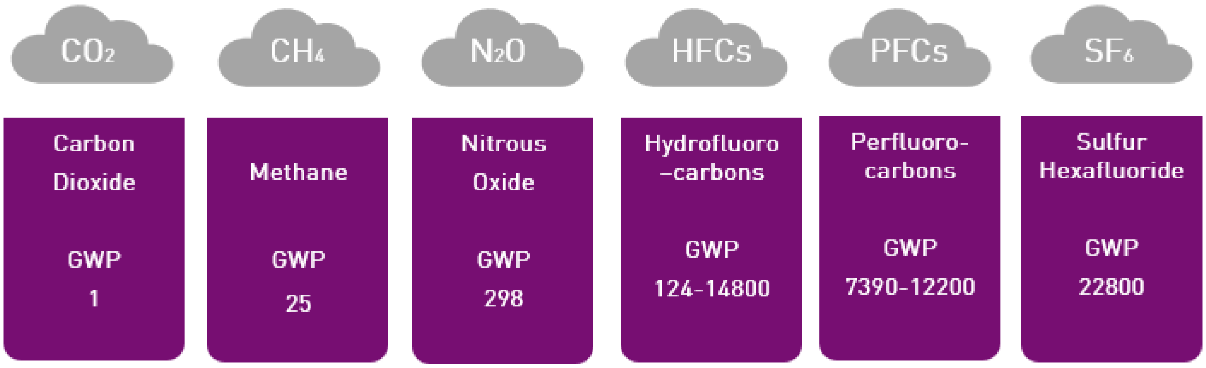
Source: GHG Protocol[1]

Figure 3. *GHG Emissions and Scopes*

GHG emissions released from The Town's operations may include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). Each gas has a global warming potential (GWP) that is expressed in terms of CO_2 equivalent or CO_2e. The GWP of GHGs is a measure of how much heat a greenhouse gas traps in the atmosphere. The GRRAP accounted for emissions from Scope 1, and 2 calculated the GWP relative to tonnes of carbon dioxide equivalent (tCO_2e). For example, for every tonne of methane released, about 25 tonnes of equivalent CO_2 is released as the GWP for methane is 25. Each GHG must be converted to equivalent CO_2 for calculations and reporting.

[1] Greenhouse Gas Protocol: http://ghgprotocol.org/about-us

The global warming potentials (GWP) associated with these six common GHGs are depicted in Figure 4 below.



Source: National Inventory Report 1990 –2019: Greenhouse Gas Sources and Sinks in Canada

Figure 4. *Common Greenhouse Gases and Respective Global Warming Potentials*

The Scope boundaries, activities that were included in the GHG emissions calculations for The Town, were selected based on the availability of data and discussions with the Facilities and Construction Management office and are summarized in Table 1 below.

Table 1. *GHG Emission Scopes & Sources*

Scope of Emissions	Definition	Source of Emission
Scope 1	Direct emissions from sources owned or controlled by The Town	• Natural Gas • Refrigerants • Diesel • Gasoline
Scope 2	Indirect emissions from the consumption of purchased energy generated upstream from The Town	• Purchased electricity

Stationary sources such as oil (#1-4), natural gas, the use of refrigerants and organic fertilizers were all considered in the GHG emissions calculations for Scope 1 emissions. Scope 2 GHG emissions in The Town are solely generated from purchased electricity. The share of The Town's GHG emissions in 2020 is illustrated in Figure 5.

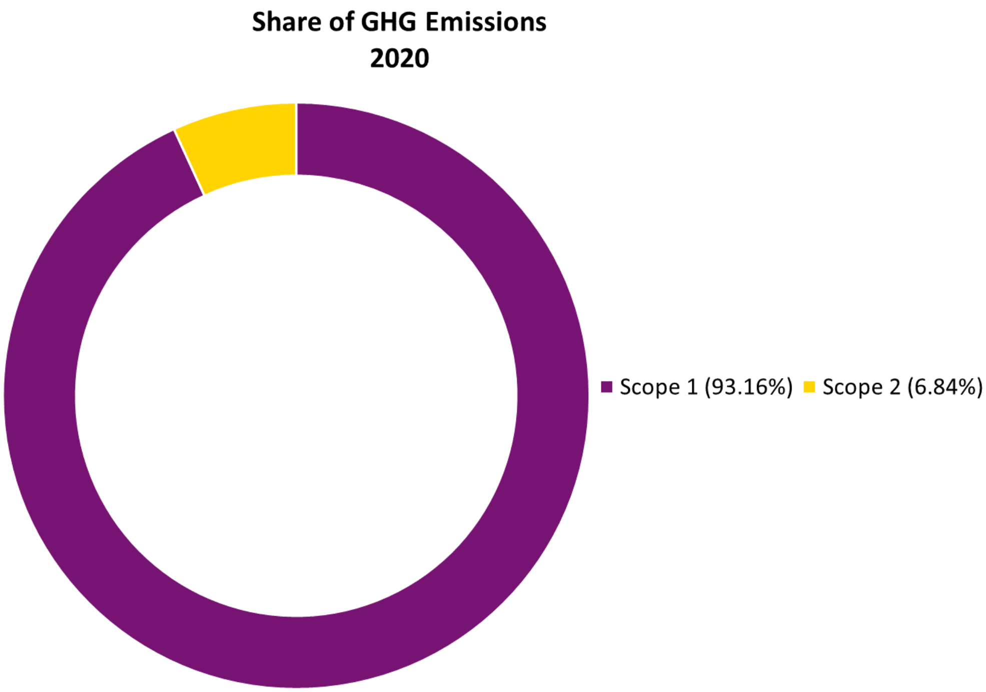


***Figure 5**. 2020 Share of Emissions for The Town*

The emissions were calculated for building archetypes including Community Centers, Operations and Admins, Arenas, and Other (streetlights, parks, parking lots) – and mainly addresses Scope 1 and Scope 2 emissions which are directly under The Town's operational control given they are driven by energy use and facility management. Scope 3 emissions are dependant on human and social behaviour and can best be addressed by awareness and policy implementation across the corporation and community. Scope 3 emissions are dealt with briefly in Section 9.

3.2. GHG Emissions Baseline

To set appropriate, ambitious yet achievable emissions reductions targets, and to set dates by which to achieve those targets, a baseline year of emissions must be set as a benchmark to measure the progress of the GRRAP. The Town's official baseline year has been selected to be 2014 and The Town has confirmed the baseline year of 2014, as established in its Sustainability Action Plan. **It is Blackstone's recommendation to switch the baseline year to 2015 as that is the first year that coal-fired electricity has been phased out**. Coal-fired electricity has a much higher GHG emissions factor making any GHG reductions in 2015 and forward unrelated to conservation or GHG mitigation measures. Any electricity-saving projects before 2015 would require GHG emissions factor adjustments for any cumulative sum accounting.

The emission reduction targets for The Town are absolute numbers (versus an intensity-based value such as energy units/capita) as a percentage of The Town's emissions compared to the baseline year of 2014. Absolute GHG reduction targets are increasingly more common in municipal and large portfolio operations and are considered best practice (intensity-based targets tend to be used in manufacturing/production-based operations). The following table summarizes the GHG emissions in the baseline year and the resulting absolute targets set by The Town (in metric tonnes of carbon dioxide equivalent – tCO_2e).

Table 2. *Baseline, Current and Target Emissions for The Town*

GHG Emissions (tCO_2e)	2014 (Baseline)	2020 (Current levels)	2030 (20% reduction from baseline)	2050 (80% reduction from baseline)
Scope 1	19,300	14,427	15,440	3,860
Scope 2	1,206	1,059	965	241
TOTAL	**20,506**	**15,486**	**16,404**	**4,101**

EF and Quantification Method Source: National Inventory Report 1990 –2019: Greenhouse Gas Sources and Sinks in Canada

3.3. Historic Emission Trends

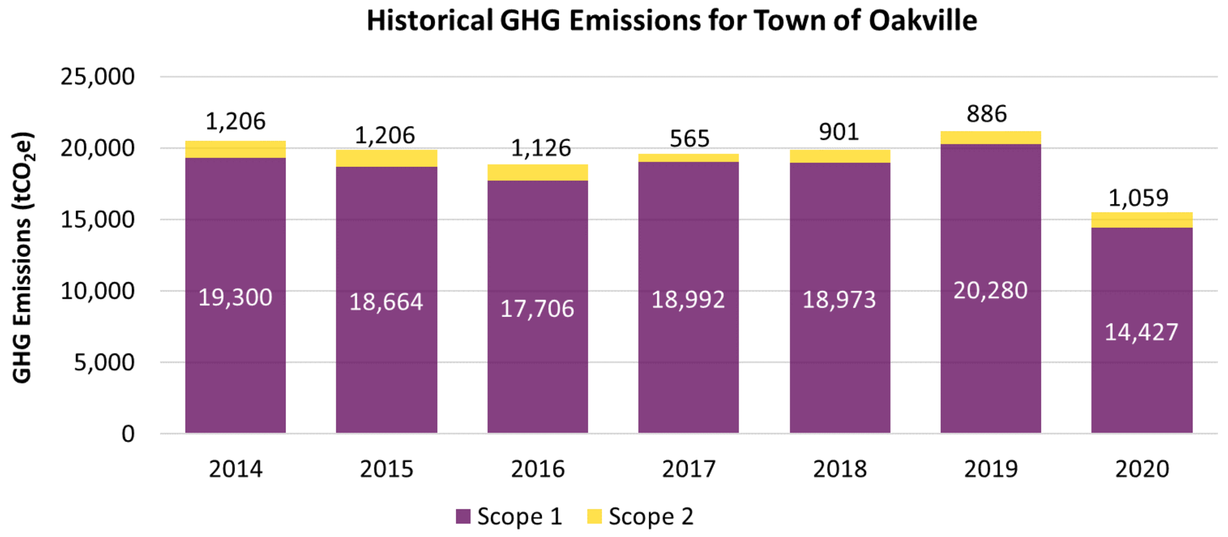


Figure 6. *Historical Emissions Trends for The Town*

Figure 6 above shows the annual GHG emission trends from the baseline year of 2014 through to 2020. The trends in the GHG emissions are broken down further between community Centers, Operations and Admins, and Arena's buildings. Factors affecting the GHG trends are explained on the following page by archetype.

3.3.1. Community Centers

The Community Centers archetypes – including Central Libraries, Community Centers and Performing Art Centers – were responsible for almost 21.62% of The Town's total GHG emissions in 2020. Scope 1 emissions peaked in 2014 at 3,738 tCO_2e, although it decreased in 2020 reaching 2,955 tCO_2e. Scope 2 emissions had a peak in 2014 at 478 tCO_2e. While there has been a significant reduction in emissions in 2017, they still stand on the high side in 2020 at 394 tCO_2e. Though not fully quantified, the impact of COVID-19 likely had some impact on the energy used in many of these facilities during 2020. The influence of municipality growth (in both population and physical size) on GHG emissions is further explored in Section 3.5.

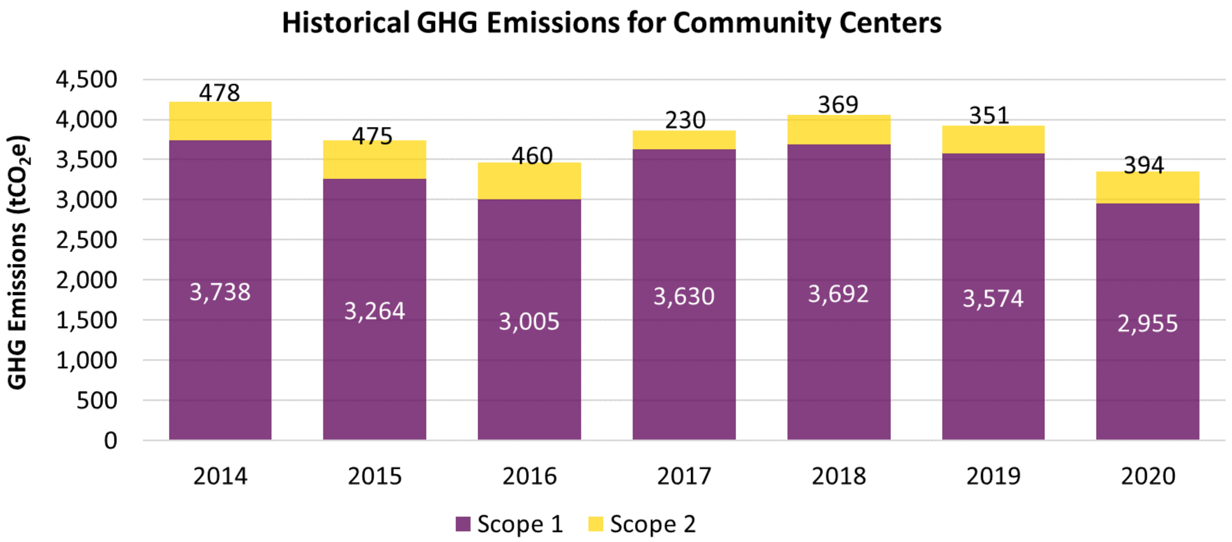


Figure 7. *Historic Emissions Trends for Community Centers*

3.3.2. Operations and Admins

Operations and Admins archetypes – including Town Halls, Transit Facilities, and Operations Centers – account for 71.65% of The Town's overall emissions. Scope 1 emissions increased to their peak in 2019 at 15,619 tCO_2e. However, Scope 1 emissions decreased largely by 2020. Scope 2 emissions experienced a rise in the same year, standing at the high end after 2015 with 425 tCO_2e. As with Community Centres above, the impact of COVID-19 is likely showing up as a part of reduced GHG loads.

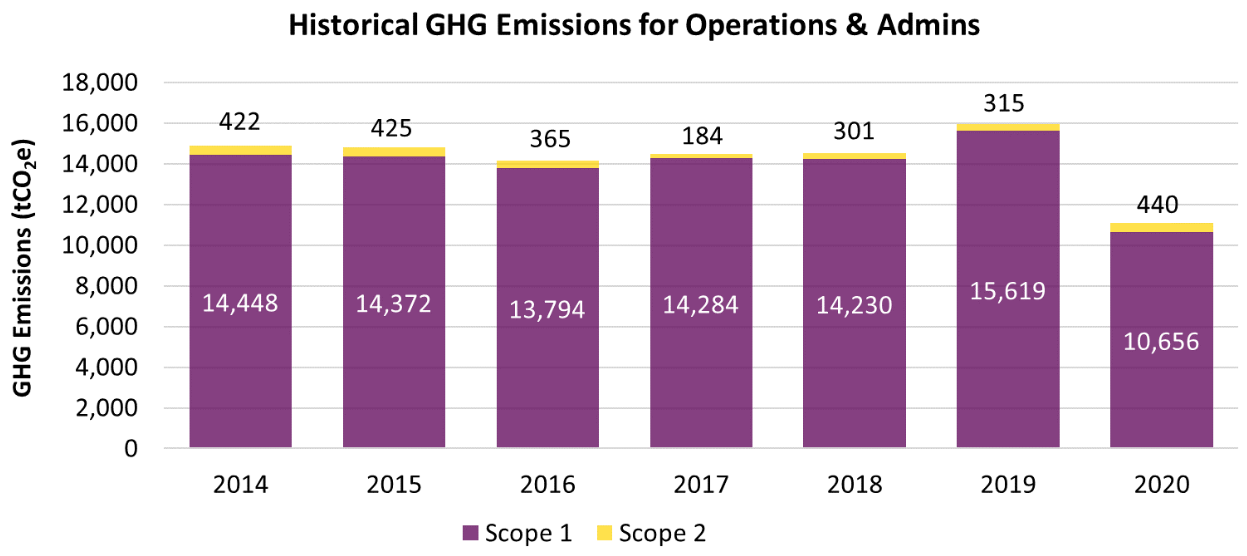


Figure 8. *Historic Emissions Trends for the Operations and Admins*

3.3.3. Arenas

Arenas' archetypes – including Sports Complexes and Arenas – account for 6.66% of The Town's overall emissions. The Scope 1 emissions have a significant drop in 2020. The Scope 2 emissions increased in 2018 and 2019, even though they got reduced over the first three years of the period and it has been increased again in 2020 at 223 tCO_2e. Again, COVID-19 may have had some effect on the GHG levels in 2020. Less than 1% of The Town's total GHG emissions is attributed to Others including parking garage, meters, splashpads and outdoor washrooms.

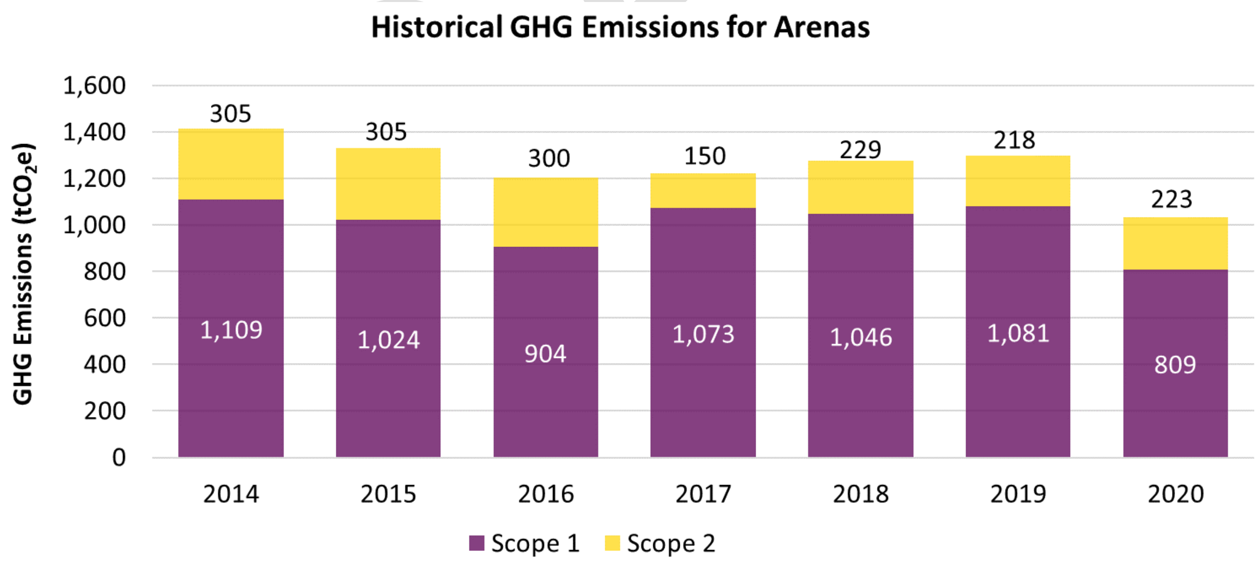


Figure 9. *Historic Emissions Trends for the Arenas*

3.4. The Town of Oakville GHG 2020 Inventory

The Town's 2020 GHG footprint includes Scope 1 & 2 emissions. The breakdown of emissions by Scope is similar year over year. The highest contributors to The Town's GHG emissions are Diesel and natural gas (Scope 1), and electricity (Scope 2). Figure 10 below illustrates the share of various GHG sources for all Scope 1 & 2 combined for the year 2020, aggregated for all buildings and facilities – Community Centers, Operations and Admins and Arenas. Figure 10 below shows Diesel with 42.8% is the largest contributor of The Town's total emissions. For this reason, diesel has been broken down into diesel transit and diesel fleet to give a better view of their contributions separately.

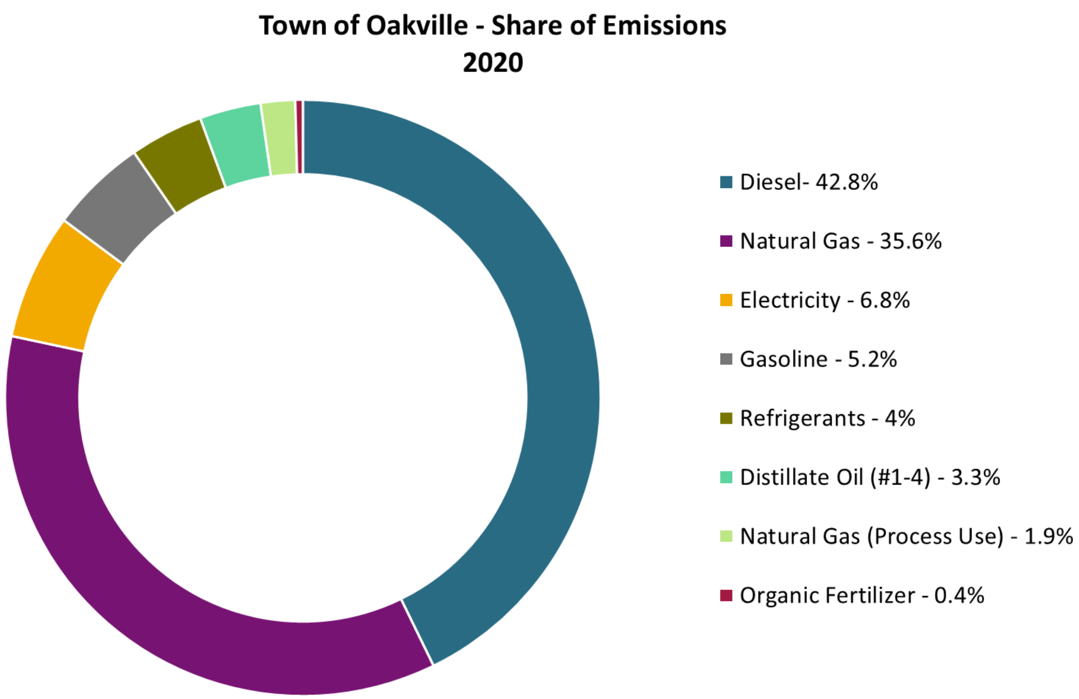


Figure 10. *Share of Various GHG Sources for Scope 1&2 in 2020*

Scope 1 represents most of the total corporate GHG emissions, which are primarily from diesel and natural gas as shown in Figure 11. Of The Town's scope 1 emissions 11.12% are produced by diesel fleet and 34.79% by diesel transit which represents ~46% of the total scope 1 emissions. Emissions reductions strategies, including electrification, that target the use of natural gas and diesel will result in the most significant decreases in Scope 1 emissions.

Only about 8% of Ontario's total power generated from natural gas plans which results in relatively clean electricity grid at 40 g CO_2e.

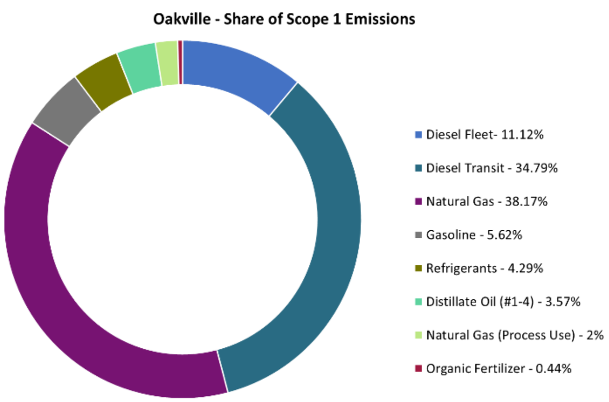


Figure 11. *2020 Scope 1 Emissions and Sources*

3.5. Growth

In 2014, The Town's total size of corporate facilities-Community Centers, Operations and Admins, and Arenas was 2,078,734 sq. ft (please note that this total square footage includes some buildings which have been reportedly sold or have no energy data). This real estate size stayed stable by 2018 and there is a modest increase by 2019 to 2,083,273 sq. ft. The annual growth trends are summarized in the graph below.

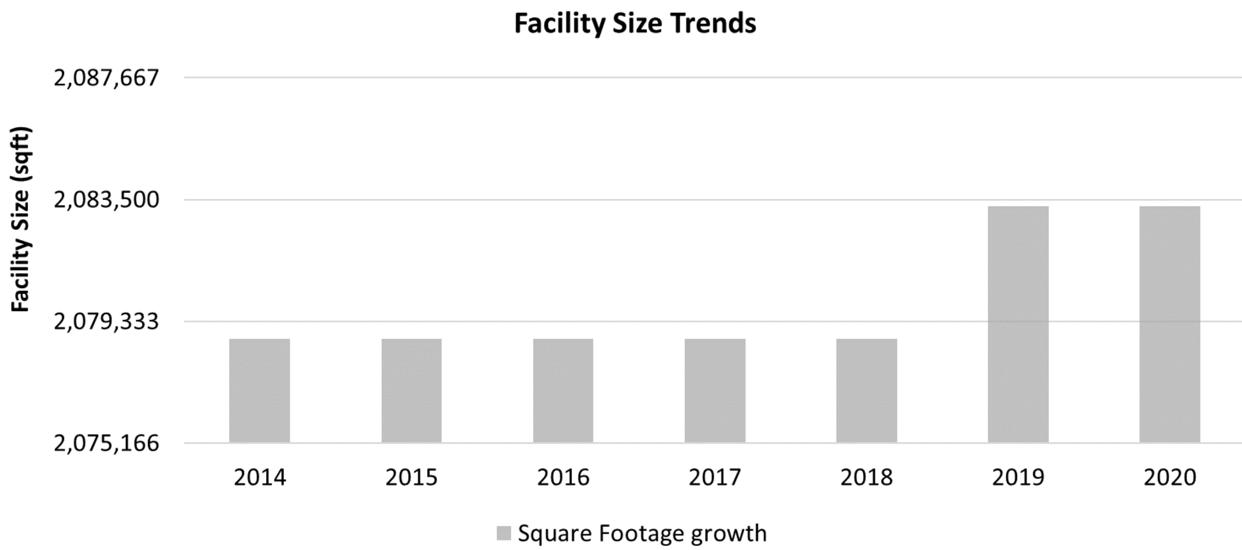


Figure 12. Historic Growth Trends

When analyzing data from the baseline year-to-date and forecasting trends to estimate The Town's expected facility size growth by 2022, 2030 and 2050, there is only one important factor to consider, the increase in corporate facilities' square footage. Every day The Town will need more facilities for the residents and expansions will be added to existing buildings, and new facilities will be constructed to provide residents' demands. As this factor increases, it is expected that total GHG emissions will increase as well.

For Scope 1 and 2 emissions, it is assumed that electricity and natural gas consumed per square foot is constant (2020 level). As square footage increases, the emissions rise proportionally though neglecting (directly) any energy conservation measures in any specific building.

3.5.1. The Town of Oakville Growth

Scope 1 and 2 emissions for the years 2014 to 2020 are modelled against the increase in square footage. Historically, increases in emissions and square footage follow an almost linear growth pattern. The scope 1 emissions had a moderate reduction in 2016 and then a small increase over 2017 and 2018. However, by 2019 there was a facility growth of 4,539 sq ft which resulted in a growth of scope 1 emissions at 1,307 tCO_2e.

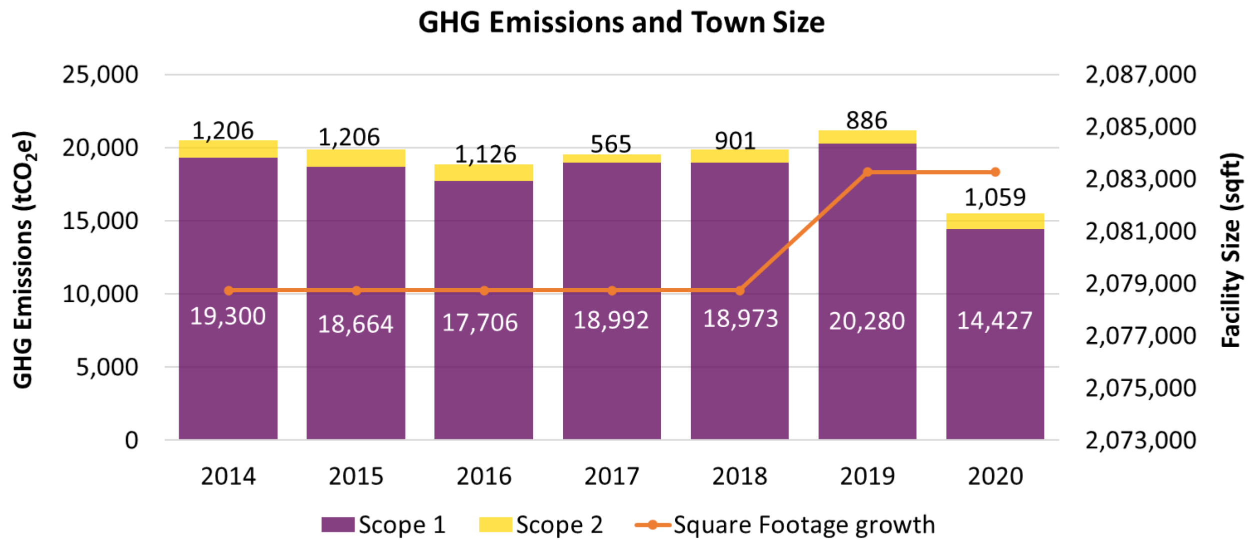


Figure 13. *Historic GHG Emissions Relative to The Town Size*

3.6. Business as Usual (BAU) Emission Forecast

The following assumptions were considered to model The Town's forecasted emissions. Growth assumptions are based on Blackstone's experience and Statistics Canada.

Table 3. *Growth Assumptions for The Town*

Annual Growth Assumptions	Community Centers	Operations and Admins	Arenas
Facility Growth (sq. ft)	5% every 10 Years		

Figure 14 below demonstrates the business as usual (BAU) increase in The Town's total forecasted GHG emissions compared to The Town's target emissions level. It is expected that, by 2030, The Town's total emissions will be 17,138 tCO_2e, which is ~733 tCO_2e above its target for that year. Keeping with this trend, The Town's total emissions will be 19,321 tCO_2e in 2050 if no conservation or GHG mitigation strategies are implemented, this amount will be 15,220 tCO_2e above the GHG target of 2050. These findings are further explained in the graph below.

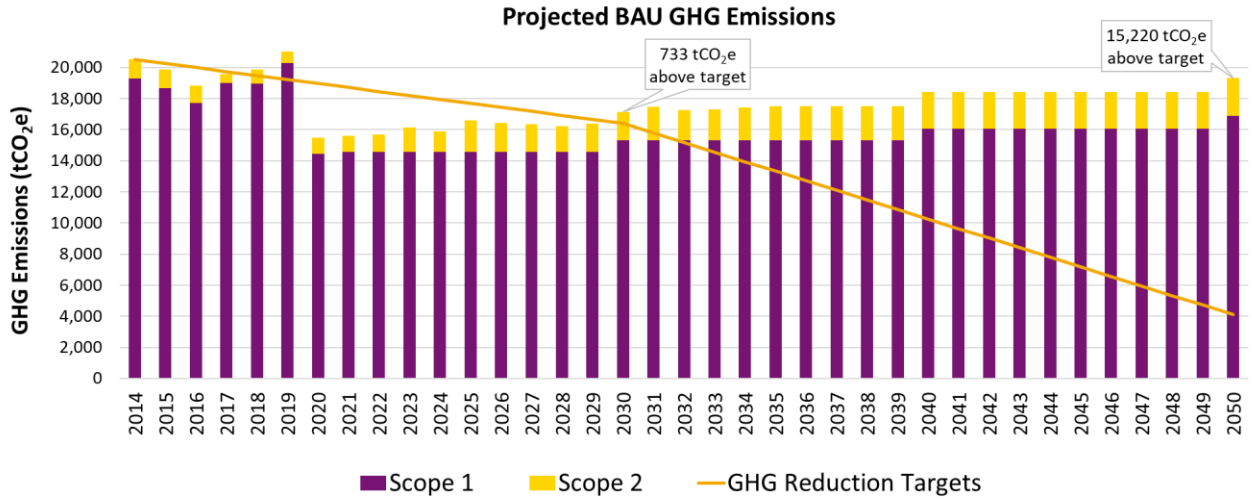


Figure 14. *Projected Business as Usual GHG Emissions*

4. Pillars of Carbon Reduction Roadmap

To reach The Town's reduction carbon target, the following factors were analyzed in conjunction with a study of their HVAC+L infrastructure, utility portfolio, projected facility size growth and the potential for renewable energy generation. To meet its 2030 and 2050 GHG emissions targets, The Town's GRRAP will be centred around the following four pillars, as previously mentioned:

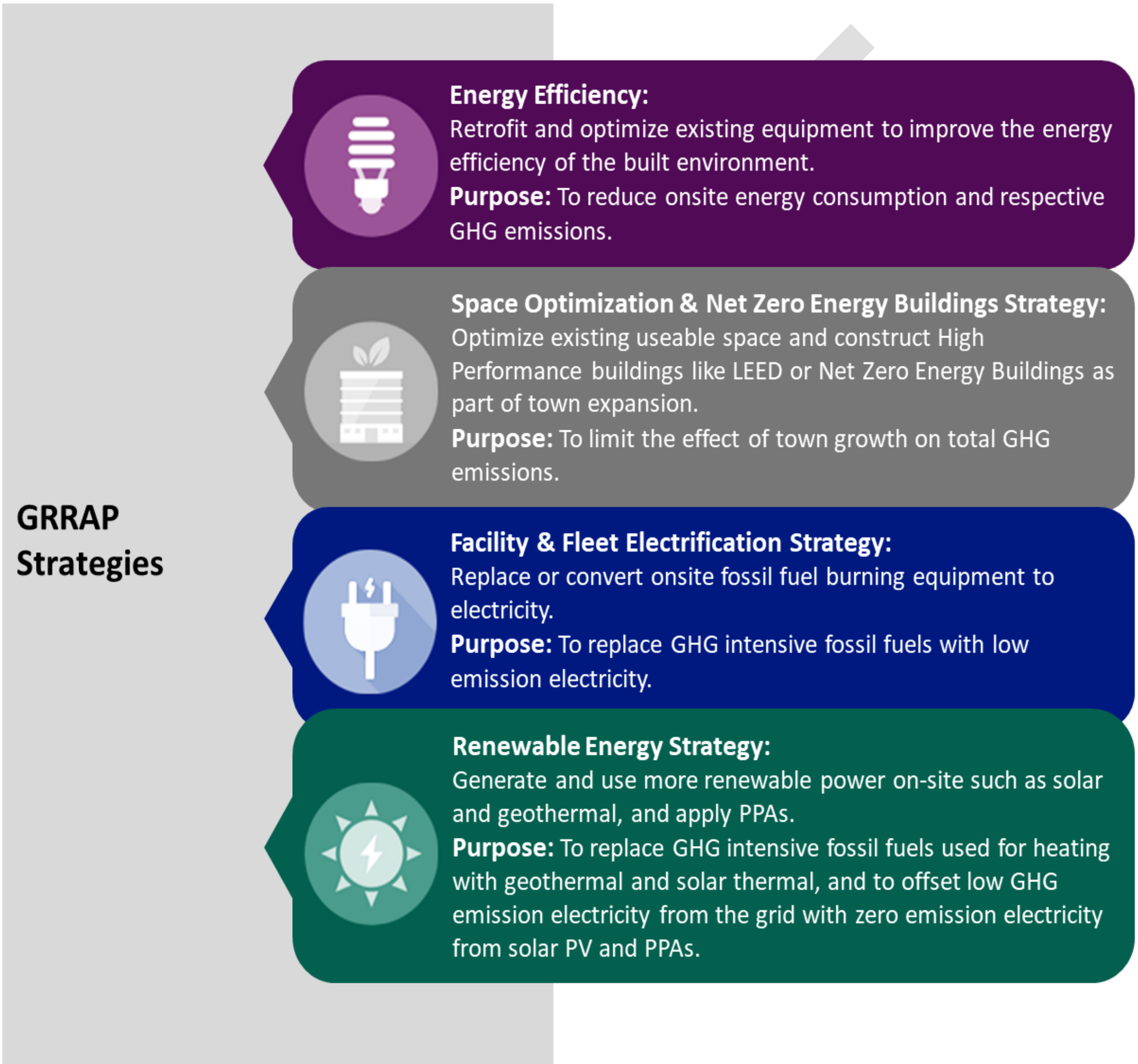


Figure 15. *GHG Reduction Pillars for the GRRAP*

4.1. Pillar 1: Energy Conservation & Demand Management

Energy Conservation and Demand Management (ECDM) refers to The Town's ongoing commitment to energy management and the improvement of Town-wide energy efficiency. ECDM measures reduce Scope 1 and Scope 2 emissions through facility upgrades, energy efficiency improvements and renewable energy projects. The estimated savings and GHG reductions associated with the implementation of the ECDM, and measures and renewable energy generation planned from 2022 to 2028 are summarized in the table below. Note, the table below does not include the renewable energy systems recommended by the RE report.

Table 4. *Estimated Annual Savings from Pillar 1 Initiatives*

ECDM Summary	2022 - 2024	2025-2028	
Total Investment in Conservation	$9,757,773	$2,329,801	**$12,087,574**
Electricity Savings (kWh)	5,636,456	0	**5,636,456**
Electricity Cost Savings	$799,192	$0	**$799,192**
Gas Savings (m3)	140,176	166,645	**306,821**
Gas Cost Savings	$40,214	$53,466	**$93,680**
Total Utility Savings ($)	**$839,406**	**$53,466**	**$892,872**
GHG Reduction (tCO_2e)	**554.11**	**314.96**	**869.07**

The Town should continue to be committed to creating a culture of ECDM and should update the ECDM Plan on a five-year renewal timeframe. To implement all measures identified in the EDCM Pillar, The Town would need to invest $12,087,574 over 6 years. Once completed, the ECDM measures will save electricity and natural gas and reduce GHG emissions by 869.07 tCO_2e annually. The detailed list of measures covered under the ECDM Pillar can be found in Appendix 2.

4.2. Pillar 2: Space Use Optimization & Zero Carbon Buildings

The built environment is a crucial element in The Town – community and corporately. As such, it is important for their spaces such as community centers, parking, parks, libraries, Town halls, etc., to be well maintained, efficient, resilient, and have the flexibility to support new municipal demands. Space use optimization and zero-carbon building designs provide opportunities for The Town to meet the needs of its community while remaining in alignment with their GHG emission reduction targets.

4.2.1. Space Use Optimization

Space utilization analysis is a tool that can help The Town uncover which areas in the buildings are underused, why they are underused, and how to best move forward to improve space utilization. For example, space utilization will point out when and where HVAC systems are being operated for spaces that are not fully occupied and too large for the number of people using the space.

Space utilization audits provide a data-centred assessment of the condition of building stock and the state of deferred maintenance. This is coupled with insights on how relocating certain activities could better centralize multiple facilities. It can also help with the development of a capital allocation plan to achieve desired improvements.

Space utilization audits provide insights into wasted space and outline how rethinking existing assets can achieve cost-savings goals previously thought to be out of reach. Municipalities have spaces that are designated for " more general use" (rooms that can be used for multiple municipal purposes such as community Centers) and other spaces that are considered "owned-space" (parking, libraries, Arenas, central depots). A space utilization audit would identify the potential positive and negative impacts, as well as barriers, to The Town implementing a policy to release "owned" spaces for general assignment.

Indoor space mapping, combined with real-time occupancy and schedule monitoring, determines how existing spaces can be better utilized. Space-sensing technology, combined with building automation systems (BAS), can support energy-saving lighting and HVAC optimization, further reducing total GHG emissions.

Space use optimization is a preventive measure against building new spaces. By maximizing the use of the existing built environment and underutilized spaces, and using technology and data analysis, space utilization can give municipalities useful information to avoid unnecessary new construction projects. It is a useful tool to evaluate if expansion requirements can be met by effective utilization of existing spaces, avoiding the significant costs associated with new construction and operations and maintenance required for the new space. Proper space utilization combined with high-performance design standards will promote correct sizing and operation leading to consistent and repeatable energy/GHG reductions.

Case Study 1: Space Optimization – Compatible Technology

Cloud computing, artificial intelligence analytics and internet-connected sensors allow BAS to continually re-adjust temperatures. These adjustments are based on real-time data from occupancy and humidity sensors, commands from individual users via mobile or desktop applications, exterior temperature readings and predictions based on historical patterns of user behaviour, and time-of-use energy pricing policies in Ontario[2]. Smart heating, ventilation and air conditioning controls can limit energy consumption in unoccupied building zones, detect and diagnose faults and help reduce HVAC usage during times of peak energy demand.

As an example, the setup and functions of GE Current's smart office system are demonstrated below.

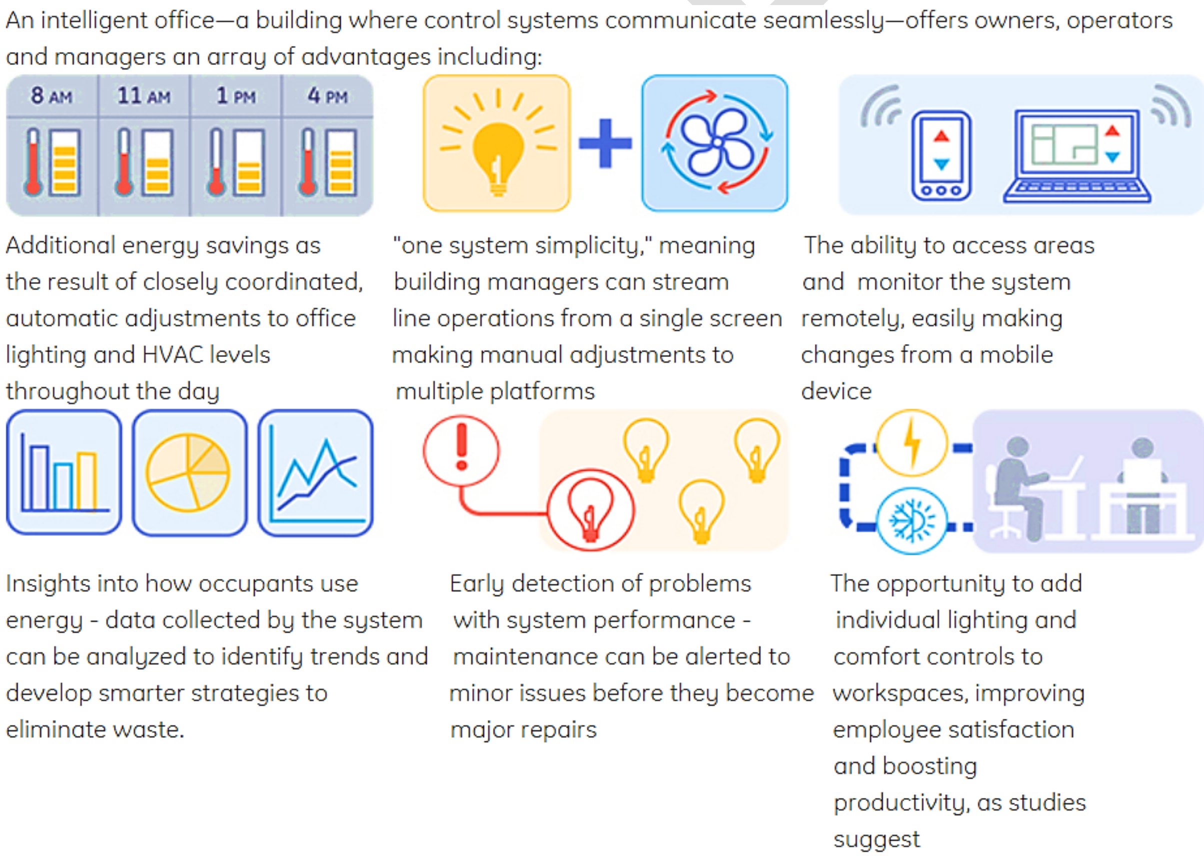


Figure 16. *GE Smart Office System*

[2] GE Current: How to build an intelligent office https://www.currentbyge.com/ideas/how-to-build-an-intelligent-office

Case Study 1: Space Optimization – Compatible Technology

Integrating smart office technology in operations has many advantages:

- Space availability and booking are dynamically adjusted based on occupancy and proximity.
- Hoteling or desking opportunities are created for remote workers, enabling effective use of underutilized space.
- Tracking equipment and furniture use can be implemented to improve logistics, facility operations and resource management.
- HVAC and lighting can automatically adjust to room occupancy.
- Up to ~20% annual utility cost savings can be achieved across typical office environments[3].
- Networked lighting control and BAS create energy management strategies that:
    - Enable facilities to never forget to flip the switch when leaving a room
    - Empower users to personalize their lighting and temperature controls
    - Set up facilities that coordinate lighting, heating, and cooling for optimum operational efficiency

[3] Brasington, 2019: Smart Buildings – Innovation in Space Utilization
https://www.cleantech.com/smart-buildings-innovation-in-space-utilization/

4.2.2. Zero Carbon Buildings

The design, and operation of new and renovated spaces can have a significant impact on total GHG emissions for a long time. Environmental performance measures that promote sustainable new and retrofit development have a significant impact on the energy, GHG and comfort characteristics. Buildings in the corporate portfolio tend to be retained for long lives meaning a structure built today will still be in use past 2050 – designs now will impact carbon loads in a time when low to zero carbon buildings will be the norm and carbon fees could be very high relative to the cost of the actual fuel itself. Low to zero carbon building (L-ZEB) designs will help The Town to reduce its carbon presence now and continue to keep GHG levels low as the building ages.

There are several existing L-ZEB standards and guidelines The Town can refer to and tailor to their own needs and circumstances. A dominant concept is to define absolute performance metrics for new builds and renovations. This refers to defining fixed energy and GHG performance as units/m^2, such as kWh/m^2 and kg CO_2/m^2. Selecting these performance indices with The Town's GHG goals for 2030 and beyond will guide new developments and renovations to assist in meeting the targets without compromising the path.

For example, the Toronto Green Standards, British Columbia Step Program and Canadian Green Building Council (CaGBC) – all with best practices standards, have been shown to drive high-performance construction without causing insurmountable incremental costs while yielding reduced life cycle energy and carbon costs. These typically reference the current Building Code requirements and are updated at the same time the Codes are. In the case of The Town, we recommend setting design standards that surpass the requirements of the current Ontario Building Code (OBC) including the Supplementary Bulletin 10 before the Code is updated to allow for planning cycles and permitting. For example, The Town could pursue zero carbon building standards for new builds as an upper-tier design target.

These standards differ slightly but are all focused on designing high-performance buildings that can be augmented (or in some cases, totally) by renewable energy sources. The more energy-efficient a building is constructed to be, the less energy is required to power the building which also means any renewable energy will have a more significant impact.

With high-performance design goals, the architectural/engineering teams would be required to pursue L-ZEB concepts from the beginning. For example, by considering solar panel location, shading and designs with surfaces at a specific angle to optimize the solar access. Other considerations such as roof gardens or green walls would enhance these buildings with carbon sequestration and rain surge mitigation by green space. Location and orientation of the building on the site considering natural ventilation and daylighting can be addressed as an energy-saving concept early in the design process. In general, the standards should promote passive design features along with high-performance design elements in the envelope to keep energy and GHG levels to their lowest possible.

Benefits of an L-ZEB design/renovation are:

1. Reduced energy and carbon costs
2. Improved thermal autonomy
3. Improved resilience against extreme weather events.
4. Improved and consistent thermal control
5. Attention to and use of daylighting
6. Improved ventilation efficacy
7. Improved and consistent comfort levels

8. More consideration for the impact on the surrounding environment – exterior lighting, bird impacts, water retention, heat island, public transportation

Blackstone recommends that The Town develop their own high-performance standards tailored to their portfolio archetypes and include elements of best practices standards/guidelines (such as TGS, BC Step, CaGBC and LEED).

The New Buildings Institute studied the cost and savings from the construction and operation of ZCB. In the study, costs were separated into two categories: 1) the incremental costs for energy conservation measures and 2) the costs for the purchase and installation of renewable energy systems. By increasing energy efficiency, the number of renewable energy systems (and therefore the cost) will be reduced. The Institute also extended the framework to retrofits and refurbishment of existing buildings to net-zero carbon by considering the design strategies listed in Figure 17 below.

***Figure 17**. Design Considerations for High Performance Buildings*

The average construction cost of office space in Ontario is an estimated $300 per square foot (sq. ft), compared to the average cost of a LEED building in Ontario, which was found to be ~$295/sq. ft. A ZCB is estimated to add approximately 13% to the cost premium of LEED buildings. The differences in cost for The Town expansion are estimated in Table 5 below.

Table 5. Capital Cost Considerations for Zero Carbon Buildings

Construction Type	$ / sq. ft		Example Facility Expansion in 2028	Estimated Total Cost (2028 $)
	2018 $	2028 $		
Building Code	$270	$315	100,000 sq. ft	$31,500,000
LEED Gold Construction	$295	$339		$33,900,146
ZCB Construction	$320	$368		$36,800,000

Although construction of a ZCB comes with a cost premium of 13%, there are long-term financial savings in building the Zero Carbon Standard. A typical ZCB has an annual utility and maintenance cost savings of approximately 26% when compared with a LEED construction project[4]. This is shown in Table 6 below.

Table 6. Comparing LEED & Zero Carbon Buildings

	LEED Construction	Zero Carbon Buildings	Savings
Addition to Community Centers (sq. ft)	100,000	100,000	-
Estimated Construction Costs ($/sq. ft)	$295	$320	-
Estimated Construction Costs	$29,500,000	$32,000,000	-$2,500,000
Annual Natural Gas and Electricity Utility Cost ($/sq. ft)	$1.49	$0.97	26%
Estimated Annual Utility Expense	$148,532	$96,546	$51,986
Simple Payback (Years)	-	-	48
Simple Payback with Utility Rate Escalation (Years)	-	-	34

Investing an additional $2,500,000 to construct a ZCB would generate an annual utility cost saving of $51,986 and would result in a 48-year payback based on additional construction costs and at current utility rates. However, when accounting for the escalation of utility rates, the payback for a ZCB goes down to 34 years.

Consideration must also be given to the cost of carbon and how it will increase over the next 9 years. In all cases, we recommend a life cycle cost analysis be followed that includes the cost of carbon and best estimates for the cost of utilities. The comparison timeframe should be 15 years minimum. Note that current photovoltaic warranties are 25 – 30 years with an 80% of nameplate at end of the warranty. This timeline should be used when PV is being considered for electrification planning.

[4] Canada Green Building Council & WSP, 2019: Making the Case for Building to Zero Carbon.

Case Study 2: Zero Carbon Buildings

Completed in Fall 2018, "evolv1" is a three-story, 110,000 sq. ft commercial multi-tenant office building and one of 16 participants in CaGBC's Zero Carbon Building pilot program.

Figure 18. *Evolv1 in Waterloo, ON*

Building highlights:

- Modelled as zero carbon balance for future operations.
- Incorporated a highly efficient energy and ventilation system to meet a defined threshold for thermal energy intensity.
- Designed onsite renewable energy systems capable of providing a minimum of five percent of building energy consumption.

The building's design includes elements aimed at maximizing its energy efficiency and producing more energy than it consumes:

- High-performance building envelope.
- Geo-exchange/variable refrigerant flow (VRF) HVAC system.
- Triple pane glazing.
- Solar wall for preheated ventilation.
- Combination of a carport and roof-mounted photovoltaics producing 700kw of electricity for the grid.
- Three-story green wall to improve indoor air quality.

Estimated construction cost:

$318/sq. ft (without interior fit-out)

4.3. Pillar 3: Facility & Fleet Electrification

To meet The Town's 2050 GHG emission target, they must transition away from fossil fuel-based energy consumption and move towards low-carbon alternatives. Total facility and fleet electrification would entail the complete conversion of onsite equipment, including natural gas-fired boilers and HVAC equipment, natural gas cooking equipment, as well as fleet gasoline and diesel vehicles.

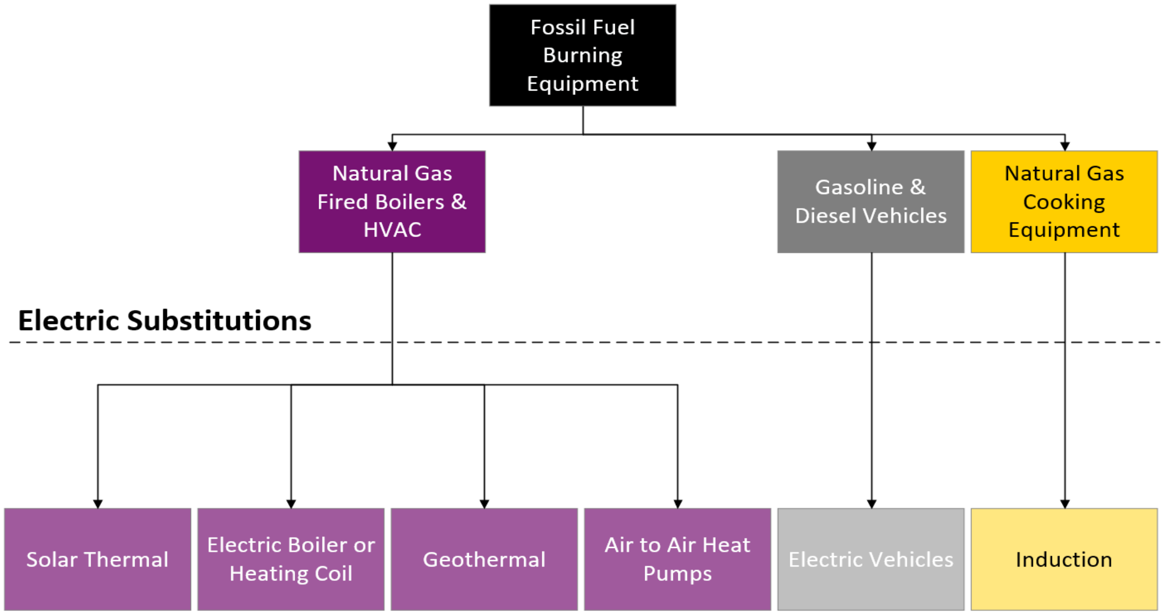
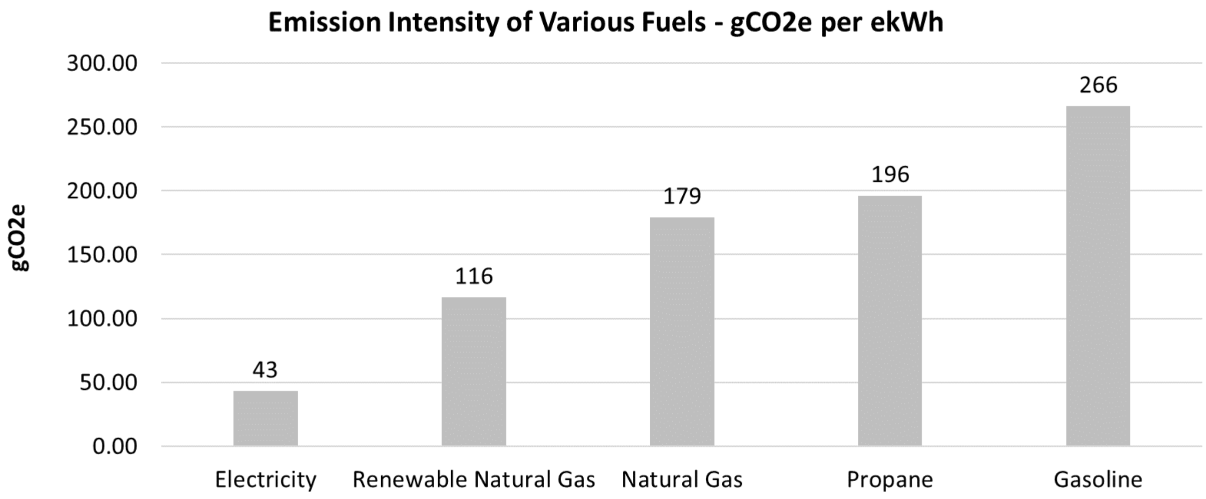


Figure 19. *Electric Equivalents for Traditional Equipment*

When comparing natural gas and electric systems, electric systems produce fewer CO_2e emissions per kWh consumed. Comparatively, 1 kWh of electricity would emit 40g of CO_2e while 1 equivalent kWh (ekWh) of natural gas would emit 179 g of CO_2e (note that some databases will show slightly different factors depending on the source) The carbon content of various fuels converted to equivalent kWh is



represented in Figure 20.

Figure 20. *Emissions Intensity of various Fuels for Equivalent Energy Output*

Source: National Inventory Report: Greenhouse Gas Sources and Sinks in Canada.

Based on the timeline and rate of electrification, two actions were developed: aggressive action electrification and delayed action electrification. We understand The Town is considering the purchase of some electric buses to supplement the transit fleet. This has not been taken into account though we encourage the switch to non-diesel transit whenever possible. The net carbon accounting will include the difference between the electric emissions and diesel for the year.

Under the aggressive and delayed actions, it is expected that The Town will fully implement the projects needed under Pillars 1, 2 and 4.

The actions were based on the expected asset end of life characteristics using ASHRAE standards (see Table 8) and applied to The Town's equipment list. For example, as each natural gas-fired air handling unit (AHU) approaches the end of life, the GRRAP considered the cost and carbon reduction associated with replacing it with an electric equivalent or high-efficiency natural gas replacement. Depending on the current age of the equipment, it may be replaced approximately two times with similar natural gas equipment before being replaced with low carbon electric equivalents, as shown in Table 7.

Table 7. *Sample Replacement Schedule for Fossil Fuel Equipment*

Facility	Initial Installation Date	Estimated Replacement Schedule		
Community Centers	1999	2020	2035	2050
Potential Fuel Source →	Natural Gas	Natural Gas	Natural Gas	Electric

As part of Pillar 3, replacing equipment at the end of its life expectancy creates a decision point for The Town to assess whether the equipment should be replaced with electric equivalents or conventional natural gas systems. Under the aggressive action, The Town will replace fossil fuel burning equipment at the *first* end-of-life replacement cycle and with an electric equivalent. Under the delayed action, it will defer electrification and convert equipment at the *final* end-of-life replacement cycle before 2050. In all cases, energy conservation measures should be pursued so that replacement equipment is "right-sized" according to efficient operations, further improving the energy/GHG performance over the life of the equipment.

The following table shows the life expectancy of equipment and the last date of potential installation for fossil fuel burning equipment.

Table 8. Fossil Fuel Burning Equipment Expected Life Table

Fossil Fuel Burning Equipment	Expected Life (Years)[5]	Last Date of Potential Installation / Replacement
Boiler	20	2030
Make-up Air Unit / Air Handling Unit – Interior Installation	25	2025
Make-up Air Unit / Air Handling Unit – Exterior Installation	15	2035
Cars / Trucks	10	2040
Cooking Equipment	15	2035

**Expected Life - ASHRAE Equipment Life Expectancy Chart*

Under the aggressive and delayed actions, The Town will increase its electrification efforts and reduce its GHG emissions from natural gas-based equipment. The sooner The Town invests in electric systems, the quicker it will reduce emissions and be on track to achieve GHG reduction goals. The following chart depicts the potential replacement (under each action) for fossil fuel-burning equipment during the process of electrification (based on currently available technologies). The types of equipment that make up these measures are boilers, MAUs and AHUs.

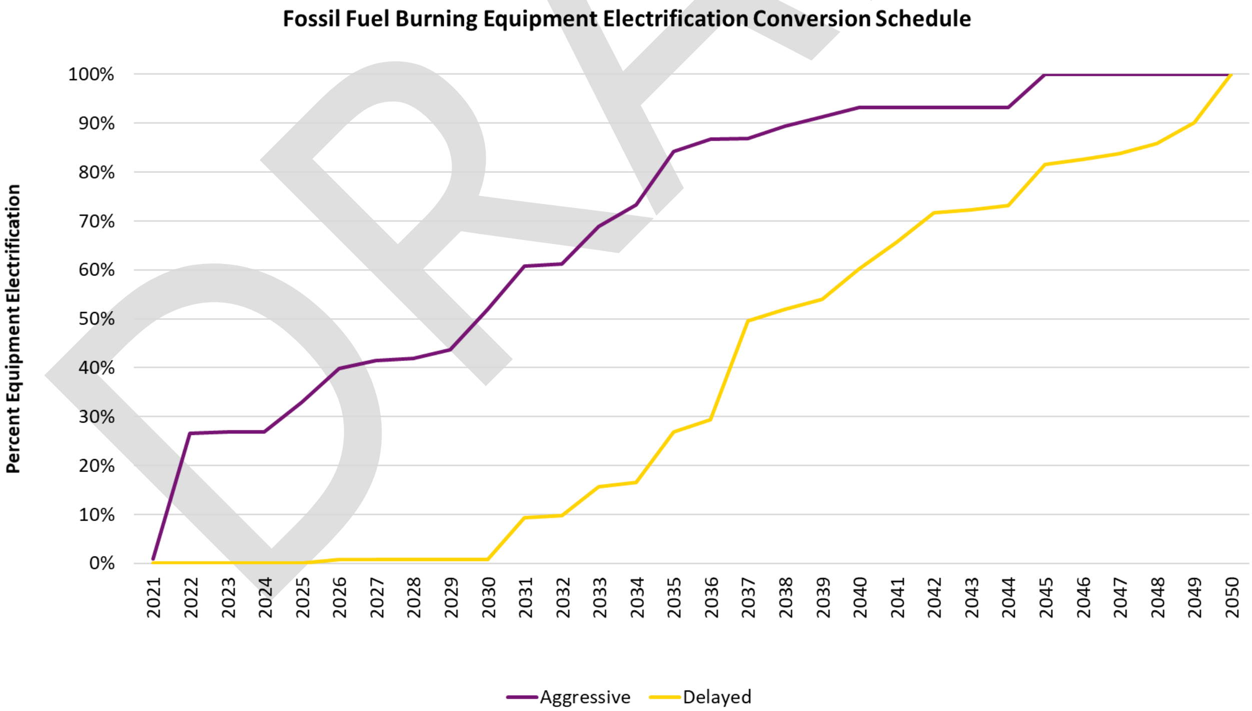


Figure 21. *Equipment Electrification Conversion Schedule*

[5] ASHRAE Equipment Life Expectancy Chart

4.4. Pillar 4: Renewable Energy Generation

Solar photovoltaic (PV) is a proven, low-maintenance and cost-effective form of renewable energy. High-level estimates indicate The Town could install 1,094 kW of carport systems and produce 1.71 million kWh of renewable power per year, rooftop systems also could produce 2.53 million kWh/yr. with 2,204 kW installation. This estimate is based on the information available during the period of this study and the actual number could vary depending on multiple factors such as changes to the master plan, connection capacity, and parking plans.

Carports provide a great opportunity to produce renewable power when space constraints on a building are a concern. Carport solar PV systems are a highly visual symbol of The Town's commitment to sustainability and portray them as actively looking for low carbon solutions. The steel structures (or canopies) required to hold the solar panels typically make carport PV systems about twice as expensive to install as rooftop PV systems.

The limiting factor for renewable energy generation is the space requirement per kilowatt (kW) installed. Based on estimates of the rooftop solar potential for The Town, using current solar technology efficiency estimates and assuming the roof space can take the load, the existing facilities can accommodate about 1,040 kW of rooftop solar PV at an estimated cost of ~$1,850 per kW. Solar PV is typically net-metered to the local grid system. The amount produced would contribute to lowering The Town's Scope 2 emissions by reducing the amount of electricity it purchases from the grid. A more detailed renewable energy study has been completed which illustrates how low carbon solutions could be implemented across the corporate portfolio. The estimates here are a snapshot of the opportunities within The Town. See the more detailed report for concepts with more information regarding areas, costs, and performance.

PV technologies being applied more often are the building integrated and building applied photovoltaics more available (BIPV and BAPV). Case Study 3 in the following pages elaborates on the BIPV and BAPV systems, their space and cost considerations.

Other forms of solar technology – hot water and heated air, are not as popular due to the current low cost of natural gas. However, when the cost of carbon is included over the next 9 years, these technologies might be feasible for The Town and should be considered. The following table illustrates the potential for solar hot water systems at some selected sites. These sites were chosen based on solar access and estimated solar energy contribution capacity. These systems were estimated based on contributing ~20% of the annual natural loads, which is a common metric for commercial hot water loads. The solar fraction amount of hot water that can be supplied by solar energy, was assumed at 20% annually. The tonnes avoided per year are based on all current hot water loads being supplied by natural gas heaters. The technology used to estimate the performance is the vacuum tube with storage tanks and circulating a water/propylene glycol mixture.

Table 9. *Estimated opportunities for solar hot water at select sites.*

Archetype	Site	2019 m3	Est DHW, m3	Target SDHW, m3/yr.	GHG saved tonnes/ yr.	Proposed Solar water est. cost	$/yr. Saved	$/ tonne
Community Center	Glen Abbey	353,953	70,791	14,158	268	$154,000	$4,247	$576
Community Center	Iroquois Ridge	311,548	62,310	12,462	236	$143,000	$3,739	$607
Community Center	Queen Elizabeth Park and Community Centre	218,849	43,770	8,754	165	$110,000	$2,626	$665
Community Center	River Oaks	218,048	43,610	8,722	165	$110,000	$2,617	$667
Community Center	Trafalgar Park Community Centre	167,431	33,486	6,697	127	$99,000	$2,009	$782
Operations and admins	Fire Station #3	24,521	4,904	981	19	$44,000	$294	$2,374
Operations and admins	Transit Facility	537,745	53,775	10,755	203	$132,000	$3,226	$649
Arenas	Joshua Creek Arena	165,526	33,105	6,621	125	$99,000	$1,986	$791
Arenas	Maple Grove Arena	31,583	6,317	1,263	24	$46,200	$379	$1,935
Arenas	16 Mile Sports	349,377	41,925	8,385	158	$107,800	$2,516	$680
Operations and admins	North Operations	62,403	7,488	1,498	28	$107,800	$449	$3,808
	Total	**2,440,984**	**401,481**	**80,296**	**1,518**	**$1,152,800**	**$24,088**	**$759**

Another solar heating system that has been in use for over 35 years is Solar wall technology. This is an aspirated wall with perforations on the surface of a metal wall attached to the outside wall which is heated up by the sun then draws air in and then into an air duct connected to the pre-heat section of a rooftop unit. This concept pre-heats outside air before it has to be warmed up by a natural gas (typically) coil inside the rooftop unit. Recognizing that only a fraction of the required air in a building is drawn from the outside, these systems are estimated at ~7% of the estimated ventilation loads.

Table 10. Performance for solar pre-heated air at select sites.

Archetype	Site	Est Air preheat, m3	GHG saved, tonnes	Est wall area sq. ft	Solar wall cfm	Estimated solar wall cost
Community Center	Glen Abbey	24,777	468	4,955	11,893	$297,000
Community Center	Iroquois Ridge	-	-	-	-	$-
Community Center	Queen Elizabeth Park and Community Centre	15,319	290	3,064	7,353	$198,000
Community Center	River Oaks	15,263	288	3,053	7,326	$187,000
Community Center	Trafalgar Park Community Centre	-	-	-	-	$-
Operations and admins	Fire Station #3	-	-	-	-	$-
Operations and admins	Transit Facility	37,642	711	7,528	18,068	$473,000
Arenas	Joshua Creek Arena	-	-	-	-	$-
Arenas	Maple Grove Arena	-	-	-	-	$-
Arenas	16 Mile Sports	24,456	462	4,891	11,739	$297,000
Operations and admins	North Operations	4,368	83	874	2,097	$66,000
Totals		**121,825**	**2,302**	**24,365**	**58,476**	**1,518,000**

Both of these solar heating concepts have been in use (in Ontario) for over 40 years. They have not been as popular over the last 10 years due to the low price of natural gas. Now, with the cost of carbon to be taken into account, they should be reconsidered for any renovations and new buildings where hot water and/or air pre-heat is required. The following table illustrates the estimated benefit due to reduced natural gas use for these solutions. Though these are high-level estimates and assuming the systems can be installed, savings on the order of $3 million over the next ~9 years can be predicted on an installed cost of ~$3 million of both solar water and air pre-heating. This implies paybacks on the order of 12-15 years for solar heating (also assuming natural gas commodity prices do not increase significantly over the next 9 years).

Table 11. *Estimated carbon saved and carbon costs avoided from solar heat systems, 2022 – 2030*

Archetype	Site	Solar Hot Water; 2022-2030		Solar Air pre-heat; 2022-2030	
		Tonnes	$	Tonnes	$
Community Center	Glen Abbey	2,408	$26,491	4,215	$509,957
Community Center	Iroquois Ridge	2,120	$23,317	-	$ -
Community Center	Queen Elizabeth Park and Community Centre	1,489	$16,380	2,606	$315,306
Community Center	River Oaks	1,484	$16,320	2,596	$314,152
Community Center	Trafalgar Park Community Centre	1,139	$12,531	-	$-
Operations and admins	Fire Station #3	167	$1,835	-	$-
Operations and admins	Transit Facility	1,829	$20,123	6,403	$774,754
Arenas	Joshua Creek Arena	1,126	$12,389	-	$-
Arenas	Maple Grove Arena	215	$2,364	-	$-
Arenas	16 Mile Sports	1,426	$15,689	4,160	$503,364
Operations and admins	North Operations	255	$2,802	743	$89,907
	Totals	**13,658**	**$150,241**	**20,723**	**$2,507,440**

The table above illustrates the impact carbon costs will have on natural gas use for heating. Avoiding these costs using solar energy where feasible will assist The Town in meeting their 2030 and beyond GHG reduction goals and should be reviewed in more detail.

Case Study 3: Building Integrated and Building Applied Photovoltaics (BIPV and BAPV)

Recent PV technology improvements are making building integrated and building applied photovoltaics more available (BIPV and BAPV). The difference between the two is that BIPV is when the PV is a part of the building such as embedded into the windows or forms the actual envelope, whereas BAPV is when the PV system is mounted onto the building such as the roof or vertical racking onto a wall.

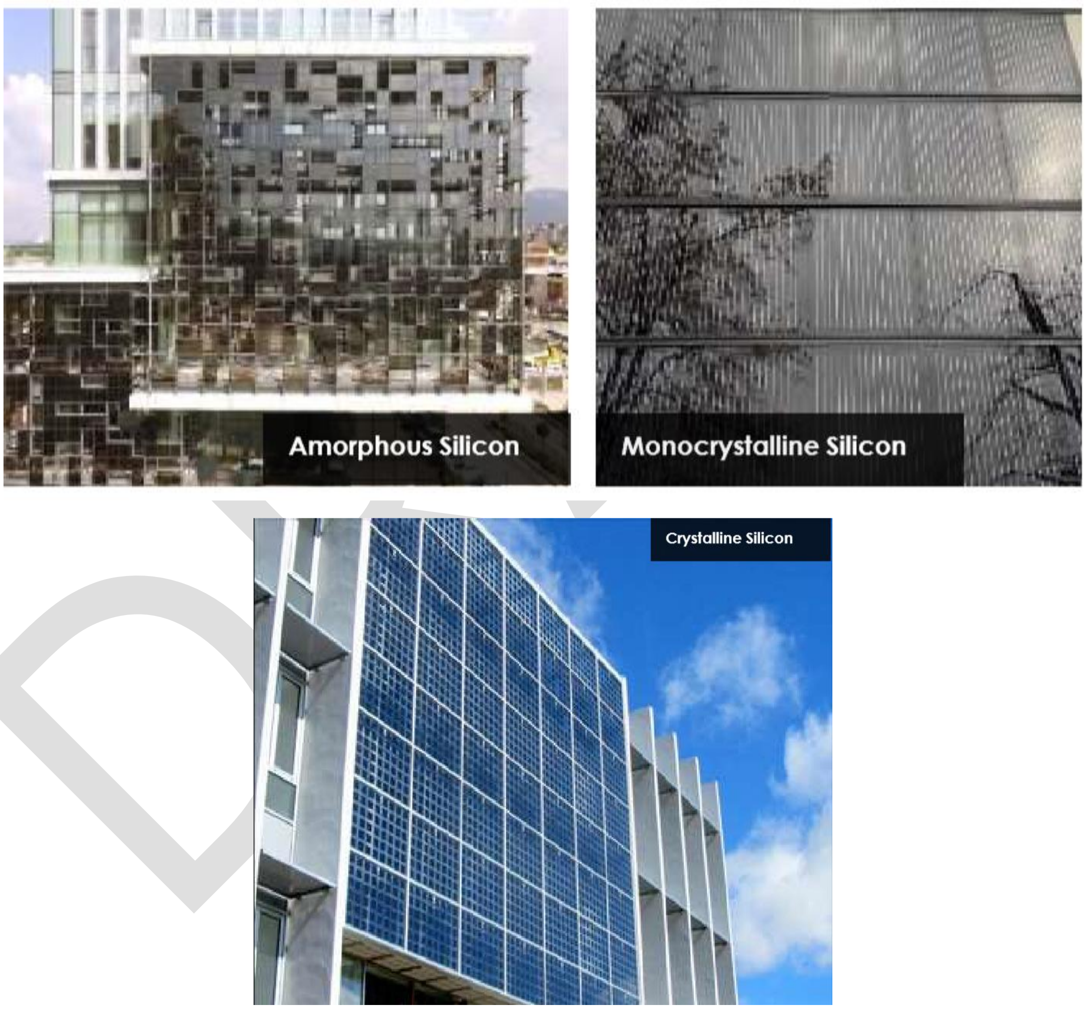


Figure 22. *Examples of BIPV & BAPV*

Case Study 3: Building Integrated and Building Applied Photovoltaics (BIPV and BAPV)

Some examples of BIPV – the PV modules are a part of the envelope. These can be customized with a range of transparencies and limited colours. The lower left image shows crystalline modules; the right is amorphous.

BIPV applications are typically considered from the start of a new building as the architect is generally the lead to make sure the “look”, style and appropriate design teams are involved – i.e., structural, electrical. If an envelope BIPV system is being considered, the existing wall will be removed and the new BIPV envelope installed. Other examples of BIPV are the skylight and window style of BIPV, which will require a structural survey as well and best coordinated with a design team to ensure compatibility with the building style and envelope integrity.

An alternate version is the building applied PV or BAPV. In this case, the PV array is mounted onto the structure. A fixed or ballasted PV array on a roof is an example of this arrangement and is very common. Wall-mounted PV can be hung onto the wall using a racking system or used as an awning over windows to provide some shading as well as power.

Figure 23. *Examples for mounting of BIPV & BAPV*

Case Study 3: Building Integrated and Building Applied Photovoltaics (BIPV and BAPV)

BIPV and BAPV Considerations

BIPV systems are used as cladding or window units. The design possibilities are in keeping with the envelope designs available. There are curtain walls, skylights, canopy, ventilated facades, and floors. They are usually constructed as sandwiched PV between the glass so can be a substitute for conventional architectural glass. They offer energy production, lighting (depending on transparency), infra-red and UV filters, acoustic and thermal characteristics.

The PV module is either amorphous or crystalline cells. Amorphous can be supplied in a variety of shapes, sizes, colours, and transmission from 0% to 30%. These have a consistent colour across the complete face of the glass. Due to the transparency the power ranges from ~57 W/m^2 at 0% to about 28 W/m^2 at 30%.

Crystalline silicon PV can also be customized but is usually configured as square to rectangular shapes. These look more like conventional PV modules with cells spread across the face. This also means they always let some light through even at high cell densities. They range from ~15% to 38% transparency. The power is dependant on the cell density.

Production Potential

The graphs below illustrate a sample output for an amorphous array, 100 m^2, 5.7 kW, 0% transmission, 4,000 kWh/yr. and a crystalline array, 100 m^2, 3.5 kW, 15% transmission, 2,756 kWh/yr., both mounted on a vertical wall, facing due south.

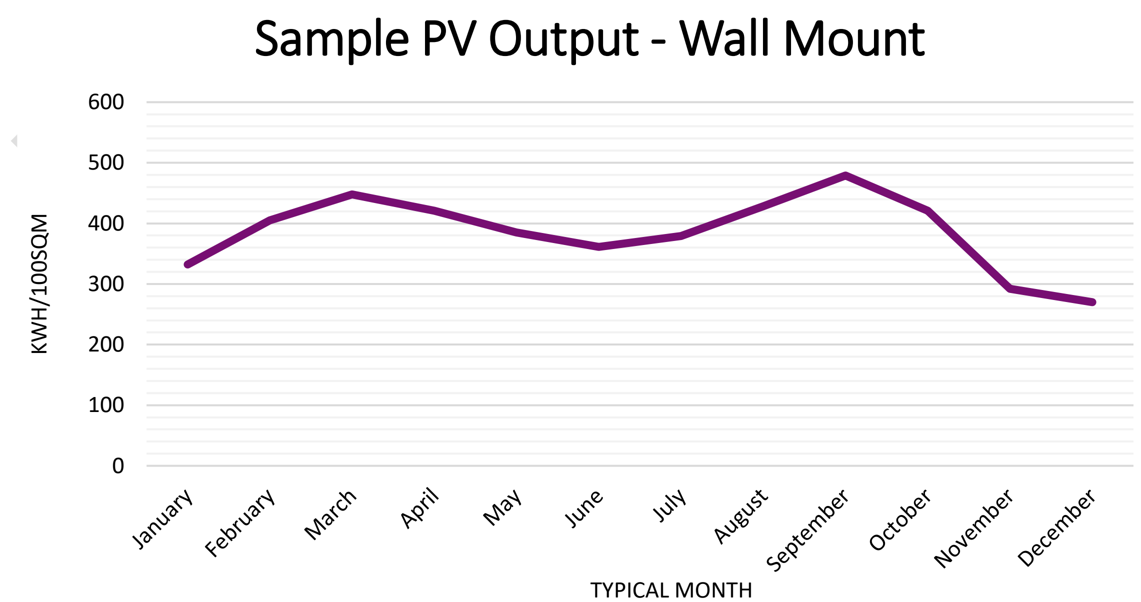


Figure 24. *Sample amorphous wall 100m2 BIPV at 0% transmission, 5.7 kW, 4,000 kWh/yr.*

Case Study 3: Building Integrated and Building Applied Photovoltaics (BIPV and BAPV)

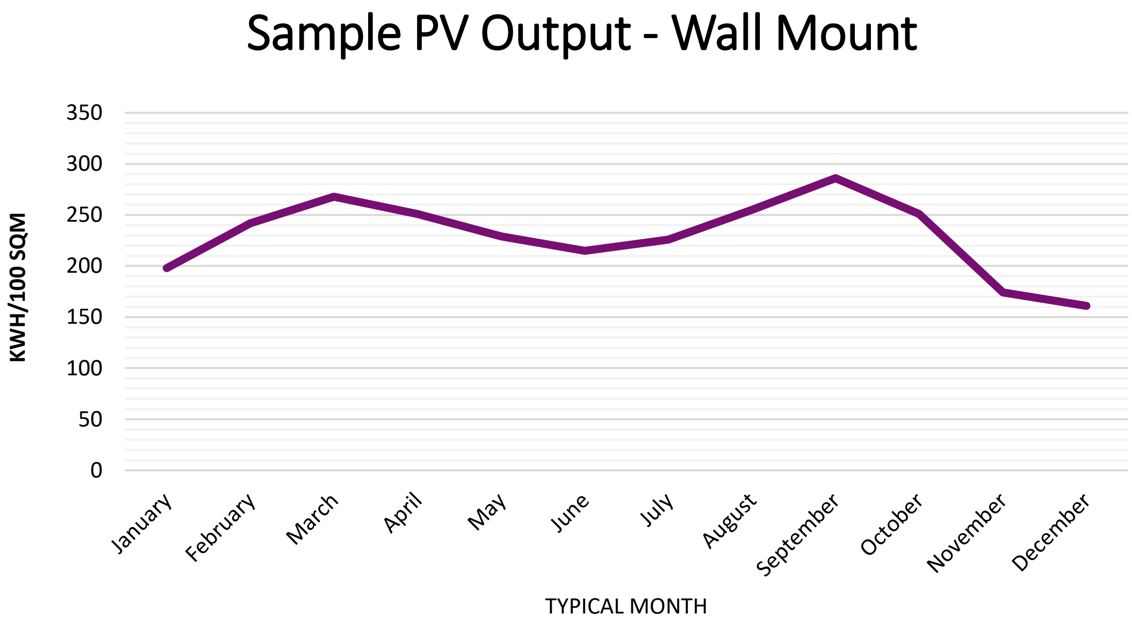


Figure 25. *Sample crystalline wall 100m2 BIPV at 15% transmission, 3.5 kW, 2,756 kWh/yr.*

Cost Considerations

Of the BIPV applications, a fully integrated PV envelope will be more expensive due to the structural elements required to complete the wall. Though a sample has been shown above for 100 m^2, most BIPV systems are at or above 1,000m^2 before the benefits of scale are available. An estimated cost for a full BIPV wall can be expected to be between $1 million and $1.5 million depending on the fastening system.

A wall-mounted BAPV can be expected to cost about half of a BIPV but is more dependent on the structural integrity of the existing wall.

As for any PV system, the connection must be evaluated before deciding to go forward with an installation. This is done early in the design process in coordination with the local distribution company.

4.5. General Sustainability Initiatives

The four pillars will reduce Scope 1 and 2 emissions that result from the energy used by The Town facilities and fleets. To reduce Scope 3 emissions, which is excluded from this study, from air travel, mileage reimbursements, waste and purchased paper, The Town will need to support general sustainability initiatives that typically require staff and resident engagement.

The Town should ensure that all municipal policies are aligned with the GRRAP and the goal of encouraging a low carbon future. For example, banning single-use plastics and continue initiatives to limit food waste. The Town has a well-developed waste management program called 'Towards Zero Waste Procedure' aside from other sustainable plans that have contributed to a reduction in their GHG emission footprint and increased awareness of sustainability issues. The Town should also expand sustainable transportation options for urban transportation – such as EVs, hybrid and electric buses, bikes, and electric bikes – to ensure that low carbon modes of transportation are a part of its carbon reduction future. We are aware that The Town is purchasing electric buses and this direction should be promoted to reduce the significant GHG contributions from diesel engines.

4.6 Sustainability Indicators

Climate change is recognized as a risk for financial and sustainability modelling. Markets and society are increasingly aware of the costs and risks of climate change and the results of inaction to mitigate the effects. Establishing a strategy will help with managing the risks associated with environmental, societal and governance dimensions for The Town. This GRRAP is a part of the strategic planning and combines with their sustainability plans and efforts to align with current programs that are being used as benchmarks for acknowledging the efforts. The UN Sustainable Development Goals (SDG) are another recognized platform for this. Elements of this GRRAP support the UN SDG categories that relate to clean energy, resiliency, and action.

Figure 26. *UN Sustainable Development Goals*

5. GHG Emissions Reduction Scenarios

For The Town to meet its emission reduction targets, it must implement programs to support the four GRRAP pillars. Based on the combinations in which the GRRAP pillars are implemented, four scenarios for The Town to advance towards 80% GHG reduction from 2014 level, are presented.

5.1. Scenario 1: Energy Conservation and Renewables Only

Under this scenario, The Town implements Pillars 1 and 4 – Energy Conservation and Demand Management, and Renewable Energy Generation. Efforts under this scenario are minimal and do not deviate from BAU operations considerably, although Blackstone recommends solar domestic hot water and air solar systems be further investigated for reduced natural gas in the HVAC systems. With consideration of these measures, the GHG emission reduction target for 2030 can be achieved but the corporate GHG emissions reduction target by 2050 will not be achieved. The assumptions made under this scenario apply to three different time periods that are outlined below.

Between 2022 and 2024, The Town will:

- Implement all electricity and natural gas conservation (ECDM) measures.
- Invest in Rooftop and Carport Solar energy and promote the use of heat pumps if applicable.
- Develop high-performance design standards.
- Implement a measurement & verification (M&V) plan.

Between 2025 and 2035, The Town will:

- Continue to implement electricity and natural gas conservation (ECDM) measures.
- Update The Town's ECDM plan.
- Conduct annual M&V reporting.
- Continue to invest in Rooftop and Carport Solar and heat pumps.
- Invest in solar domestic hot water and solar air systems.

Between 2036 and 2050, The Town will:

- Update The Town's ECDM Plan regularly.
- Investigate and implement RE technology as they evolve.

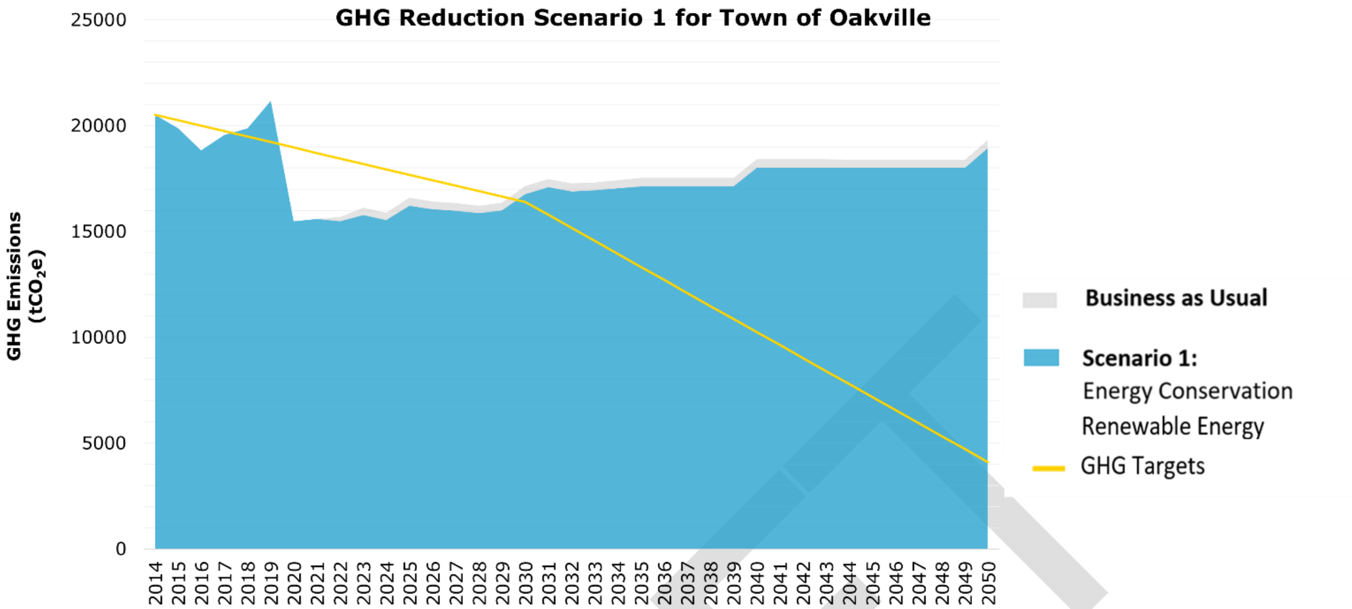


Figure 27. *GHG Reduction Scenario 1 for The Town*

5.2. Scenario 2: Energy Conservation, Renewables and Zero Carbon Buildings

Under this scenario, The Town will implement Pillars 1, 2 and 4 – Energy Conservation and Demand Management, Space Use Optimization & Zero Carbon Buildings, and Renewable Energy Generation. The Town will undertake all efforts from Scenario 1 and additional efforts to manage its space use and the built environment. This scenario eliminates the rise in future GHG emissions resulting from expansion, but the corporate GHG emissions reduction target for 2050 will not be achieved. The assumptions made under this scenario apply to three different time periods that are outlined below.

Between 2022 and 2025, The Town will, in addition to Scenario 1:

- Conduct space utilization audits to ensure a 90% space utilization rate and optimize HVAC use for those spaces according to actual loads.
- Consider electrification of HVAC replacements.
- Construct Zero Carbon Buildings for planned expansion.

Between 2026 and 2035, The Town will, in addition to Scenario 1:

- Invest in solar domestic hot water and solar air systems
- Update high-performance design standards.

Between 2036 and 2050, The Town will, in addition to Scenario 1:

- Update The Town's ECDM Plan with more aggressive reduction planning for high-performance building designs.

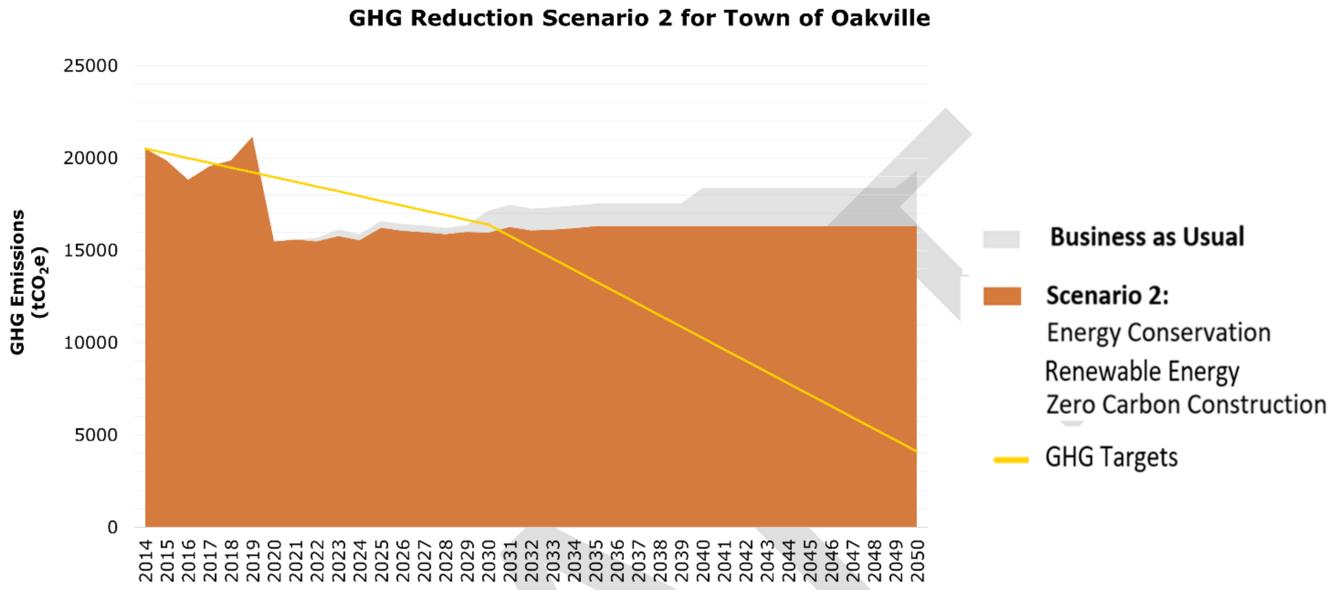


Figure 28. *GHG Reduction Scenario 2 for The Town*

5.3. Scenario 3: Energy Conservation, Renewables, Zero Carbon Buildings and Delayed Electrification

Under this scenario, The Town will implement Pillars 1, 2, 3 and 4 – Energy Conservation and Demand Management, Space Use Optimization & Zero Carbon Buildings, Electrification, and Renewable Energy Generation. The Town will undertake all efforts from Scenario 2 and the delayed action for electrifying its natural gas-based equipment. This scenario effectively reduces Scope 1 GHG emissions resulting from natural-gas use and accelerates them towards its GHG reduction target. However, it still does not reach the corporate 2050 GHG emissions reduction target. The assumptions made under this scenario apply to three different time periods that are outlined below.

Between 2022 and 2025, The Town will, in addition to Scenario 2:

- Electrify 0% of natural gas-based HVAC equipment.

Between 2026 and 2035, The Town will, in addition to Scenario 2:

- Electrify 27% of natural gas-based HVAC equipment.

Between 2036 and 2050, The Town will, in addition to Scenario 2:

- Electrify 73% of the remaining natural gas-based equipment.

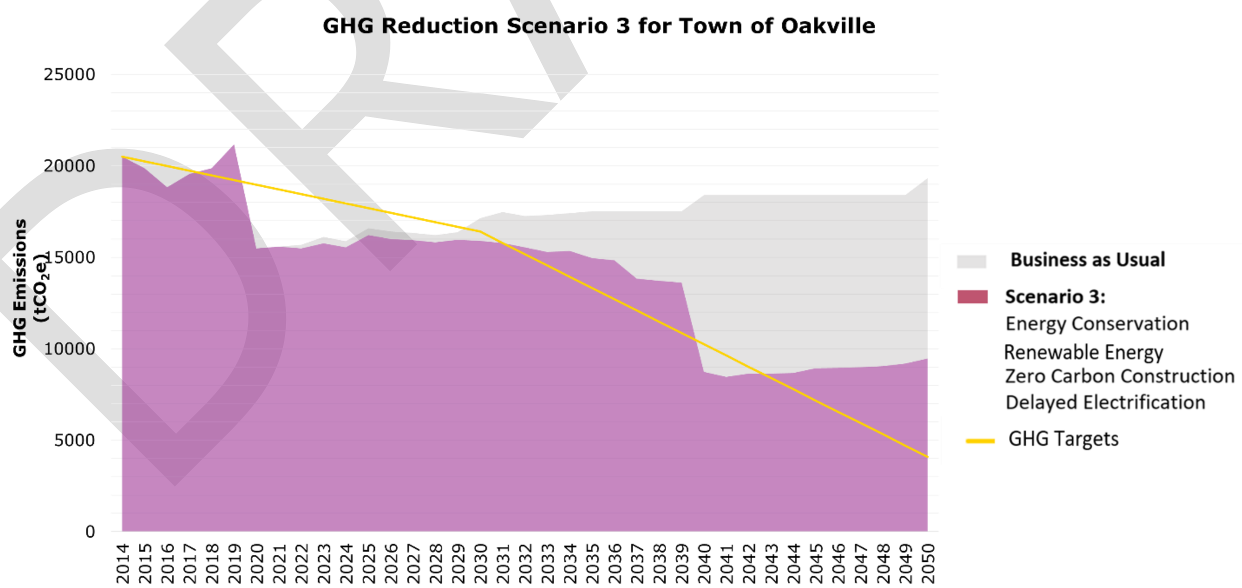


Figure 29. GHG Reduction Scenario 3 for The Town

5.4. Scenario 4: Energy Conservation, Renewables, Zero Carbon Buildings and Aggressive Electrification

Under this scenario, The Town implements Pillars 1, 2, 3 and 4 – Energy Conservation and Demand Management, Space Use Optimization & Zero Carbon Buildings, Electrification, and Renewable Energy Generation. The Town undertakes all efforts from Scenario 2 and the aggressive action for electrifying its natural gas-based equipment. This scenario drastically reduces Scope 1 GHG emissions resulting from natural-gas use and provides the maximum GHG reduction, but still falls short of the 2050 GHG emissions reduction target. The assumptions made under this scenario apply to three different time periods that are outlined below.

Between 2022 and 2025, The Town will, in addition to Scenario 3:

- Electrify 32% of natural gas-based HVAC equipment.

Between 2026 and 2035, The Town will, in addition to scenario 3:

- Electrify 51% of the remaining natural gas-based equipment.

Between 2036 and 2050, The Town will:

- Electrify 17% of the remaining natural gas-based equipment.

The graph below depicts four scenarios for advancing towards 80% GHG reduction from 2014 level, by depicting the GHG emissions under each scenario and the business as usual (BAU) scenario.

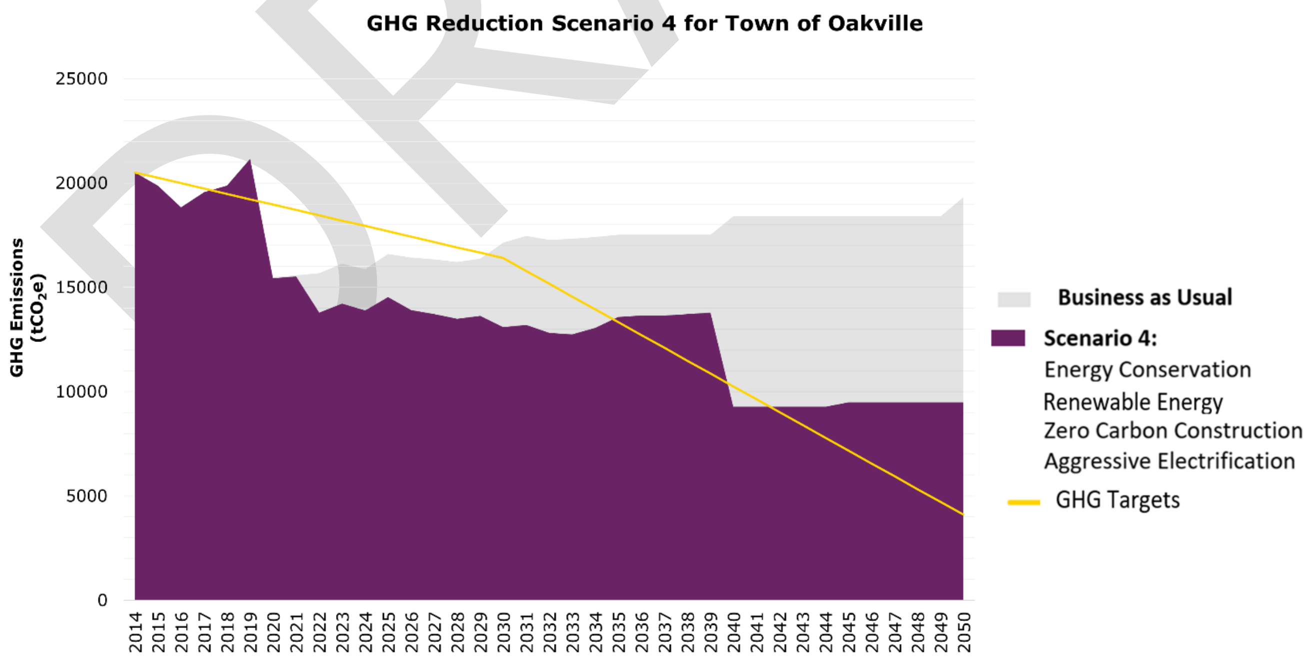


Figure 30. *GHG Reduction Scenario 4 for The Town*

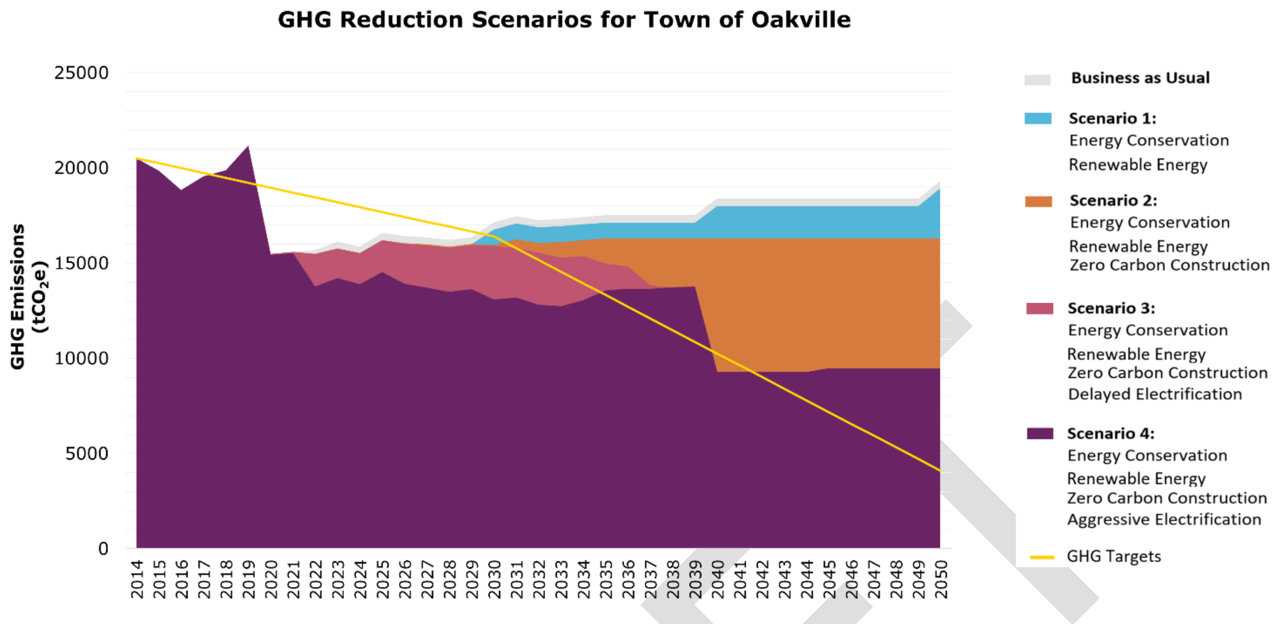


Figure 31. *GHG Reductions Scenarios for The Town*

Natural gas consumption accounts for the largest share of The Town's Scope 1 and 2 GHG emissions. However, after only electrification is implemented, the share of emissions would get redistributed. This is demonstrated in Figure 32.

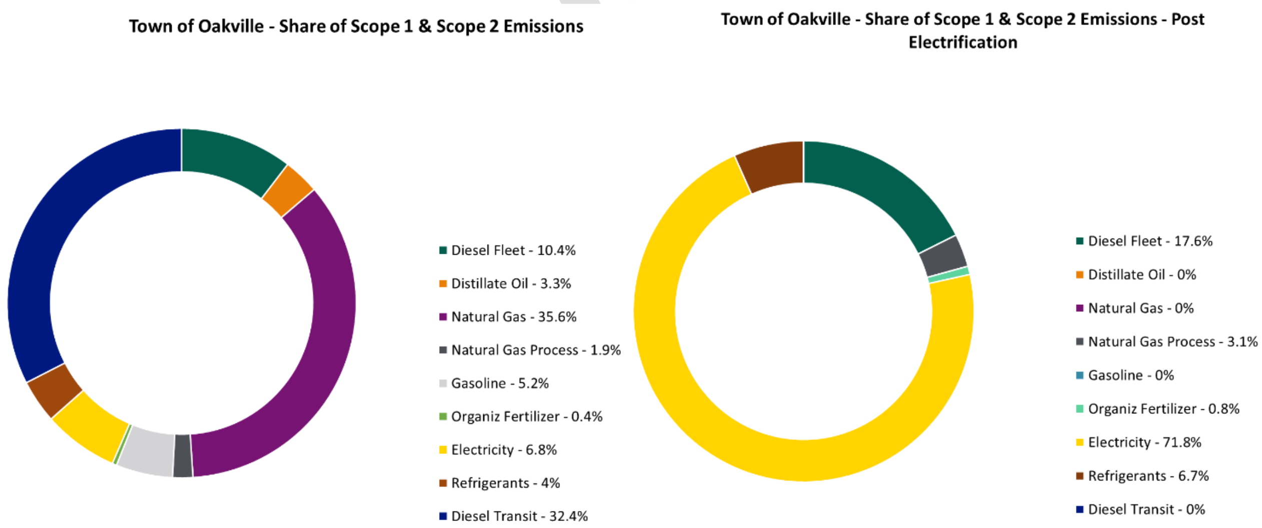


Figure 32. *Effect of Electrification on Scope 1 & 2 Emissions*

Figure 31 shows aggressive electrification but still will not be meeting the 2050 target. The Ontario electricity grid is removing nuclear power generation, which will cause an increase in GHG emissions between 2022 and 2030. Therefore, Blackstone recommends applying solar PV panels to reduce the electricity supplied by the grid. The RE Report recommends these measures in detail. Figure 33 shows the GHG emissions profile with the Solar PV panels as suggested in the RE report.

Figure 33 shows that with the implementation of all four (4) Scenarios and intense renewable measures implementation, the corporate GHG emissions reduction target in 2050 will be achieved.

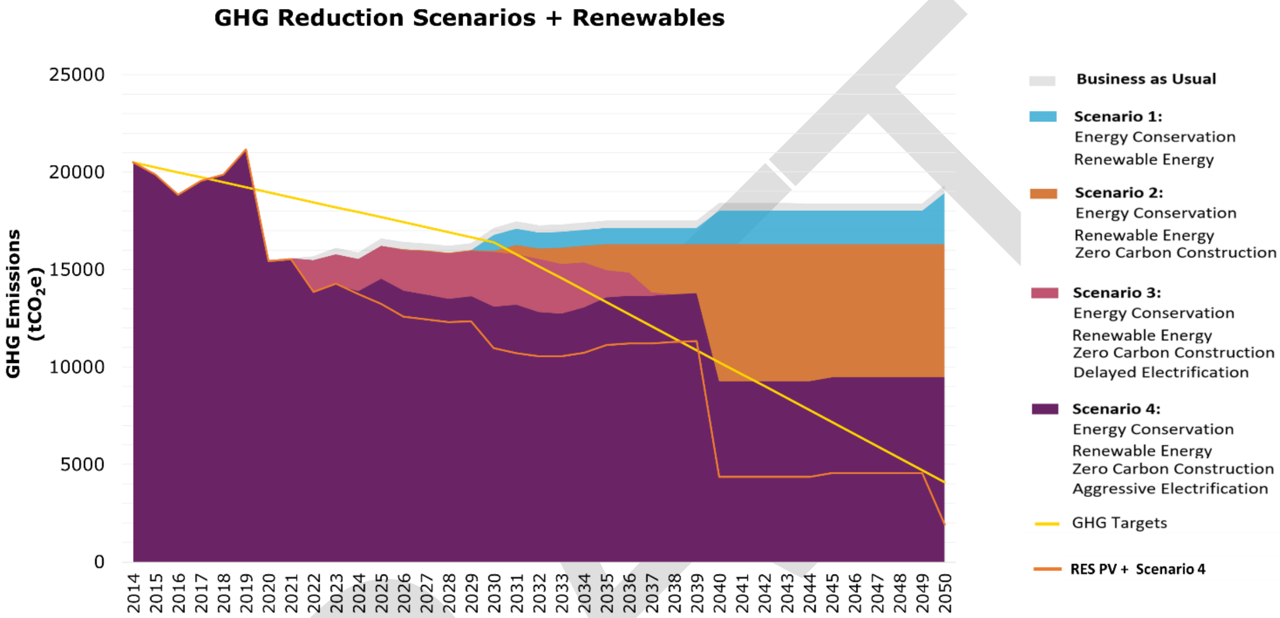


Figure 33. *GHG Reduction Scenarios + Renewables – Path to Achieve GHG Reduction Target*

6. Net-Zero Gap

An analysis of The Town's future GHG emissions from 2019 to 2050 suggests there is a high chance of achieving the interim target of 2030, however, more aggressive measures are required in order to meet the 2050 target. The "gap" between The Town's GHG emissions and its 2050 target is defined as the "Net-Zero Gap.

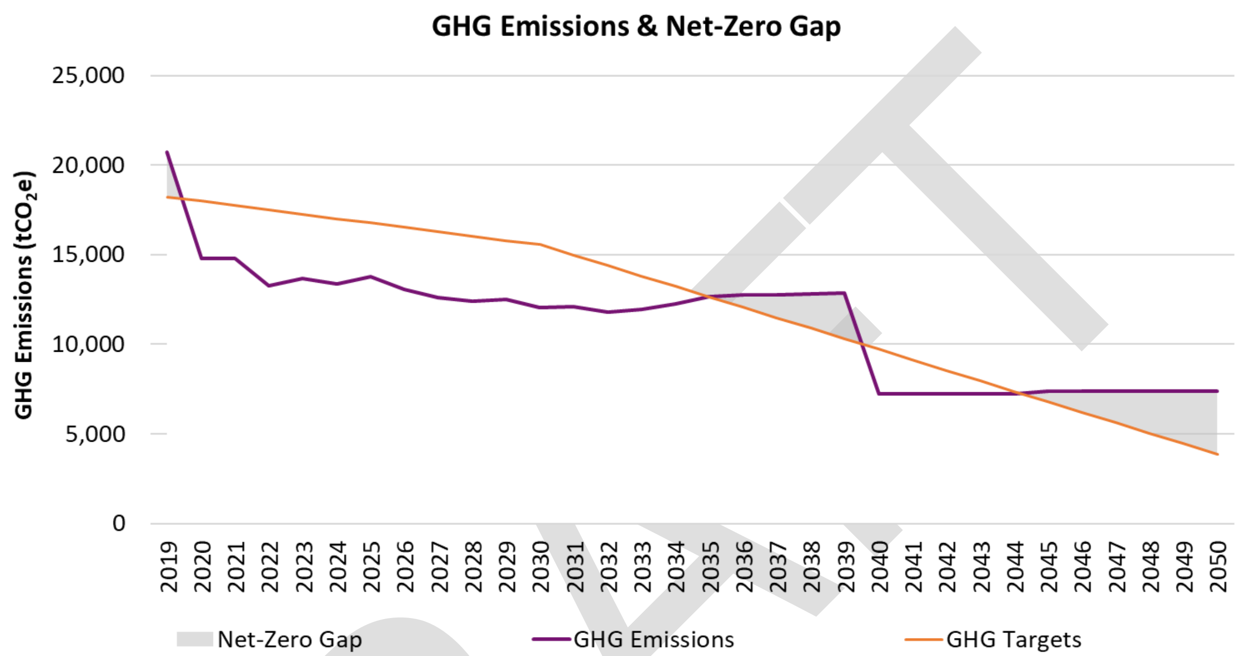


Figure 34. *The Net-Zero Gap Based on The Town's GHG Reduction Plan*

The Town's 2050 GHG reduction goal is not currently in line with the Federal GHG emissions reduction plan which is Carbon neutrality by 2050. Figure 35 below shows the gap between The Town's GHG emissions and the Federal GHG reduction plan. There are significant gaps over the period for complete facility and fleet electrification that would still not be enough for The Town to become carbon neutral or achieve their GHG emission reduction target of 80% by 2050. In both Scenario 3 and 4, with current technology and based on the provincially projected electricity mix, The Town will be able to reduce emissions to more than 9,000 tCO_2e. To reduce emissions and achieve the goals, it is recommended that The Town converts fossil fuel burning equipment and vehicles to electric alternatives as soon as possible. This means the conversion of natural gas burning equipment (HVAC heating and hot water boilers, natural gas-fired rooftop units) as well as corporate fleet vehicles to grid-provided and/or onsite renewable electricity.

It is expected that the annual electricity consumption for The Town will be approximately 89 million kWh in 2050 with the implementation of aggressive electrification. Installing renewable power generation, with current technology could provide approximately 1.38 million kWh of electricity to The Town. The remaining 87 million kWh of electricity will be provided through the Ontario electrical grid which will account for ~70% of the total GHG emissions in 2050 at 7,501 tCO_2e. However, based on the recommendations from Blackstone in the RE Report, potential PV systems installation could create 88 million kWh by 2050 and reduce The Town's dependency on grid electricity.

The Net-Zero Gap also refers to the amount of energy The Town would have to produce using renewable energy, and/or the degree of decarbonization that Ontario's electrical grid would have to undergo, for The Town to achieve an 80% reduction from 2014 level.

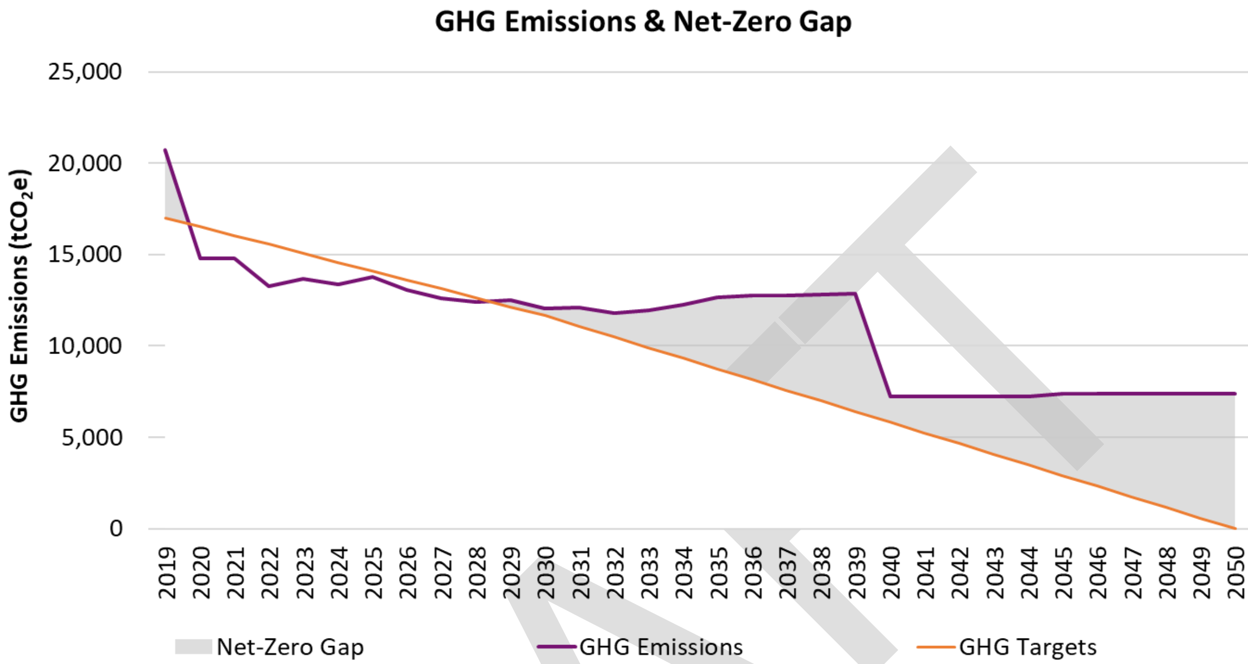


Figure 35. *The Net-Zero Gap Based on Federal GHG Reduction Plan*

The Net-Zero Gap will either increase or decrease depending on factors including corporate asset expansion, the adoption of high-performance building designs for both new and renovation projects, engagement by staff and the evolution and timely acceptance of low carbon solutions.

The Town's Net-Zero Gap could be addressed by emerging technologies and changes to the Ontario electrical grid. To address the Net-Zero Gap, consider the following options, which will each be explored in more detail below:

- Renewable Generation
- Grid Carbon Intensity
- Renewable Natural Gas
- Carbon Offsets
- New low carbon Technologies

6.1. Renewable Generation

In addition to renewable generation becoming more affordable, the energy density of renewable generation systems is increasing. Significant advancements are being made in the amount of electricity that is produced per square foot of renewable PV panel, which would increase the amount of electricity The Town can produce on its sites.

The Town may have the opportunity to produce renewable energy at an offsite location if the regulatory barriers to Virtual Net Metering are removed. The Town could then install renewable generation capacity offsite using increasingly common power purchase agreements. The renewable electricity produced would be fed into the grid and the renewable generation would be credited to The Town as an offset to balance the electricity is consumed (e.g., the increase due to electrification of HVAC).

Figure 36 below shows the Net-Zero gap when the renewable generation based on the RE Report being applied. The Town would easily meet a Net-Zero target by 2050 under this model.

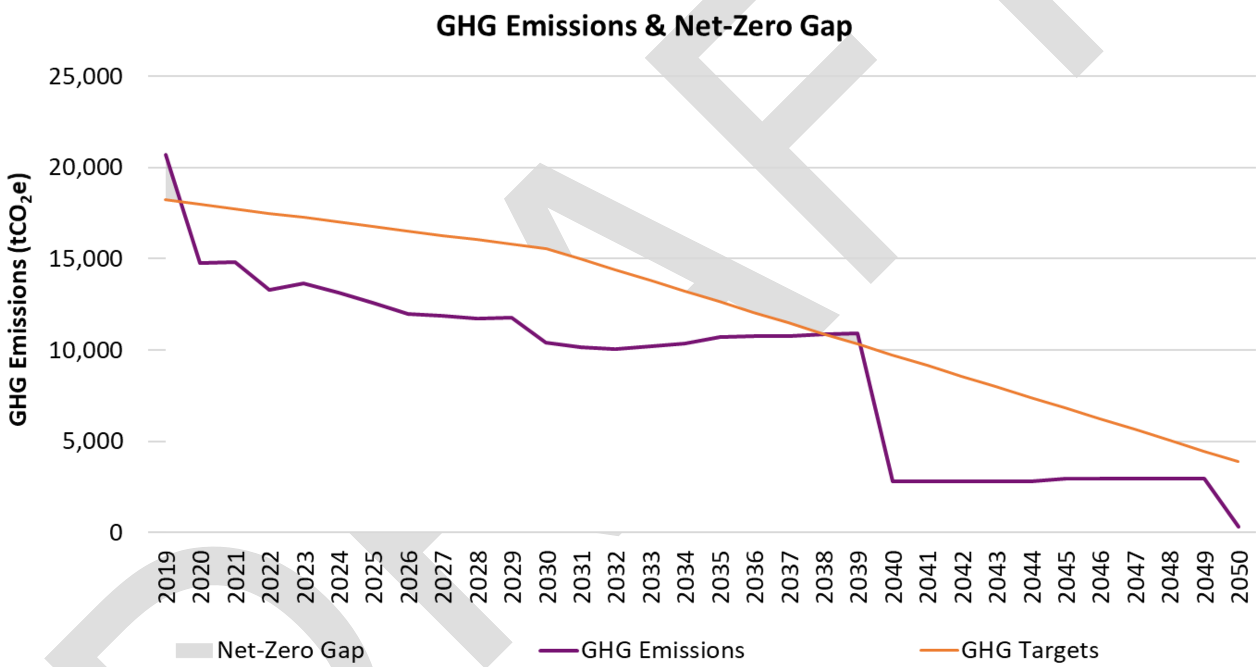


Figure 36. *The Net-Zero Gap Based on The Town GHG Target and RES PV + Scenario 4*

6.2. Grid Carbon Intensity

The existing carbon grid intensity determines the amount of carbon produced per electricity unit consumed. Since 2014, there have been significant reductions in carbon grid intensity because of the closing of coal plants. If carbon grid intensity is lowered, this would assist The Town in reaching its net-zero target. Grid carbon intensity is discussed further in Section 8.4. However, in upcoming years there would be an increase in carbon intensity due to refurbishment (in the near term) and possible phasing out of nuclear from the Ontario electricity grid.

6.3. Renewable Natural Gas

Renewable natural gas (RNG) is a low-carbon alternative to traditional natural gas (TNG). It is produced from biosources such as food waste, sewage, or other organic materials. RNG is currently expensive, about ten times more expensive than traditional natural gas, and is difficult to source in large quantities. However, in the future RNG will be more readily available. Several Ontario municipalities and major gas distribution companies are investing in RNG facilities. There is potential for the market to supply renewable natural gas through the existing distribution system, which would greatly impact the need for and cost of conversion to electrification. Lastly, as carbon taxes are increased, the price gap between RNG and TNG will be reduced.

6.4. Carbon Offsets

To address the Net-Zero Gap, The Town could buy carbon offsets. A carbon offset is a credit for GHG reduction that has been achieved by one party that can be purchased and used to offset the emissions of another party. Carbon offsets can range from $10 to $20 per tonne, depending on the location and type of offset. It is recommended that if The Town considers offsets, only those registered under The Gold Standard – the highest global standard for carbon offsets, be utilized. BESL is well versed in the capacity of carbon offset and commodity evaluators and could be consulted if this path is chosen for more details. At this time, we recommend following strategies that reduce energy and GHG using internal and grant/program funding.

6.5. New Technologies

There is of course an "unknown" factor when it comes to the availability and viability of future clean technologies. Energy technology trends suggest that the alternatives to create low-carbon electricity are improving, becoming more efficient and less expensive. However, is it difficult to predict the rate at which new technologies will make their way onto the market and which will be technically suitable to reduce the Net-Zero Gap. For example, air-source heat pumps can now maintain high-performance ratios (coefficient of performance >1.0) at outdoor temperatures below freezing which makes them candidates for HVAC replacements. Some examples of emerging technologies are discussed in Case Study 4, in the following pages.

6.6. Power Purchase Agreement (PPA)

To reduce the carbon intensity of the electricity provided by the grid, power purchase agreements (PPAs) can be applied between The Town as the buyer and a second party as the seller to provide offsite electricity generated by renewable power and will be shipped through the Ontario grid. This partnership is contracted to last for a set time, 15 – 20 years, with the power cost set for that time period. The Town is not responsible for the site. Currently, the type of arrangement called a virtual PPA), whereby the client can use the generated power to offset their loads is not available in Ontario. The concept is gaining traction across North America and is available in Alberta and Saskatchewan. Until that time – and it was being investigated about 5 years ago in Ontario, The Town should maintain awareness of any changes to the VPPA model.

Case Study 4: Emerging Technologies - Algae Cultivation

Photobioreactors

When it comes to organic processes that can be leveraged to tackle the problem of climate change, the carbon-sequestering capabilities of algae may be some of the most effective means that can be deployed. The U.S.-based company Hypergiant Industries uses a box-shaped machine for algae cultivation. This machine can soak up as much carbon from the atmosphere as an acre of trees[6].

Figure 37. *Bioreactor Concept by Hypergiant Industries*

Through the process of photosynthesis, the aquatic plant algae soak up carbon dioxide, water, and sunlight to produce energy. Hypergiant's Eos Bioreactor measures 3x3x7ft and is designed to be installed in urban environments, where it captures and sequesters carbon from the atmosphere and produces clean biofuels and other products like fertilizers, soaps, cosmetics, and even food. Artificial intelligence (AI) systems are used to monitor and manage airflow, amount of light, available CO_2, temperature, pH, and bio-density to ensure optimum conditions for maximum carbon sequestration.

The company is in the final stages of the production of a commercial device. Hypergiant says it aims to make the bioreactor designs available publicly in hopes that this will inspire others to come up with similar solutions. Hypergiant plans to share details about bringing the reactor to market sometime in 2020.

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[6] Hypergiant Industries Green R&D
https://www.hypergiant.com/green/
https://www.hypergiant.com/wp-content/uploads/2019/09/algae_is_the_new_green.pdf

Case Study 4: Emerging Technologies - Algae Cultivation

Bio Façades

Bio façades are reactive structures that use algae cultivation within glass-panelled facades to generate energy and provide shade to a working building. Unveiled in a pilot project at the International Building Exhibition (IBA) in Hamburg in 2013, the BIQ House uses about 100 bioreactors to cultivate algae[7]. The façade houses a unique architectural ecosystem where living organisms play a crucial role. The design was developed collaboratively by Strategic Science Consult of Germany (SSC), Colt International and ARUP.

Figure 38. *Bio Facade at the BIQ House*

The biomass and heat generated by the façade are transported by a closed-loop system to the building's energy management centre, where the biomass is harvested through floatation and the heat is utilized by a heat exchanger. As the system is fully integrated with the building services, the excess heat from the photobioreactors (PBR) can be used to help supply hot water or heat to the building or can be stored for later use.

The algae also work as dynamic shading and acoustic buffering systems that respond naturally to external changes. The more sunlight the system gets, the more the biomass grows and blocks off excess natural light. During peak daylight hours, this provides an organic and automatic shade, plus a noise reduction layer to protect interior spaces.

The notion of bio-architecture – or "growing structures" – has always been a green building ideal. The use of such technologies and building design concepts is growing and will likely continue to do so on a commercial scale in the years to come. As such, it is recommended that The Town stays vigilant in monitoring future developments in integrated biotechnology.

[7] Solar Leaf Concept by ARUP
http://www.morethangreen.es/en/solarleaf-solar-leaf-algae-bio-reactive-facade/
https://99percentinvisible.org/article/architectural-ecosystems-bioreactors-generate-green-energy-shade-oxygen/

7. Financing Net-Zero

This section of the GRRAP outlines the required steps and financial implications of The Town meeting its 2030 and 2050 GHG targets under Scenarios 3 and 4, as the scenarios with the best GHG emission reduction potential. As part of each scenario, the idea of replacing fossil fuel equipment with electricity equipment is explored. The proposed measures require capital investment and may have utility cost implications or savings. It should be noted that converting from natural gas to electricity will increase operational costs.

7.1. Capital Costs Required

7.1.1. Scenario 4: Energy Conservation, Renewables, Zero Carbon Buildings and Aggressive Electrification

Under Scenario 4, the investment and associated costs include the following:

- The total investment cost for energy conservation, renewable energy projects and Renewable Energy Systems according to the RE report.
- The incremental investment cost for the construction of ZCB.
- The incremental investment cost for replacing traditional equipment with electric equivalents at the **first end-of-life replacement.**
- The increase in electricity cost is due to equipment electrification.

The cost estimates listed above also include utility cost escalation. This is illustrated in Figure 39. Note, in the following graphs the recommended solar systems based on the RE report have been considered in the calculations.

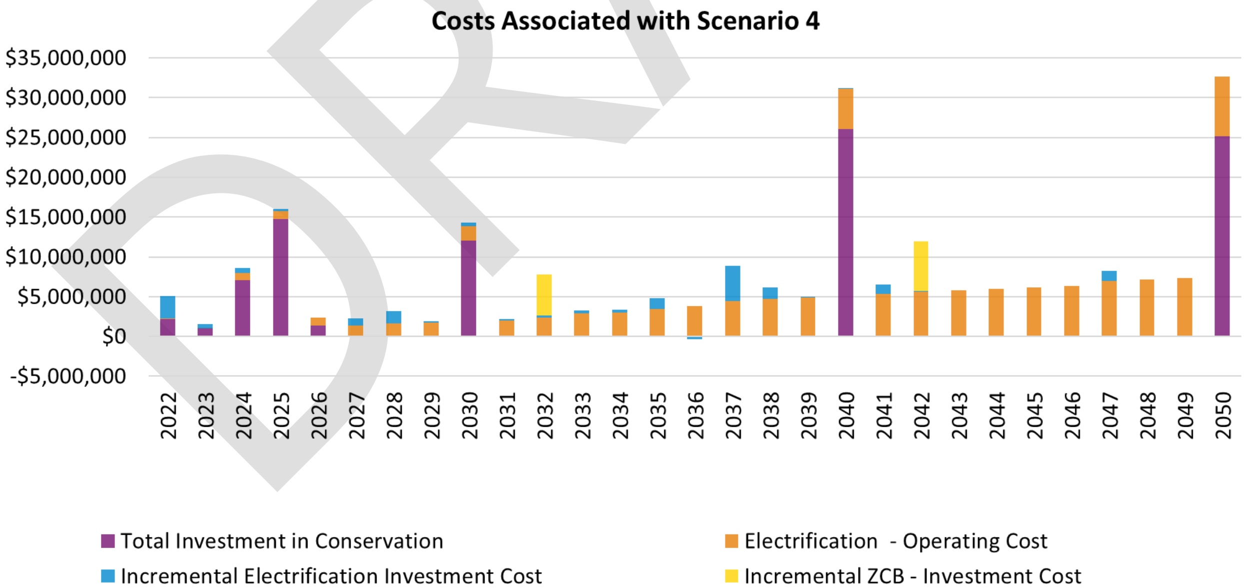


Figure 39. *Annual Costs Associated with Aggressive Electrification Scenario*

Table 12 below summarizes the cumulative total costs of all initiatives under Scenario 4 at the target milestone years between 2022 and 2050.

Table 12. Cumulative Costs Associated with Aggressive Electrification Scenario

Scenario 4 - Cumulative Costs	GHG Target Milestone Years		
	2022 - 2024	2025 - 2035	2036 - 2050
Total Investment in ECDM & Renewable Energy	$9,757,773	$27,050,321	$51,154,708
Incremental ZCB - Investment Cost	$0	$4,437,709	$5,354,607
Incremental Electrification Investment Cost	$3,961,138	$5,960,822	$8,292,448
Electrification - Operating Cost	$947,328	$20,380,080	$79,835,929
Total Cost	**$14,666,239**	**$57,828,932**	**$144,637,692**

7.1.2. Scenario 3: Energy Conservation, Renewables, Zero Carbon Buildings and Delayed Electrification

Under the Delayed scenario, The Town would invest in high-efficiency natural gas systems. Fossil fuel-burning equipment would be replaced at the last date of potential replacement and onsite conservation activities would continue. The annual investment and associated costs include the following:

- Total investment costs for energy conservation projects, renewable energy projects and building envelope upgrades.
- The incremental investment cost for the construction of ZCB.
- The incremental investment cost for replacing traditional equipment with electric equivalents at the **end-of-life replacement**.
- The increase in electricity cost is due to equipment electrification.

The cost estimates listed above also include utility cost escalation. This is illustrated in Figure 40.

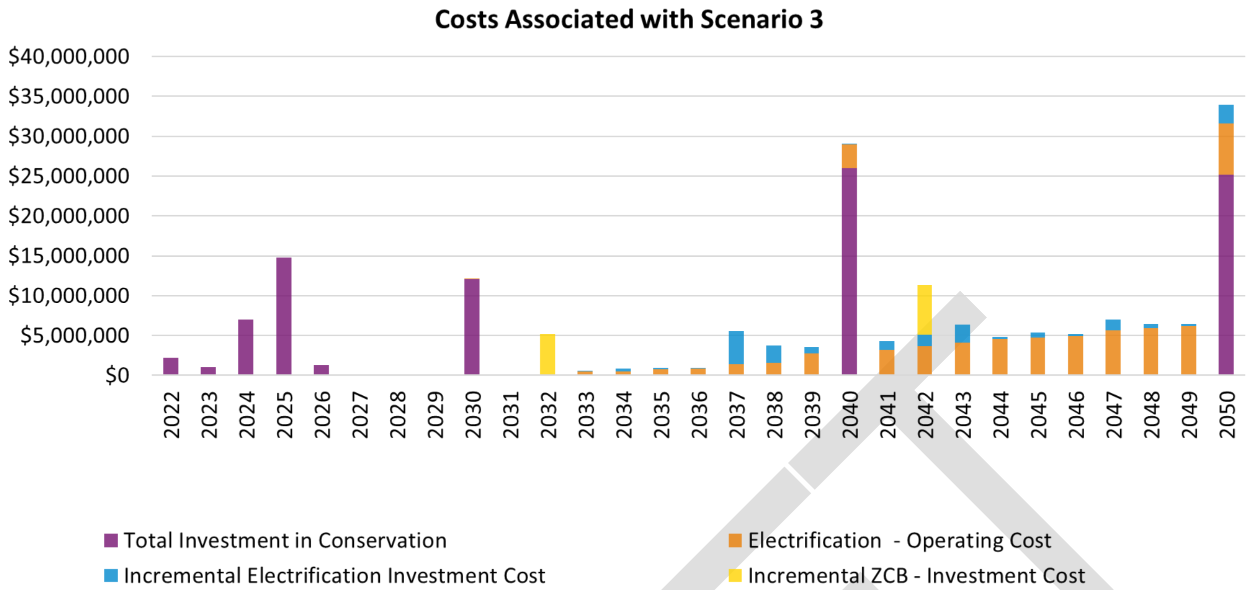


Figure 40. *Annual Costs Associated with Delayed Electrification Scenario*

The following table summarizes all initiatives under Scenario 3 for the period 2022 to 2050.

Table 13. *Cumulative Costs Associated with Delayed Electrification Scenario*

Scenario 3 - Cumulative Costs	GHG Target Milestone Years		
	2022 - 2024	2025 - 2035	2036 - 2050
Total Investment in ECDM & Renewable Energy	$9,757,773	$27,050,321	$51,154,708
Incremental ZCB - Investment Cost	$0	$4,437,709	$5,354,607
Incremental Electrification Investment Cost	$0	$645,267	$17,873,377
Electrification - Operating Cost	$0	$1,734,128	$54,065,762
Total Cost	**$9,757,773**	**$33,867,425**	**$128,448,454**

The decision of which of the four scenarios to choose for reaching 80% GHG reduction from 2014 level is dependent upon when The Town decides to replace fossil fuel-based technologies with low carbon alternatives. The sooner The Town switches, the faster emissions will be reduced. However, switching to electricity from natural gas, or from internal combustion vehicles to electric vehicles, requires a significant investment of capital and operational costs (except for electric vehicles which tend to have lower operating and maintenance costs). This will likely influence which scenario The Town chooses. The path to The Town's GHG reduction target can be financed through multiple approaches which are discussed in Section 7.2 below.

7.2. Investment Scenarios – Further Financial Details

7.2.1. Capital Investment Required

For The Town to meet its 2050 GHG target, it is vital to reduce and where possible, eliminate the consumption of natural gas and diesel. Hence, all GHG reduction scenarios prioritize conservation, high-performance designs, the implementation of renewable energy systems and ECDM measures. To develop plausible investment strategies for the implementation of these projects several factors must be considered. These include the current cost of technology, utility prices and incentives or funding avenues, which in some cases do not immediately provide a sound business case for facility electrification and ultimately carbon reduction.

Please keep in mind that all future systems designs should take into consideration the measures being planned to not design equipment based on past performance energy use. The new designs (and renovations) will have lower energy use and demand indices which means smaller systems. "Rightsizing" equipment to suit the actual design conditions (also taking into consideration that the weather patterns are changing) will help ensure energy/GHG reductions are met.

Table 14 below depicts financial details of the ECDM and RE measures only recommended in this report.

Table 15 below depicts financial details of all recommended initiatives required to be implemented for The Town to achieve the 2050 GHGs reduction target.

The details of all measures and recommended year of implementation are provided in Appendix 2.

Table 14. *Investment Costs and Benefits for ECDM & RE Program- Scenario 1*

Average Annual Savings ($)	Total Cost ($)	Simple Payback (years)	NPV	IRR
$8,594,052	$87,962,802	10.2	$325,531,769	8.58%

Table 15. *Investment Costs and Benefits for all Recommended Initiatives*

Average Annual Savings ($)	Total Cost ($)	Simple Payback (years)	NPV	IRR
$5,105,661	$217,132,863	42.5	-$237,029,110	-4.87%

The cumulative net cash flow for all recommended initiatives is illustrated in Figure 41.

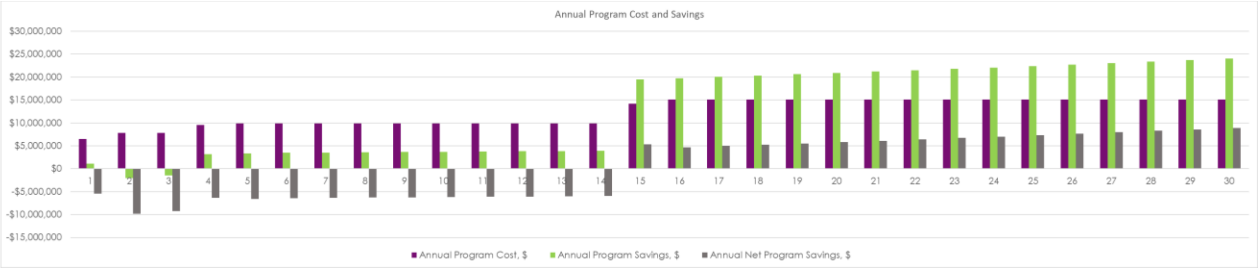


Figure 41. *Cumulative Net Cash Flow for all Recommended Initiatives*

7.2.2. Role of Deferred Maintenance

The above capital investment models shown in the previous section depict cash flows based on total project costs and do not account for cash injection like incentives from provincial and federal programs and The Town's capital budgets for deferred maintenance. At the moment, there are no incentives offered by the Federal and provincial governments on ECDM measures. The capital budget allocated for asset renewal for equipment directly targeted in the ECDM measures recommended in this report is approximately $44 million over the next 30 years. Hence, it is vital to consider deferred maintenance costs when considering ECDM and renewables programs. This effectively reduces the capital cost of projects from $87 million to approximately $43 million. The financial details on the incremental costs are shown below.

Table 16. *Deferred Maintenance & Recommended ECDM Measures for The Town*

Consolidated ECDM & Aggressive Renewables					
Measure	Average Annual Savings ($)	Total Cost ($)	Simple Payback	NPV	IRR
Initial Investment Model	$8,594,052	$87,962,802	10.2	$325,531,769	8.58%
Revised Model with Deferred Maintenance Included	**$8,594,052**	**$43,767,570**	**5.09**	**$412,286,523**	**15.01%**

7.2.3. Canada Infrastructure Bank (CIB) Public Retrofit Initiative

The CIB Public Retrofits Initiative provides financing for decarbonization retrofits in privately-owned commercial buildings in Canada through an investment of up to $2 billion. The Initiative is part of the Canada Infrastructure Bank's (CIB's) $10 billion Growth Plan that aims to stimulate jobs for Canadians and strengthen Canada's economy through new infrastructure investments. By increasing levels of public and private investment in infrastructure, the CIB's Growth Plan will contribute to Canada's competitive, connected, and resilient economy. The program overview is shown below.

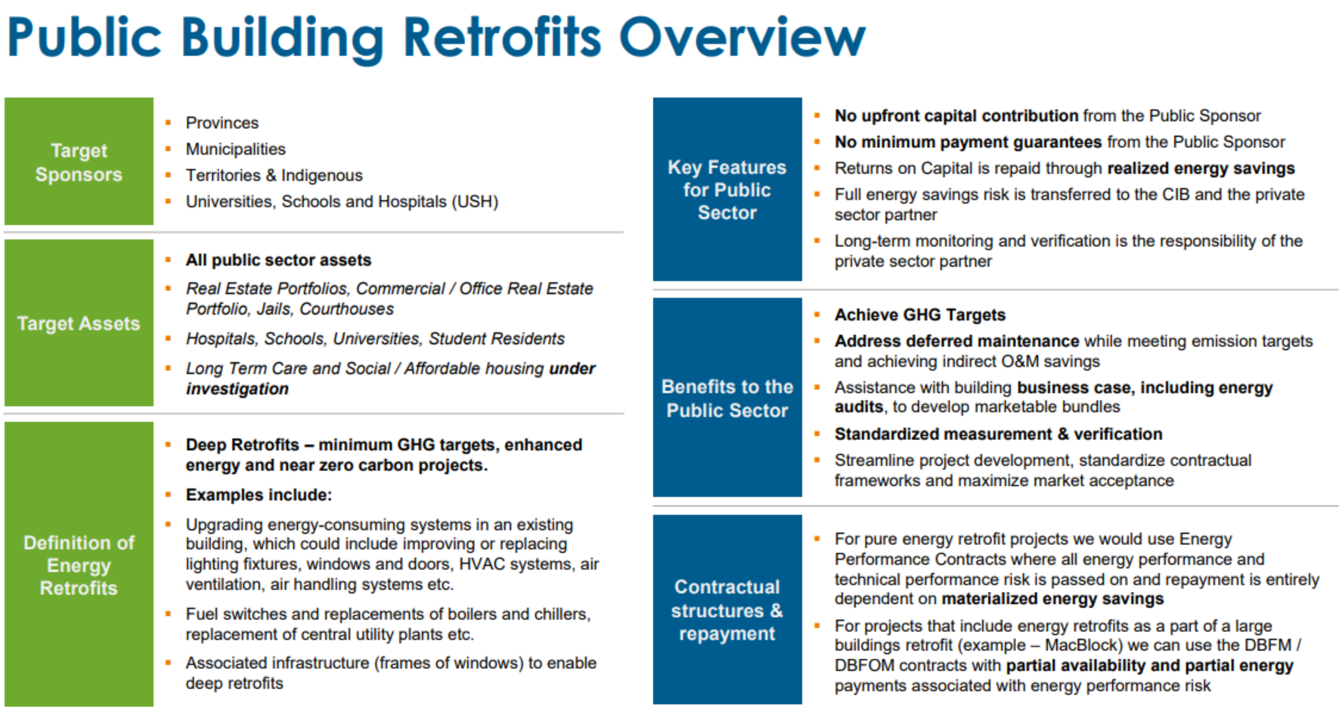


Figure 42. *Public Buildings Retrofits Overview*

The Initiative offers long-term, high leverage, below-market interest rate investments for public sector building retrofits that substantially reduce GHG emissions. Financing can apply to investments in large individual projects, or a pool of investments originated by a retrofit aggregator. To encourage the market to pursue deep retrofits that go beyond the industry norm, the Initiative requires that all projects achieve a minimum level of GHG savings while offering more favourable financing terms (more affordable capital and longer payback periods) for projects that target deeper savings.

CIB's standardized core Initiative offering is a $40M or greater debt product that requires a minimum 30% equity investment. CIB debt is extended based on the forecasted savings derived from improvements to buildings as the primary source of repayment, with one source of recourse being energy performance guarantee contracts applied to the savings forecasts. The CIB offering is depicted on the following page.

CIB offering – large public sector projects

Large **BUNDLED** Projects (>$40m capex)	Financing Approach	CIB Advisory Services
	▪ Work with all levels of government + USH to aggregate portfolios and develop project bundles that are $50M or higher ▪ Some exceptions may exist where bundled or one-off projects less than $40m may also be included in this bucket **Bespoke Project Finance SPV Structures** ▪ CIB's financing is between 40 and 60%; financing may increase (up to 70%) to enable deeper retrofits and fuel switching projects ▪ At this time, the CIB is expected to be sub debt to protect senior lenders from requiring guarantees; Private Financing is raised at Financial Close ▪ Repayment source is based on energy savings materialized as a result of retrofits.	▪ Standardized measurements and verification standards as well as methods developed by WSP ▪ WPS to manage energy savings to avoid disputes/claims ▪ Energy audits financed and conducted by CIB's advisors or through a technical Vendor of Record (VOR). These reports and audits are required for CIB's commitments, as they form the base to build our business case. ▪ Portfolio and aggregation analysis developed by the CIB and its advisors, with Sponsors, to bundle projects ensuring target rate of returns ▪ Business case and financial modelling development by the CIB ▪ Standardized processes, procurement documents and energy performance contracts, where possible

Figure 43. *CIB Offering*

All proposals and retrofit projects are required to meet eligibility requirements and undergo a technical and financial due diligence process. Interest rates of CIB funding can range from 0.05% - 3% for terms of up to 25 years depending upon the level of GHG savings that can be achieved by the project. Example scenarios of the CIB program are illustrated below.

Illustrative example and scenarios

Capital Cost for Retrofit = $100M
(*Replacement of HVAC, windows, air distribution, roof, lightning, heating & cooling etc*)

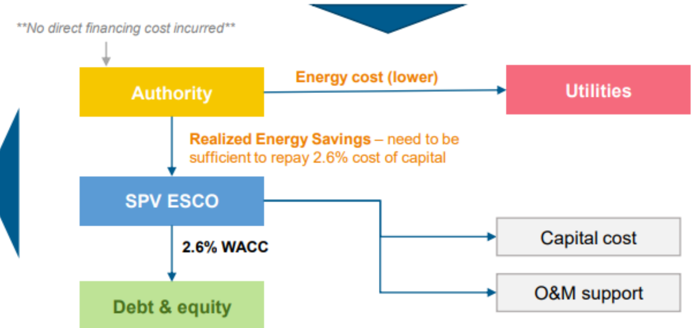
Annual Buildings Base Energy Cost in 2020 = $12M
Inflation = 2%

Equipment Maintenance = Negligible

ESCO Management Fee = Negligible

ESCO Capital Structure	Rate	Rationale - to be confirmed	Gearing
CIB	1.0%	*Sub debt facility assumed*	*60%*
Third-Party Debt	3.5%	*GOC + 180-220 bps*	*30%*
Equity	9.0%	*Equity IRR close to utility rate (between 8.5 – 10%)*	*10%*
ESCO Cost of Capital		2.6%	

Scenarios	Option 1	Option 2	Option 3
Term (*payback period*)	**20**	**25**	**30**
WACC (weighted average cost of capital)	2.6%	2.6%	2.6%
Debt service + distributions	$6.5M	$5.5M	$4.9M
Minimum required % energy savings for business case	**45%**	**37%**	**31%**
Sponsor net savings (*energy*)	$ 0	$ 0	$ 0
Sponsor savings (indirect *O&M*)	Retained by sponsors		



Note: CIB gearing could vary between 40% to 70% of total project costs, depending on GHG reductions targets
Additional sources of repayment might be required in case cost savings cannot cover full debt service and distributions

Figure 44. *CIB Examples and Scenarios*

7.2.4. Public-Private Partnership and Energy-as-a-Service (EaaS)

To reduce their energy and carbon footprint, public and private sector facility operators and owners are increasingly exploring and leveraging innovative business models that create new opportunities for their organization to finance energy-efficient building technologies, renew infrastructure, and renew or construct net-zero ready buildings. Traditional models previously used to address these opportunities include pay-for-performance contracts, energy savings performance contracts, power purchase agreements, and on-bill financing.

One innovative business model gaining interest offers energy-as-a-service (EaaS). This represents a shift from client-owned equipment toward a model where the service provider maintains ownership and the customer pays for the services provided by the project or program. The maintenance of the equipment is also the responsibility of the service provider. Blackstone anticipates that the integrated nature with much of the EaaS infrastructure and assets, that a hybrid model of collaborative maintenance will emerge to share resources and expertise producing better outcomes for all stakeholders in this critical area of operations.

This financial solution helps organizations implement complex carbon, energy, and water efficiency projects with no upfront capital expenditure. The provider designs the project scope finances the material and construction costs maintain (in partnership with the client) project equipment/systems & buildings (if applicable) and monitors the performance to validate energy and operational savings as shown in the figure below.

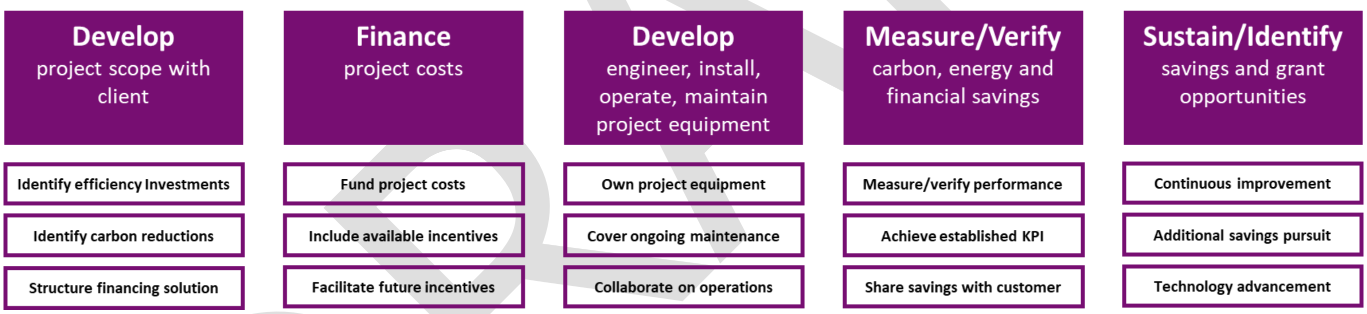


Figure 45. *Roles Overview of Energy-as-a Service Provider*

The client pays back the project/program costs through a monthly, quarterly, or annual fee for the services received. The payment is generally based, directly or indirectly, on the energy, maintenance and other quantifiable operational savings realized on the client's fiscal operating plans. Experience in Europe and the US to date with this service-based model suggests energy-related and operational savings potential up to 20–25% can be achieved to create the value for the service provider and clients to develop a mutually beneficial EaaS agreement.

Traditional energy efficiency solution models focus on lighting, HVAC equipment, software, and general energy conservation measures. EaaS solutions are more comprehensive and include green infrastructure renewal initiatives such as district heating systems, geothermal, heat pumps, solar PV, lighting retrofits, upgrades to HVAC and other equipment, building automation and controls, energy storage, Electric Vehicle charging systems, building envelope upgrades and water efficiency measures.

The EaaS Model

The figure below shows the structure of a typical EaaS relationship.

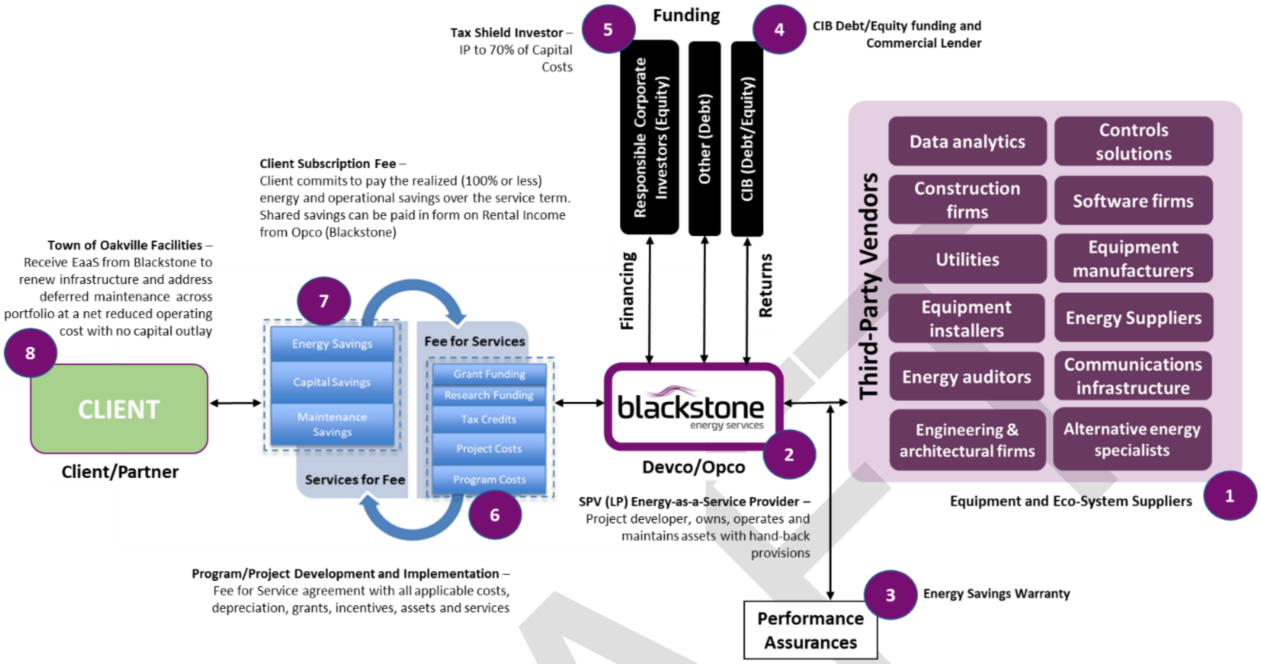


Figure 46. *EaaS Relationship Structure*

The EaaS model usually shifts the burden of financing, owning, installing, and managing the performance of an energy asset from the client to the service provider. Before any energy-related or operational saving measure(s) or services are implemented, the service provider conducts or arranges for detailed investment grade feasibility assessments to establish the business case for the client and provider. Once the project or service scope is finalized and construction completed, a measurement and verification (M&V) analysis determines the actual savings. The client is responsible for a service fee, typically based on the units of energy or operational savings associated with the project or program of works. The payment can be structured either as a percentage of the customer's utility budget or as a fixed amount that may include deemed operational savings. In any case, the client's payments are below its current utility and operating budget and the provider promises a certain level of savings and adjusts payments if it is not realized. At the end of the contract period (generally 10 to 30 years), the client can purchase the equipment at fair market value, have the provider remove it, or extend the EaaS contract.

Large buildings, or a portfolio of smaller buildings that add up to a bigger footprint, provide an opportunity for greater energy savings and represent an ideal situation of the EaaS contracting process.

The EaaS model may seem similar to Energy Services Company (ESCO) financing, but they differ significantly. While the ESCO industry has delivered savings in the public building sectors in the past, the EaaS model is designed to help public sector building owners now facing limited capital and constrained technical resources or expertise to implement these complex green infrastructure projects/programs.

Using an Energy Savings Performance Contract (ESPC) agreement, an ESCO guarantees energy savings to a client over a set period by installing and maintaining equipment. Depending on the ESCO, it may provide financing or require outside funding through loans, capital lease, or bond issuance, which are on-balance-sheet financing mechanisms. Under this structure, the client owns more-efficient equipment but may be vulnerable to the fluctuations in energy prices and cash savings short-fall due to contractual baseline changes and other risk management instruments leveraged by the ESCO. By contrast, the third-party EaaS providers are responsible for meeting the reliability and energy goals of the client. The provider takes on financial and performance risk by guaranteeing lower energy costs from implementing the selected project measures. The table below summarizes these differences.

Table 17. *ESCO financing versus EaaS Model*

Item	ESCO	EaaS
Capital Investment by Customer	Sometimes	No
Off-balance-sheet Financing	No	Yes
Ownership of Equipment by Customer	Often Yes	Often No
Performance Risk Borne by the Customer	Sometimes	No
Flexibility to add Retrofit During Contract Period	Difficult	Yes
Term of Contract	10-20 Years	10-30 Years

The Benefits

The EaaS model can provide valuable services to commercial, municipalities, hospitals, and higher education clients. This section offers a preliminary list of benefits.

First-Cost Savings

Many organizations hesitate to divert capital from essential business objectives to invest in building retrofits. The EaaS model can be a good fit for organizations that want to pursue deep energy and carbon infrastructure renewal without using their own finances. Under an EaaS agreement, the service provider obtains equity funding and secures third-party funding to pay for all project costs, so the client has no upfront expenses or internal capital outlay and can use their own funds for other projects.

Off-Balance-Sheet Financing

EaaS offerings are typically designed as an off-balance-sheet financing solution. The use of service payments allows businesses to shift energy and carbon infrastructure renewal projects from an expensive asset that they must buy, own, maintain, and depreciate to an operating expense similar to a standard utility bill or power purchase agreement.

Since the provider owns the energy equipment, clients have no debt on their balance sheet and their bottom line is improved. Thus, they can secure the energy and services they need with fewer uncertainties because the provider has assumed the risk for achieving energy and operational savings.

Deeper Operational and Maintenance Savings

The cost savings from the projects are calculated and guaranteed using agreed-upon M&V protocols. Because the EaaS paradigm generally relies on the pay-for-performance model, it offers potential operational efficiencies and positive cash flow from energy, water, and maintenance cost savings. The pay-for-performance nature, along with maintenance and verification of project savings, reduces the performance risk for clients and may encourage more-persistent savings and implementation of newer green infrastructure and clean technologies.

Clients have the additional benefit of being able to finance multi-measure deep green infrastructure retrofits with long simple payback periods. EaaS projects may include capital-intensive investments in HVAC upgrades with motor, pump, and boiler replacements, energy management systems, and distributed renewable energy resources. These measures offer greater energy savings, can optimize comfort and tackle carbon reduction targets. However, they are difficult to fund under traditional financing sources due to their lower return on investment.

As the EaaS providers are responsible for the energy equipment, they pay for periodic maintenance services to encourage long-term reliability and performance. The level and structure of such service vary by project type and client needs. By rewarding a third-party provider for successfully managing operations, clients reduce the risks and challenges associated with implementing, managing, and monitoring new technology. Installing more-efficient equipment with continuous maintenance may also mitigate the risk of unplanned events.

Lower Operational Risks

EaaS vendors provide access to experts who can design the project scope and install, maintain, and verify the performance of the efficiency measure. Clients have a lower risk of paying for underperforming equipment because vendors guarantee energy savings at a known cost and can attract large grants and incentives which can be used to lower capitals costs and ultimately service payments.

Long-term agreements allow clients to secure a fixed lower price for energy throughout the contract if the service provider can achieve the promised savings.

Ways forward

With rapid paybacks, upgrades to the latest technology, and no upfront capital investment, the EaaS model could provide solutions for municipalities to achieve net-zero targets and undertake strategic and comprehensive deferred maintenance and capital infrastructure renewal.

Some of the challenges to consider would be that the development and award process for an EaaS solution is long and complicated because it requires pitching the service to multiple organizational players.

Undertaking education and socializing EaaS contracts within an organization can help overcome inertia and simplify communications among the different divisions that are involved in the decision process (e.g., finance, procurement, facilities, and operations departments).

7.3. Factors that Influence Cost

In choosing its path to net-zero emissions, The Town will need to consider several factors that influence project costs, including:

- Replacement Cost
- Operational Cost
- Forecasted Utility Cost
- Cost of Solar/renewables
- Carbon Tax
- Funding Opportunities
- Utility Rate Structure
- Supporting Infrastructure Costs
- Emerging Technology Costs

7.3.1. Replacement Cost

The Aggressive and Delayed scenarios mentioned previously were based on the timing of when The Town's assets will reach the end of life. Each asset was evaluated to determine how expensive high-efficiency natural gas options would be when contrasted with comparable low-carbon, electric options. The investment difference was calculated and used to model the required investment needed to reach The Town's emission reduction goals.

As the tax on carbon-based fuels increases, the cost difference between natural gas equipment and non-fossil fuel-based equipment and other fuel sources will decrease. An example of this is presented in Case Study 5.

Case Study 5: Cost of Heating – Natural Gas vs. Electric Boilers

Table 18 lists the specifications of an industry-standard natural gas boiler and the specifications of the electric equivalent.

Table 18. *Comparing Electric & Natural Gas Boilers*

2 Million BTU Natural Gas Boiler (Space Heating Application)		
Specifications	**Natural Gas Boiler**	**Electric Boiler**
System Size	2 Million BTU	510 kW
Boiler Efficiency	87%	100%
Estimated Installed Cost	$60,000	$95,000
Estimated Equipment Life (Years)	20	25
Annual Maintenance Cost	$500	$125
Annual Utility Consumption	59,883 m^3 of gas	515,680 kWh
Utility Cost (including Carbon Price in 2030)	$0.5413/$m^3$	$0.182/kWh
Estimated Annual Operating Cost	$33,115.3	$93,889.85

The table above shows the equivalent electric boiler capacity required to produce the same energy (BTU) output as a natural gas boiler (510 kW electric boiler to a 2 MBTU natural gas boiler). The higher installation cost of the electric boiler ($95,000 for the electric boiler compared to $60,000 for the gas boiler) is balanced by its life cycle (25 years for electric to 20 years for gas), and operational efficiency (100% for electric and 87% for gas). However, the annual operational costs (based on current utility prices) render the electric boiler impractical from a financial perspective.

The significant difference lies in utility consumption and costs. An electric boiler requires 515,680 kWh to produce the same heat output as a natural gas boiler, which requires only 59,883 m^3 of gas to produce the same output. Grid electricity is approximately 35% more expensive than natural gas per BTU of energy, so it would make financial sense to defer the electrification of boilers to a later time.

However, considering the 20-year lifetime of a gas boiler, the latest The Town could defer its electrification would be 2030, after which it would have no option but to electrify to meet 2050 targets. In other words, no new gas boilers should be installed after 2030 and consideration for electric HVAC should be given to any replacements between 2023 and 2030.

7.3.2. Operational Cost

The cost to operate traditional equipment using fossil fuels is significantly less than using electricity. Converting all fossil fuel burning equipment onsite (including the corporate fleet) would result in an increase in operational cost, or total annual utility expenditure, at The Town.

Figure 47 compares the current price for several fossil fuels and their respective GHG emissions factors. Natural gas is inexpensive compared to other fuel sources. To date, this has made the business case ineffective for converting from natural gas to electricity. On an equivalent cost per unit of energy ($/ekWh), the prices for electricity and natural gas do not intersect under current market rate forecasts. As a result, there is no financial incentive for The Town to convert from natural gas to electricity in the short term.

Electric vehicles reduce fuel costs and carbon emissions. The business case for the replacement of existing fleet vehicles with comparable electric vehicles must be considered on a case-by-case basis. Due to carbon taxes, the cost to operate non-electric vehicles will increase due to the increase in fuel cost. Other technologies like heat pumps provide an example of how existing technology is becoming more cost-effective. This is illustrated in Case Study 6 on the following page.

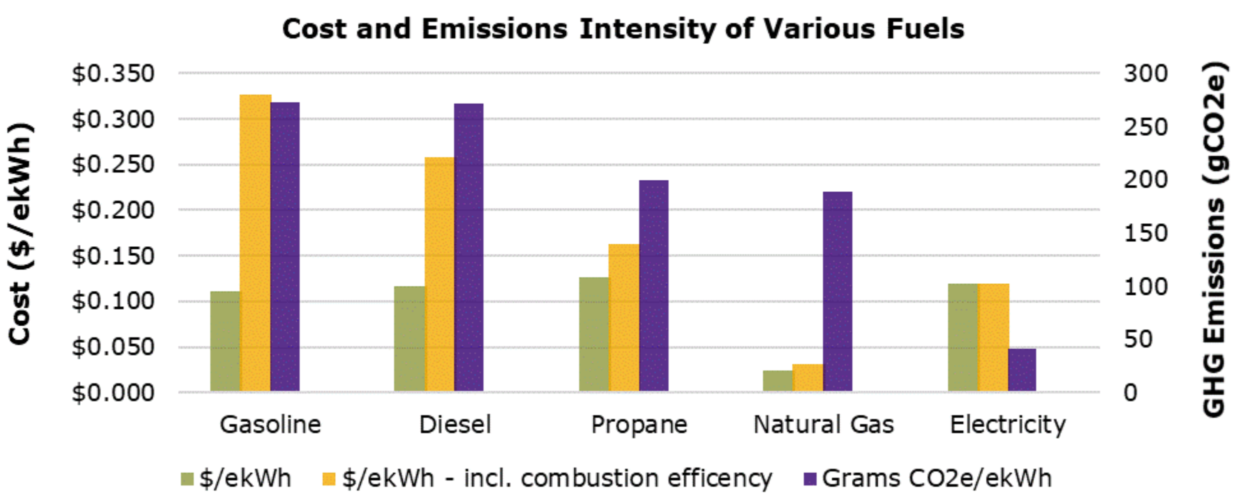


Figure 47. Cost & Emission Intensities of Various Fuels

Case Study 6: The Case for Heat Pump Technology

Heat pumps exchange energy by extracting heat from an outside source (geothermal, solar thermal etc.) and pumping it into a space. Heat pumps can also be scaled to service a wide range of building types and applications. Heat pumps are more energy-efficient than natural gas burners and electric resistance heating coils. Air source heat pumps are capable of operating at outdoor temperatures below freezing at >1.0 annual coefficients of performance.

Heat pumps with Variable Refrigerant Flow (VRF) systems can provide simultaneous heating and cooling and multiple zone control. Outdoor units are connected to indoor fan coil units via refrigerant pipes and can be integrated with smart building technology and BAS. A typical VRF system is demonstrated in the figure below:

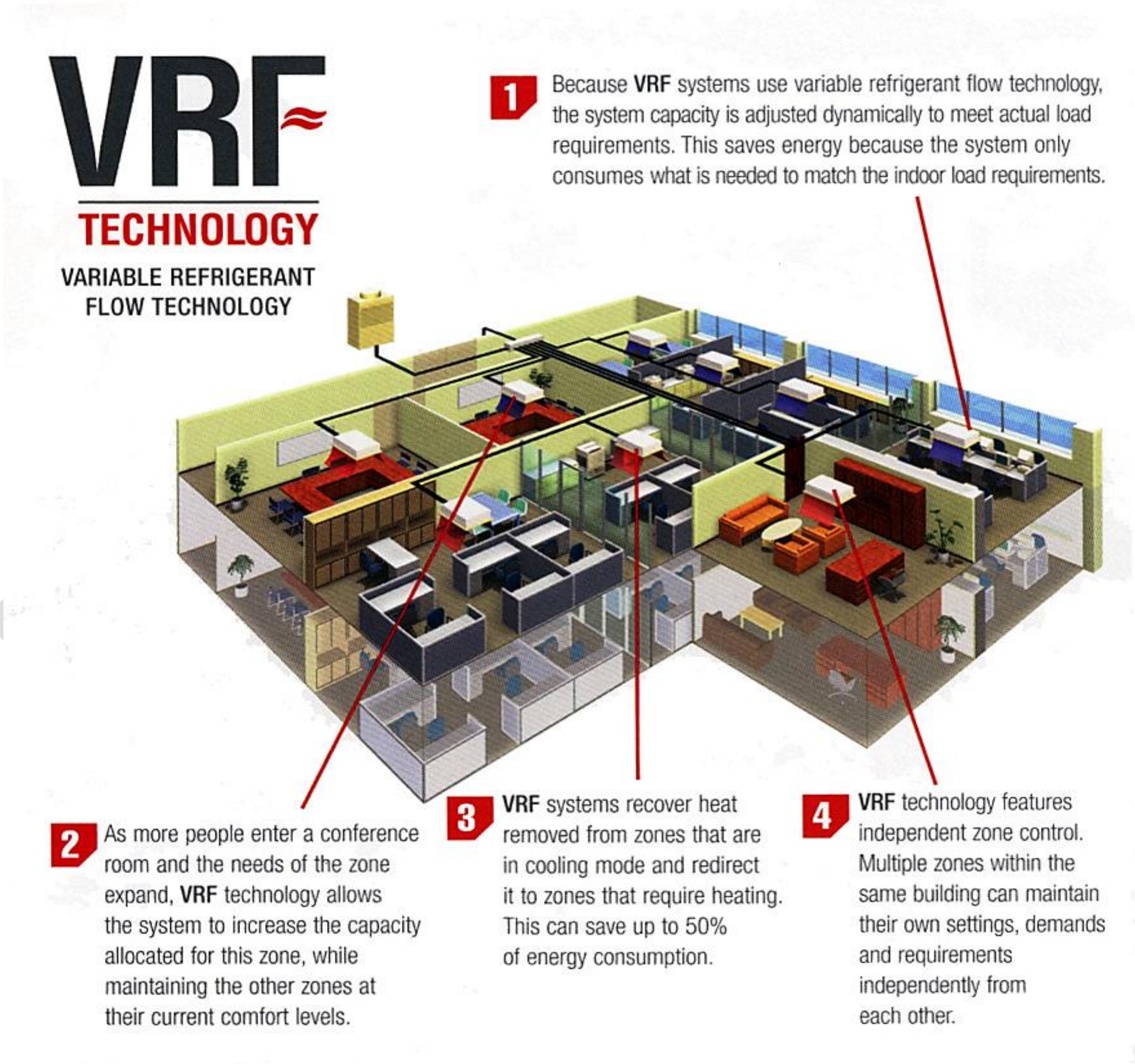


Figure 48. *Variable Refrigerant Flow Technology*

Case Study 6: The Case for Heat Pump Technology

Price

Today, using a heat pump can cost twice as much as traditional packaged rooftop units that consist of direct expansion (DX) cooling and natural gas burners. However, heat pump technology is becoming increasingly cost-effective and, according to the National Energy Board, costs could drop 10% to 20% by 2025 to 2030, and 20% to 30% by 2040. These numbers line up with the forecasted replacement HVAC replacement schedule listed throughout this GRRAP.

Heating

Depending on outdoor air temperature, a heat pump can achieve COP as high as 3.4 in heating mode, meaning the heat pump can produce 3.4 kW of heating energy for every kW of electricity consumed.

As outdoor air temperature drops below 0°C, the efficiency of heat pumps drops significantly and may require additional support from either an electric heating coil, a natural gas burner or a larger heat pump capacity. For example, at sub-zero temperatures, a 20-ton heat pump may only produce the heating equivalent of a 15-ton heat pump. Advances in heat pump technologies are targeting lower ambient temperatures with high COPs.

Cooling

High-efficiency heat pumps or DX units provide substantial energy and utility cost savings compared to traditional standard efficiency DX cooling applications, as demonstrated in the example below. Depending on outdoor air temperature, a heat pump can achieve Integrated Energy Efficiency Ratio (IEER) as high as 18.6 (COP of approximately 5.4), meaning the heat pump can produce 5.4 kW of cooling for every kW of energy consumed.

Example: 20-Tonne Heat pump RTU Annual Operating Costs

The following table shows the difference in annual operating costs associated with using a 20-ton heat pump instead of an RTU that has 15-ton DX cooling and a natural gas burner, based on current electricity and natural gas utility rates. The case is based on a theoretical 5,000 sq. ft space with one exterior wall in the Greater Toronto Area. The assumed operating schedule is Monday to Friday from 7AM to 5PM.

Table 19. *Comparing Heat Pumps with Natural Gas Burning Equipment*

Technology	Cooling Energy ($)	Heating Energy ($)	Fan Energy ($)	Total Annual Energy Cost ($)
Rooftop Unit + Gas Boiler	$1,014	$1,026	$1,688	$3,728
20-ton heat pump	$460	$4,377	$434	$5,271
Heat pump savings	$554	-$3,351	$1,254	-$1,543

Case Study 6: The Case for Heat Pump Technology

Relatively low prices of natural gas compared to electricity prevents electric heat pumps from yielding cost savings compared to high-efficiency natural gas furnaces. A 20-tonne electric heat pump is more expensive to operate annually than a rooftop natural gas unit based on current electricity and natural gas utility rates. However, improvements to heat pump technology and an increased cost of carbon will make heat pumps a cost-competitive alternative to natural gas equipment[8]. The cost of carbon has been mentioned a few times in this report and must be taken into consideration when comparing natural gas and electric systems. A life cycle cost assessment is recommended when this comparison is being made, over 15 years minimum and including the costs of carbon. The technology cost curve mapped against technology efficiency is illustrated in Figure 49.

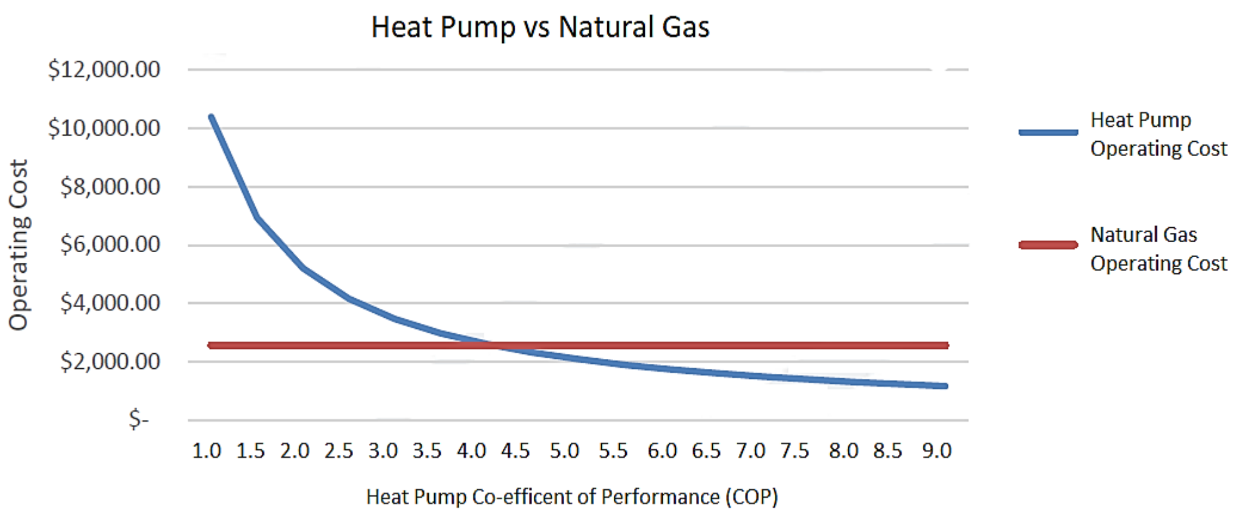


Figure 49. *Technology Cost Curve for Heat Pumps*

[8] Graham Cootes (P.Eng.), HTS Toronto. Email: graham.coote@hts.com

7.3.3. Forecasted Utility Cost

Ontario's 2017 Long Term Energy Plan (LTEP) created by the Independent Electricity System Operators (IESO), states that electricity prices will continue to rise in Ontario between 2019 and 2050. The federal carbon tax will increase the price of electricity and natural gas. The price escalation rate for electricity was derived from Ontario's LTEP[9], and escalation forecasts for natural gas were derived from the current commodity and distribution costs.

Table 20. *Forecasted Utility Prices*

Forecasted Utility Prices	2019	2030	2050
Electricity ($/kWh)	$0.1377	$0.2113	$0.2768
Natural Gas ($/m3)	$0.26	$0.35	$0.46
Natural Gas ($/ekWh)	$0.025	$0.034	$0.047
Nat Gas with Eff Losses ($/ekWh)	$0.032	$0.044	$0.059

The future forecasted rates for both grid electricity ($/kWh) and natural gas ($/ekWh) would not intersect, i.e., the forecasted price for grid electricity was not found to be equal to or less than the price for the equivalent amount of energy from natural gas.

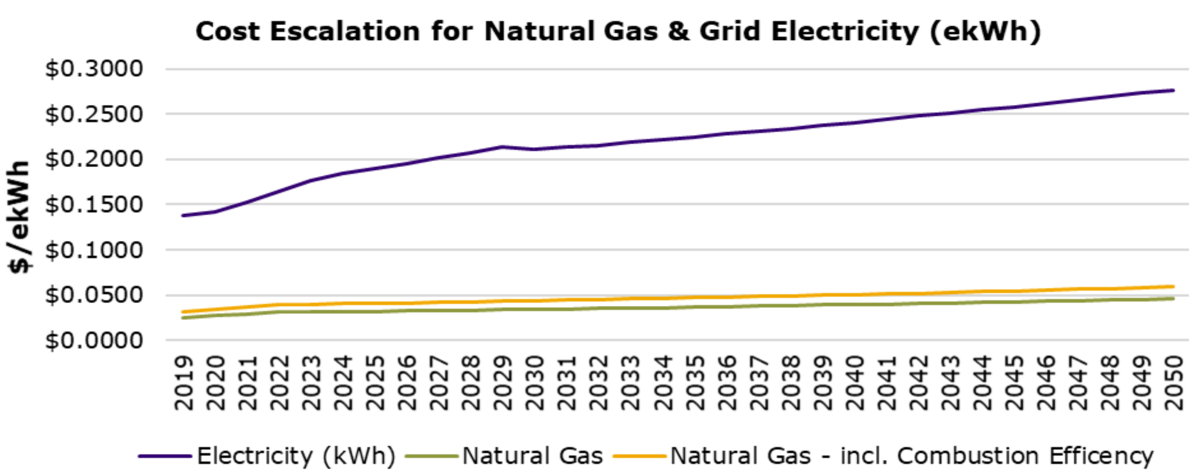


Figure 50*. Forecasted Utility Cost Escalation*

[9] Ontario's Long-Term Energy Plan - Delivering Fairness and Choice, 2017; https://files.ontario.ca/books/ltep2017_0.pdf

7.3.4. Cost of Solar Power

Pillar 4 of The Town's GRRAP, renewable energy, plays a significant role in supporting them in meeting their 2050 targets. Under each scenario, The Town will need to acquire electricity from clean or renewable sources to reduce the impact of electricity costs and electrification. Solar panel prices, for example, have been declining steadily since 2010. The following chart shows the estimated price for solar panel installations in Ontario. Costs are also dependent on system size – larger systems are lower cost/kW.

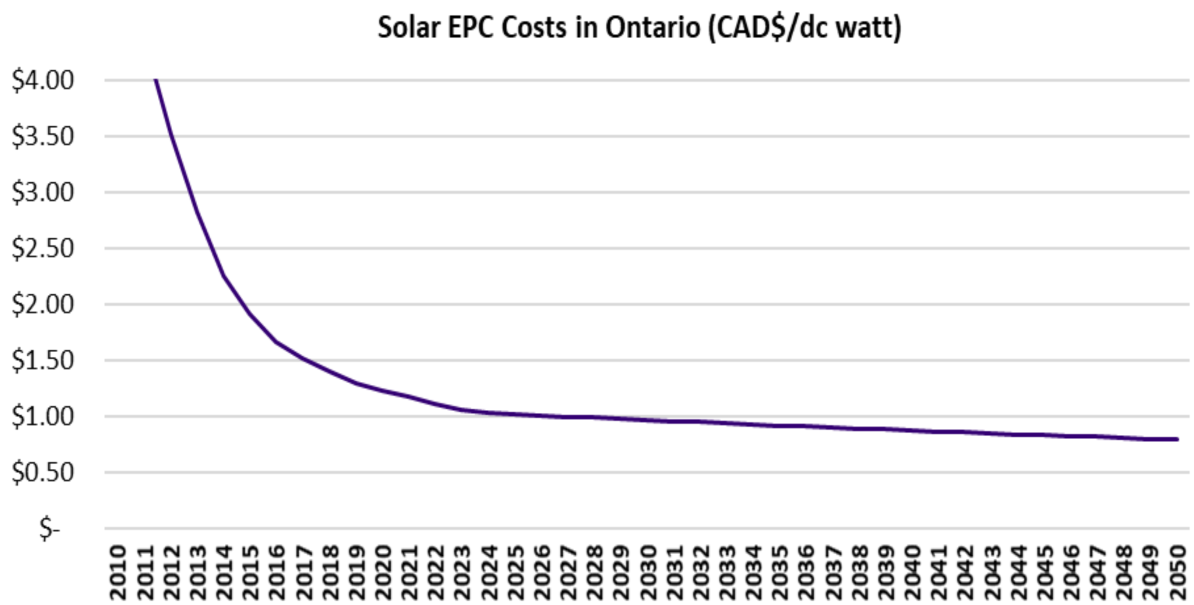


Figure 51. *Forecasted Solar PV Costs*

The following analysis was conducted based on the price curve in the chart above, Solar EPC Costs in Ontario, forecasted grid electricity rates ($/kWh) in Ontario, and the price for electricity generation ($/kWh) for onsite solar generation (including annual maintenance costs) assuming a 25-year life on solar panels.

Figure 52 shows that the price to produce electricity from either roof-mount or carport solar onsite would be less expensive than the cost to purchase electricity from the grid from 2019 through 2050. The chart also shows the cost of solar electricity if The Town was to finance the roof-mount or car park solar. The model assumes an interest rate of 6.5% over a 25-year term. The price for electricity generation ($/kWh) was determined under the assumption that an average solar panel at 1 kW would produce 1,200 kWh/year.

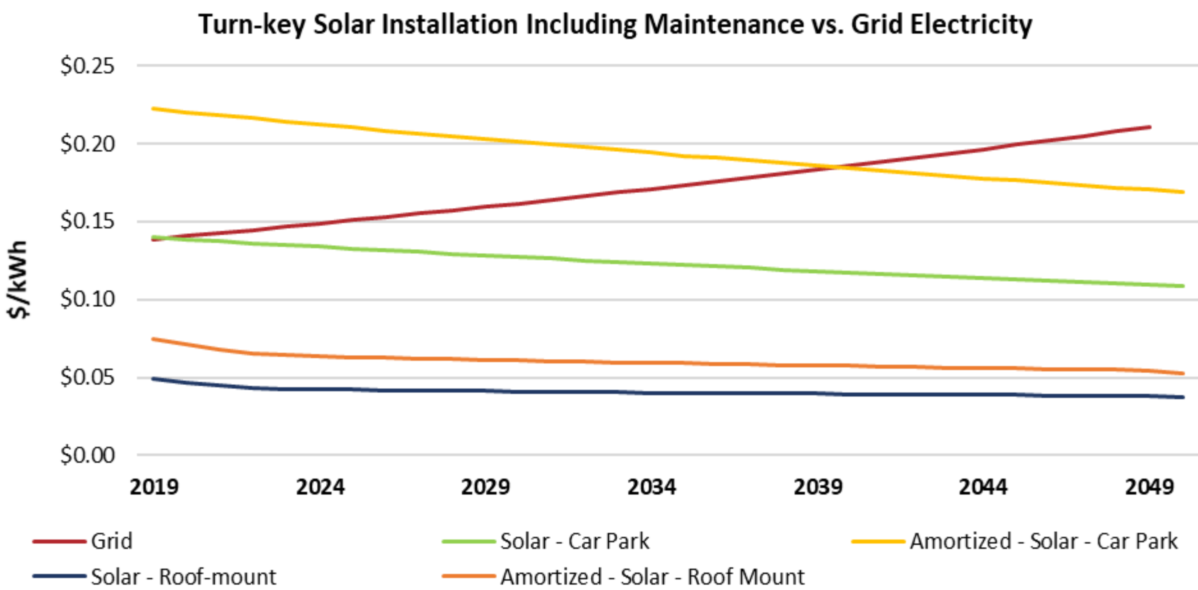


Figure 52. *Solar PV Costs vs Utility Cost for Grid Electricity*

7.3.5. Carbon Tax

A carbon tax increases the price of natural gas, gasoline, diesel, and propane. It will have minimal impact on the price of Ontario's grid-produced electricity, as it is relatively low carbon. The federal government of Canada committed to a carbon tax of \$20/tCO_2e in 2019, which will escalate annually by \$10 until 2022 when it would reach \$50/tCO_2e. this was further revised to escalate annually by \$15 until 2030 when it would reach \$170/tCO_2e.

Table 21. *Effect of Carbon Price on Natural Gas Costs*

Effect of the Federal Carbon Backstop	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Federal Price on Carbon (\$/tCO_2e)	\$20	\$30	\$40	\$50	\$65	\$80	\$95	\$110	\$125	\$140	\$155	\$170
Federal Price on Carbon (\$/m^3)	\$0.039	\$0.059	\$0.078	\$0.098	\$0.127	\$0.157	\$0.186	\$0.215	\$0.245	\$0.274	\$0.303	\$0.333
Actual Price of Natural Gas (\$/ekWh)	\$0.025	\$0.027	\$0.029	\$0.031	\$0.057	\$0.070	\$0.083	\$0.096	\$0.109	\$0.122	\$0.135	\$0.149

The implementation of a carbon tax creates financial incentives to move to low-carbon fuel sources. Currently, the prices of gasoline, diesel and propane are like the price of electricity for the equivalent energy output with a cost of between 0.111 \$/ekWh and 0.127 \$/ekWh. Natural gas, at 0.027 \$/ekWh, is currently about a fifth of the cost of grid electricity for the equivalent energy output.

The Canadian federal government has established a 2030 price for carbon at \$170/tCO_2e. To truly discourage burning natural gas would require a price of ~\$372 - ~\$600/tCO_2e. Carbon pricing schemes in Canada are inconsistent and can vary year to year by jurisdiction.

7.3.6. Funding Opportunities

Identifying funding opportunities to support electrification may be required to support The Town in achieving net-zero targets. Renewable energy, ECDMs and green buildings all have proven fiscally responsible business cases. However, given the low cost of fossil fuel-based technologies, electrification currently does not have a sound business case.

In 2019, the federal government announced multiple initiatives to support Canada's achievement of net-zero emissions by 2050.

Currently, there is insufficient government funding or incentive support to assist in paying for the additional installation and/or operational cost associated with total facility and fleet electrification. However, the GRRAP provides the roadmap for The Town to be "shovel-ready" for grants and incentives as soon as they become available.

7.3.7. Utility Rate Structure

The utility rate structures differ for natural gas and electricity consumption. For natural gas, rates are based on consumption. For electricity, rates consider how much electricity (demand) is required, for how long (kWh) and when the electricity is consumed (time of use). The Town consumers who have a demand of more than 1 MW (and less than 5 MW) can opt into being "Class A" consumers to reduce their global adjustment (GA) charges. In Ontario, the GA charge is a significant component of electricity bills. It covers the cost of building new electricity infrastructure in the province, maintaining existing resources and providing conservation and demand management programs. GA currently represents approximately 80% of the total price of electricity.

To determine the full cost of an ECDM or renewable energy measure, the potential increase of The Town's total electrical cost should be considered if the Class rating is impacted. It is recommended that The Town evaluate each project on a case-by-case basis to evaluate if projects will impact Class rating. For this document, modelling assumed that the price per kWh was based on a Class B consumer rate.

7.3.8. Supporting Infrastructure Costs

In addition to the cost to upgrade infrastructure, further investments may be required to upgrade supporting electrical systems at The Town. It is likely that as each piece of HVAC equipment is converted to fully electric, the supporting electrical infrastructure will also need to be upgraded. This will have cost implications.

7.3.9. Emerging Technology Costs

New clean technologies such as EVs, battery storage and renewable energy are currently quite expensive and face roadblocks during scaling and commercialization. It is expected that these technologies will become more cost-effective in the future, either through government incentives or favourable regulatory and financial market conditions in Ontario, Canada and around the world.

8. Barriers and Considerations

The following section outlines the barriers and considerations that will impact The Town's path to achieving 80% GHG reduction from 2014 level. As The Town moves towards an 80% GHG reduction, each issue should be seriously considered.

8.1. Physical Space Available for Renewal Projects

8.1.1. Barrier

Based on the current solar analysis and a review of the potential for onsite geothermal systems, there is currently not enough space available onsite for The Town to generate the amount of renewable energy required to make its buildings net-zero. Solar PV is a proven and cost-effective form of renewable energy. However, its utility can be limited by the amount of physical space it occupies.

8.1.2. Consideration

Based on the solar review for The Town, they have enough space to accommodate approximately 75,000 kW of rooftop solar, ground and carport. This would generate approximately 86 million kWh of electricity. Based on current forecasts and business as usual scenario The Town would require about 22 million kWh of solar generation to offset the emissions but with consideration of the electrification scenario, this demand will increase significantly to 80 million kWh by 2050.

The more energy-efficient the building is the fewer solar panels required to make it zero carbon. Figure 53 shows the correlation between energy-efficient building design and future renewable energy requirements in terms of solar panels[10]. The image also references the total amount of roof space that would be required to accommodate the solar panels required for The Town's buildings to reach zero carbon.

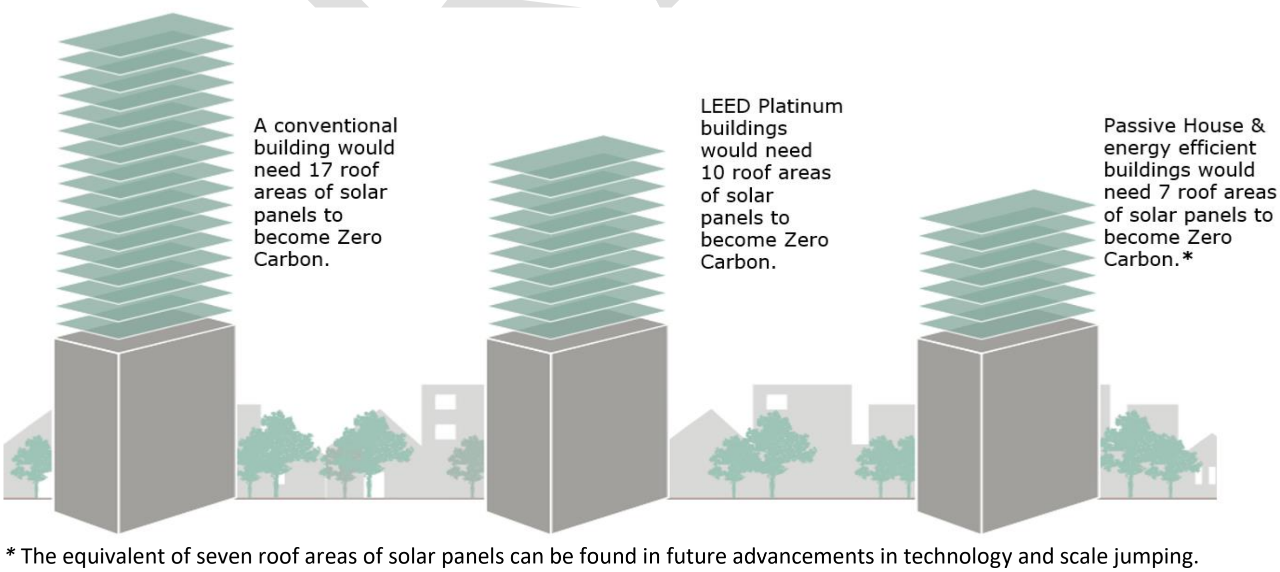


Figure 53. *Energy Efficient Building Design*

[10] New Buildings Institute: Net Zero and Living Building Challenge Financial Study: A cost comparison report for buildings in the District of Columbia

8.2. Virtual Net-Metered Renewable Energy Generation

8.2.1. Barrier

As shown in Figure 54, virtual net metering for renewable energy generation would allow The Town to produce renewable energy offsite that could be credited against the energy use in their facilities. However, virtual net metering is currently not permitted by the IESO.

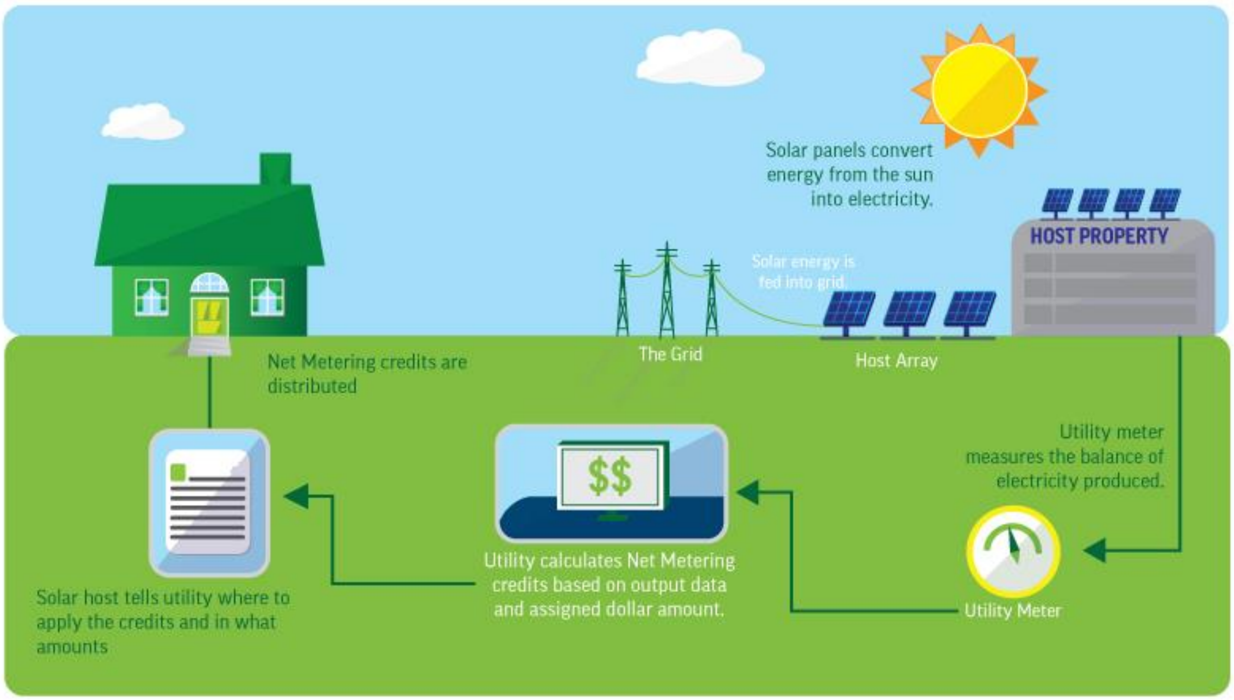


Figure 54. *Virtual Net-Metering Model*

8.2.2. Consideration

Virtual net metering is a bill crediting system administered by the local electricity distribution company that allows the owner of a power-generating asset to be in a different geographic location than that of the actual power-generating asset. With virtual net metering, the owner of the power generating asset might not be the direct consumer of the electricity generated but would still take ownership of the environmental attributes associated with the generation with the local distribution company. The local distribution company would credit The Town's monthly utility bills for the electricity generated by the renewable generation system. Virtual net metering would eliminate the need for physical space requirements for onsite generation and help The Town meet its 2050 target. However, as mentioned it is not currently permitted by the IESO.

8.3. High GHG Factor for Refrigerants

8.3.1. Barrier

The electrification of cooling systems, specifically installing heat pumps and high-efficiency chillers increase refrigerant use. Refrigerants are prone to leakage and are carbon-intensive.

8.3.2. Consideration

It is recommended that The Town replaces fossil-fuelled equipment with electrical equipment. When electric equipment is installed – specifically chillers, heat pumps and refrigeration equipment – the updated technology requires refrigerants as part of the cooling process. Refrigerants are fluorinated gases, which create GHG emissions. Refrigerants are used onsite when the technology is installed and are refilled annually as a small portion of the refrigerants can leak out. Leakage is dependent upon the operating efficiencies of the equipment and is included in The Town's annual Scope 1 emissions profile.

The refrigerants have a high global warming potential (GWP) and are expressed relevant to CO_2 emissions. The more electrification, the higher the emissions from refrigerants. However, fossil fuel-based equipment is still significantly more carbon-intensive and emits substantially more carbon per GJ produced and consumed.

8.4. Grid Carbon Intensity

8.4.1. Barrier

In every scenario considered, The Town will continue to be reliant on grid-provided electricity for a portion of electrical needs. It is difficult to project the carbon intensity of Ontario's utility-provided electricity.

8.4.2. Consideration

The carbon intensity of the electrical grid, as measured in grams produced per kWh consumed (g/kWh), is determined by the source of electricity production. Compared to other provinces, Ontario's electricity is relatively low carbon. It is predominantly supplied by non-emitting sources of power generation, including hydroelectric and nuclear.

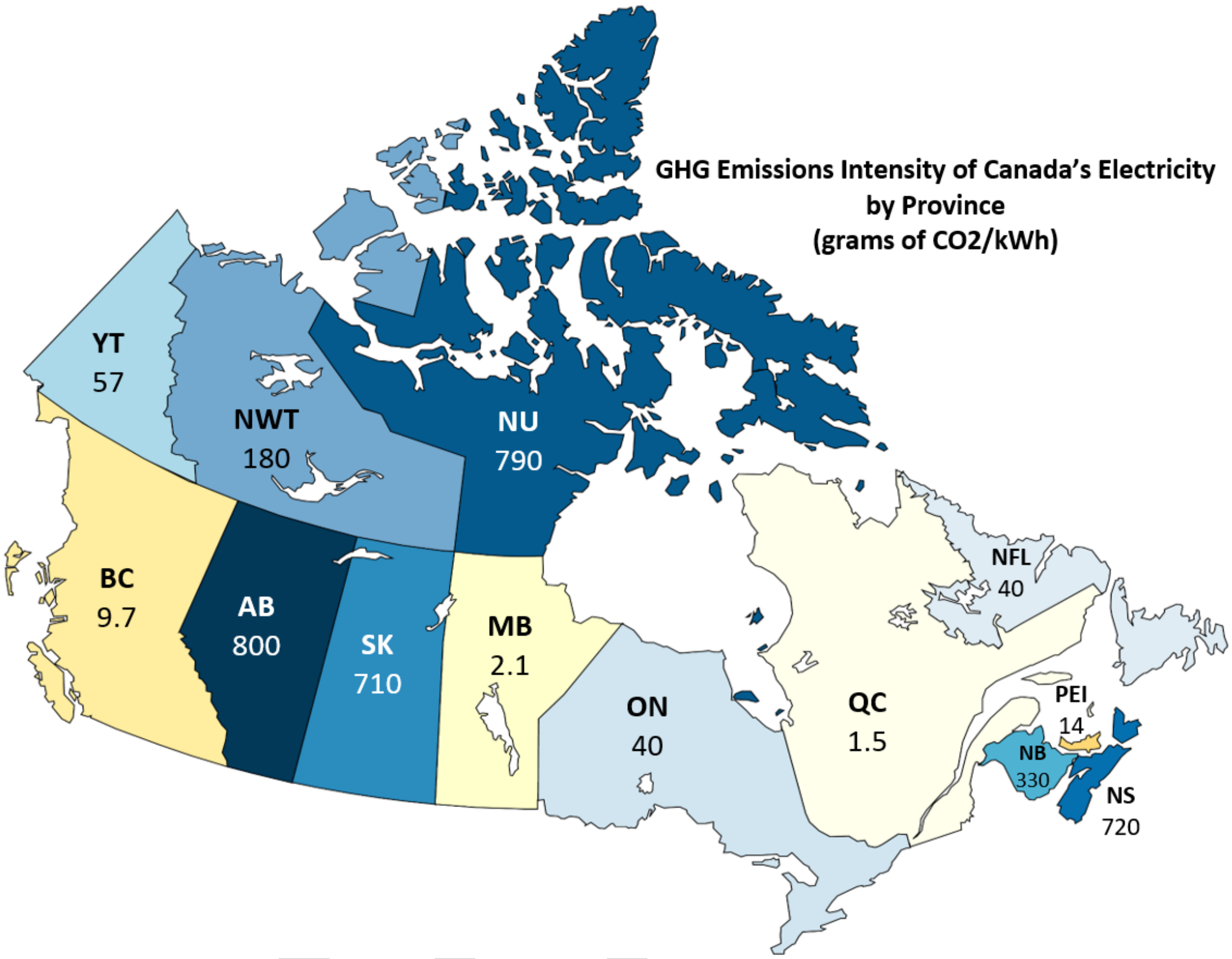


Figure 55. *Emission Intensities of Electrical Grids across Canada (2019)*

The electricity generation in Ontario is mostly powered by nuclear and hydroelectric plants. This has rendered the province with a carbon frugal electric grid – 0.000040 tCO_2e/kWh or 40 grams of CO_2e/kWh. This is one of the lowest emissions intensities of electric grids across all Canadian provinces (see Figure 55). The electrical mix of Ontario's grid is illustrated in Figure 56.

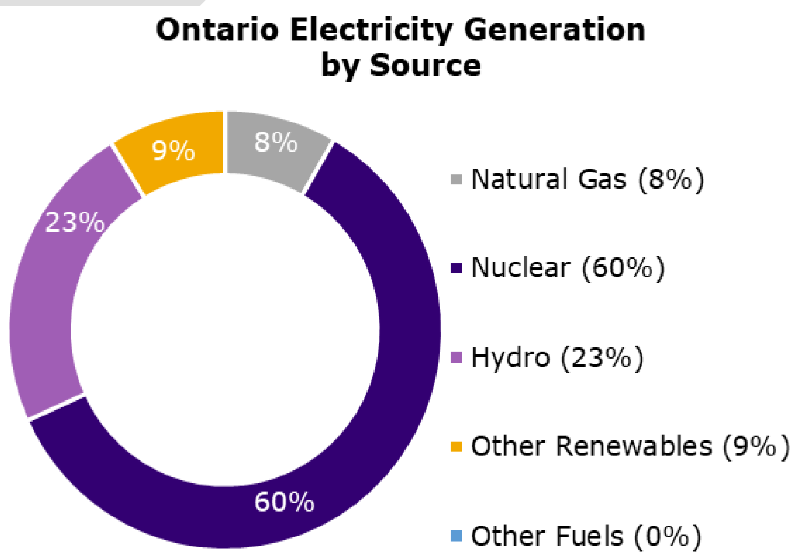


Figure 56. *Electricity Generation Mix in Ontario*

According to Environment and Climate Change Canada (ECCC), natural gas combustion provides approximately 8% of all electricity generation in Ontario. It also accounts for approximately 97% of the total GHG emissions for electricity generation. If Ontario was to replace existing natural gas generators with either nuclear or renewable energy, the GHG emissions intensity of electricity would reduce significantly, thereby reducing The Town's onsite emissions and eliminating the need to invest in its own renewable energy production.

The IESO procures Ontario electricity generation contracts. The 2019 IESO LTEP outlined Ontario's current electricity procurement contracts, including expiration dates. In Ontario, natural gas-fired electricity plants currently provide the peak energy requirements in the province and are the main contributor to the GHG emissions of the electrical grid. The last natural gas-fired generation is contracted to end between 2038 and 2041. The grid mix – and subsequent grid carbon intensity – is not defined past 2041. However, the GRRAP is assumed to be consistent to 2050.

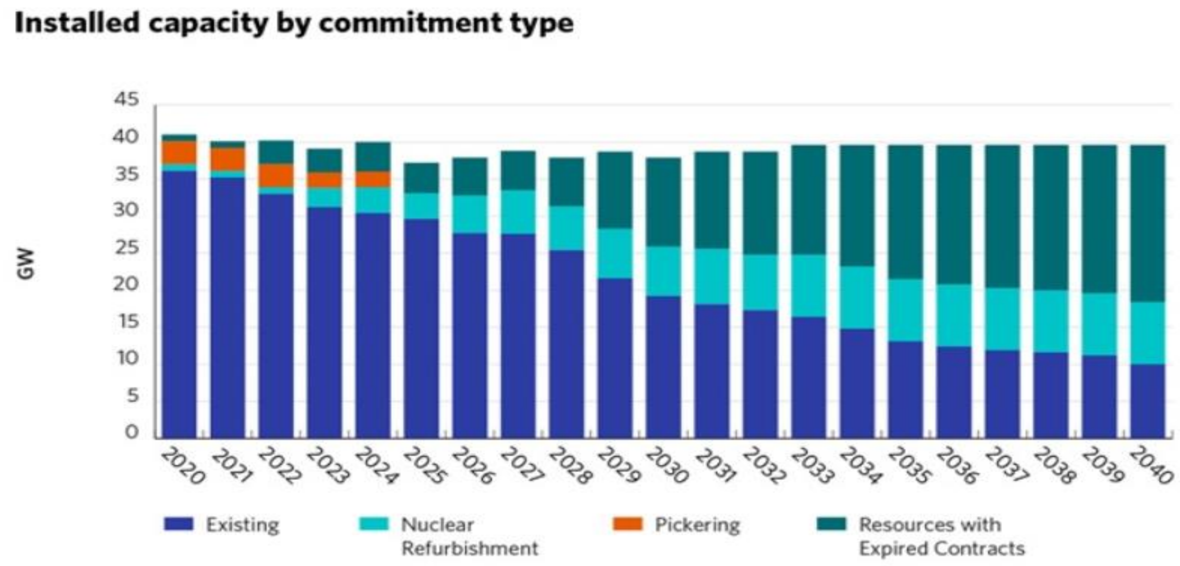


Figure 57. *Ontario's Installed Power Capacity*

Between 2020 and 2050, the grid could potentially decarbonize further if there is political will, which would significantly impact The Town's path to 80% GHG reduction from 2014 level. Ontario's electricity generation is determined by the IESO as directed by the Ontario Ministry of Energy[11]. Currently, the grid has a low carbon intensity factor as the result of eliminating coal from the generation stack in 2013.

[11] *IESO: http://www.ieso.ca/Powering-Tomorrow/Data/The-IESOs-Annual-Planning-Outlook-in-Six-Graphs*

9. Supporting Sustainability Initiatives

This section provides a summary of scope 3 emissions and suggestions on waste to continue to foster sustainable practices in The Town. The Sustainability Policy Cycle will help garner support and spread awareness amongst the broader community. Operational policies established by The Town can influence resident and employee behaviour.

Scope 3 GHG emissions are generated by both The Town's operations and as a direct result of those that live and work there. It is vital to have sustainability policies that align with The Town's climate action strategy and its GHG emissions reduction targets.

The followings are some of the sources for Scope 3 GHG emission:

- Commuting
- Air travel
- Paper purchases
- Waste

9.1. Waste Management

To achieve its GHG emissions target, The Town should implement programs and strategies to continue to reduce emissions from Scope 3 emissions, including a target to reduce waste by 2050.

Three waste diversion strategies should be focused on: upstream, onsite, and downstream. Upstream is waste that is produced before a product reaches The Town; onsite is produced in The Town, and downstream is how a product is disposed of.

The following strategies can be implemented in The Town to help achieve the goal of reducing waste and emissions associated with waste:

Upstream

- Upstream waste reduction through sustainable material management.
- A stronger focus on waste reduction as it related to purchasing decisions. Look for products with less packaging; bring fewer single-use disposable items into The Town and reduce the amount of less non-recyclable and non-compostable materials being purchased.

Onsite

- Eliminate single-use products (i.e., disposable food service ware, disposable cups, straws, etc.).
- Require new buildings, expansions, or renovations to reuse or recycle at least 50% of the construction debris or dispose of no more than 2.5 lbs. per sq. ft.
- Replace plastic bags with reusable, compostable or paper bags labelled with 40% post-consumer recycled content.
- Create programs for residents to submit proposals for service enhancements, innovations, or cost-savings on waste.
- Host recycling/reuse events.

Downstream

- Create multiple locations in facilities where staff and visitors can bring their hard-to-recycle materials (i.e., electronics, small appliances, books, textiles, etc.).
- Increase awareness around proper waste sorting to improve residents Fand staff participation in composting and recycling programs (i.e., improved signage, more centralized waste bins, expand composting).

The reduction strategies focus on reducing the total amount of disposable products purchased by The Town, while the diversion strategies focus on recycling and composting all waste.

Appendix 1: List of Included Buildings

Archetype	Facility	Facility Size (sq. ft)	Facility Size (%)
Arenas	Joshua's Creek Arena	73,400	3.59
	Oakville Arena	41,000	2.01%
	Kinoak Arena	21,000	1.03%
	Maple Grove Arena	28,971	1.42%
	16 Mile Sports Complex	196,000	9.59%
Operations & Administrative	Central Operations	98,232	4.81%
	Canada Post Office	40,290	1.97%
	Commercial Buildings (Cross Avenue)	5,296	0.26%
	Commercial Buildings	3,166	0.15%
	Fire Prevention Portable (Office)	2,000	0.10%
	Fire Prevention Quonset Hut (Storage)	600	0.03%
	Fire Station 1	5,619	0.27%
	Fire Station 2	5,673	0.28%
	Fire Station 4	4,525	0.22%
	Fire Station 5	5,906	0.29%
	Fire Station 6	8,470	0.41%
	Fire Station 7	7,950	0.39%
	Fire Station 8	11,000	0.54%
	Fire Training Centre	5,856	0.29%
	Gairloch Gallery	9,674	0.47%
	Gairloch Gift Shop	960	0.05%
	Nottinghill Park Building	2,400	0.12%
	Old Post Office & Thomas House	1,012	0.05%
	Parks Central Depot	11,100	0.54%
	School Lease Spaces	46,404	2.27%
	Southeast Satellite – Parks Office & Storage	14,100	0.69%
	Transit Main Depot- Garage	49,400	2.42%
	Fire Station 3	15,629	0.76%
	North Ops	17,909	0.88%
	Town Hall	162,092	7.93%
	Transit Facility	265,000	12.96%
Community Centers	Centennial Pool	17,640	0.86%
	Bronte Youth Centre	9,000	0.44%
	Coronation Park – Stone Barn/Outdoor Theatre	2,002	0.10%
	Glen Abbey Library	14,984	0.73%
	Greenhouse	12,250	0.60%
	Harbour Banquet and Conference Centre	23,458	1.15%

	Metro Marine & Bronte Harbour Office Trailer	5,600	0.27%
	North East Hub Building	1,150	0.06%
	Oakville Historical Society	2,379	0.12%
	Oakville Museum – Coach House	1,973	0.10%
	Oakville Museum – Erchless Estate	6,615	0.32%
	Oakville Youth Development Center	1,500	0.07%
	Seniors Drop In Centre	8,072	0.39%
	Woodside Library	14,203	0.69%
	Central Library	47,220	2.31%
	Glen Abbey CC	134,500	6.58%
	OCPA	24,720	1.21%
	Iroquois Ridge CC	69,282	3.39%
	QEPCCC	145,760	7.13%
	River Oaks CC	113,028	5.53%
	Sir John Colborne	9,065	0.44%
	Trafalgar Park CC	62,875	3.08%
	Oakville Trafalgar CC	41,200	2.02%
Other	Park Lights	-	-
	Parking Meters	-	-
	Parks Outdoor Washrooms	17,756	0.87%
	Public Parking Garage	89,165	4.36%
	Sand & Salt Structure	6,447	0.32%
	Splash pads	-	-
	Streetlights	-	-
	Traffic Lighting	-	-
	Tannery Park Harbour – Workshop & Washrooms	1,785	0.09%
Total		**2,078,734 sq. ft**	**100%**

Appendix 2: List of Recommended ECMs and Renewable Initiatives

Archetype	Building	Measure Name	Implementation Year	GHG Reduction (tCO2e)	Cost	Energy Savings	
						Electricity (KWh)	Natural Gas (m3)
Community Center	Central Library	Retrofit Indoor Lighting (T8 to LED)	2022	1.19	44,880	26,493	0
Community Center	Central Library	Install drives on fans and pumps	2022	1.36	68,416	30,192	0
Community Center	Central Library	Replace R22 Units	2023	22.76	188,830	21,512	11,325
Operations and admins	Central Operations Depot	Retrofit Indoor Lighting (T8 to LED)	2022	3.05	114,654	67,683	0
Operations and admins	Central Operations Depot	Retrofit Outdoor Lighting	2022	0.99	17,613	21,934	0
Operations and admins	Central Operations Depot	Replace R22 Units	2023	38.67	41,259	4,700	20,303
Community Center	Glen Abbey Community Centre	Retrofit Indoor Lighting (T8 to LED)	2022	0.66	25,024	14,772	0
Community Center	Glen Abbey Community Centre	Replace old (R22) AC Units	2023	18.24	277,077	31,565	8,601
Community Center	Glen Abbey Community Centre	BAS Controls Recommissioning	2022	36.68	74,350	92,590	17,202
Community Center	Glen Abbey Community Centre	Install VFD's on Fans and Pumps	2022	3.41	171,663	75,756	0
Community Center	Iroquois Ridge Community Centre	Retrofit Indoor Lighting (T8 to LED)	2022	1.28	48,125	28,409	0
Community Center	Iroquois Ridge Community Centre	Retrofit Outdoor Lighting	2022	0.66	11,828	14,731	0
Community Center	Iroquois Ridge Community Centre	Replace old Boilers	2023	17.14	65,945	0	9,070
Community Center	Iroquois Ridge Community Centre	Replace old (R22) AC Units	2023	4.04	85,257	9,713	1,814
Community Center	Iroquois Ridge Community Centre	Replace old Dehumidification Unit	2023	0.20	11,000	3,238	0
Community Center	Iroquois Ridge Community Centre	Install VFD's on Fans and Pumps	2022	2.91	146,725	64,750	0
Arenas	Joshua's Creek Arenas	Replace old (R22) AC Units	2023	12.60	110,000	0	6,667
Arenas	Joshua's Creek Arenas	Seal cracks around doors	2022	6.30	26,146	0	3,334
Arenas	Kinoak Arena	Retrofit Ice Rink Lighting (to LED)	2022	0.45	16,963	10,014	0
Arenas	Kinoak Arena	Install Magnavitalis for Zamboni water	2022	0.10	22,000	262	48
Arenas	Maple Grove Arena	Retrofit Ice Rink Lighting (to LED)	2022	0.86	32,462	19,163	0
Arenas	Maple Grove Arena	Replace outdoor lighting (HID to LED)	2022	0.22	3,990	4,968	0
Arenas	Maple Grove Arena	Seal cracks around doors	2022	1.24	5,144	0	656
Arenas	Maple Grove Arena	Install Magnavitalis for Zamboni water	2022	0.23	22,000	580	107
Operations and admins	North Operations Depot	Retrofit Indoor Lighting (T8 to LED)	2022	1.01	38,058	22,466	0
Operations and admins	North Operations Depot	Install lighting controls	2022	0.34	12,686	7,489	0
Community Center	Oakville Centre for the Performing Arts	Retrofit Indoor Lighting (T8 to LED)	2022	0.85	32,008	18,895	0
Community Center	Queen Elizabeth Park and Community Centre	Retrofit remaining Indoor Lighting to LED	2022	0.33	12,290	7,255	0
Community Center	Queen Elizabeth Park and Community Centre	Install VSD's larger fan and pump motors	2022	2.98	149,883	66,144	0
Community Center	Queen Elizabeth Park and Community Centre	Seal cracks in entrance doors	2022	4.61	19,148	0	2,441
Others	Bronte Beach Park Washrooms	Retrofit Indoor Lighting (to LED)	2022	0.38	14,287	8,434	0
Others	Bronte Beach Park Washrooms	Replace outdoor lighting (HID to LED)	2022	2.66	47,408	59,038	0
Community Center	River Oaks Community Centre	Retrofit remaining Indoor Lighting to LED	2022	0.66	24,747	14,608	0
Community Center	River Oaks Community Centre	Replace old (R22) AC Units	2023	6.05	82,500	0	3,201
Community Center	River Oaks Community Centre	BAS Controls Recommissioning	2022	21.14	17,379	21,642	10,671
Community Center	River Oaks Community Centre	Install VFD's on Fans and Pumps	2022	2.60	130,776	57,712	0
Community Center	River Oaks Community Centre	Seal cracks around doors	2022	2.52	10,461	0	1,334
Community Center	Sir John Colborne Recreation Centre for Seniors	Retrofit Indoor Lighting (T8 to LED)	2022	0.20	7,517	4,438	0
Community Center	Sir John Colborne Recreation Centre for Seniors	Retrofit Outdoor Lighting	2022	0.05	924	1,151	0
Arenas	Sixteen Mile Sports Complex	Retrofit remaining Indoor Lighting to LED	2022	0.93	34,940	20,626	0
Arenas	Sixteen Mile Sports Complex	Retrofit outdoor lighting (HID to LED)	2022	2.41	42,941	53,475	0
Arenas	Sixteen Mile Sports Complex	Use heat from refrigeration plant to melt ice	2022	18.69	11,000	0	9,889
Others	Nautical Park Splash Pad	Retrofit outdoor lighting (HID to LED)	2022	0.36	6,434	8,013	0
Others	Salt & Sand Structure	Replace outdoor lighting	2022	0.35	6,158	7,668	0
Operations and admins	Transit Facility	Retrofit Indoor Lighting (T8 to LED)	2022	8.27	311,505	183,887	0
Operations and admins	Town Hall	Retrofit Indoor Lighting (T8 to LED)	2022	1.15	43,289	25,554	0
Operations and admins	Town Hall	BAS Controls Recommissioning	2022	33.44	93,883	116,915	14,909
Operations and admins	Town Hall	Replace R22 Units	2023	9.24	109,958	12,527	4,473
Operations and admins	Trafalgar Park Community Centre	Install Magnavitalis for Zamboni water	2022	6.54	22,000	16,630	3,063

Community Center	Centennial Pool	Install Solar Domestic Hot water	2025	7.14	66,000	0	3,776
Community Center	Glen Abbey	Install Solar Domestic Hot water	2025	26.76	154,000	0	14,158
Community Center	Iroquois Ridge	Install Solar Domestic Hot water	2025	23.55	143,000	0	12,462
Community Center	Queen Elizabeth Park and Community Centre	Install Solar Domestic Hot water	2025	16.54	110,000	0	8,754
Community Center	River Oaks Community Centre	Install Solar Domestic Hot water	2025	16.48	110,000	0	8,722
Community Center	Trafalgar Park Community Centre	Install Solar Domestic Hot water	2025	12.66	99,000	0	6,697
Operations and admins	Fire Station #3	Install Solar Domestic Hot water	2025	1.85	44,000	0	981
Operations and admins	Transit Facility	Install Solar Domestic Hot water	2025	20.33	132,000	0	10,755
Arenas	Joshua Creek Arena	Install Solar Domestic Hot water	2025	12.51	99,000	0	6,621
Arenas	Maple Grove Arena	Install Solar Domestic Hot water	2025	2.39	46,200	0	1,263
Arenas	Sixteen Mile Sports Complex	Install Solar Domestic Hot water	2025	15.85	107,800	0	8,385
Community Center	Centennial Pool	Install Solar Air Systems	2026	7.14	66,000	0	3,776
Community Center	Glen Abbey	Install Solar Air Systems	2026	26.76	154,000	0	14,158
Community Center	Iroquois Ridge	Install Solar Air Systems	2026	23.55	143,000	0	12,462
Community Center	Queen Elizabeth Park and Community Centre	Install Solar Air Systems	2026	16.54	110,000	0	8,754
Community Center	River Oaks Community Centre	Install Solar Air Systems	2026	16.48	110,000	0	8,722
Community Center	Trafalgar Park Community Centre	Install Solar Air Systems	2026	12.66	99,000	0	6,697
Operations and admins	Fire Station #3	Install Solar Air Systems	2026	1.85	44,000	0	981
Operations and admins	Transit Facility	Install Solar Air Systems	2026	20.33	132,000	0	10,755
Arenas	Joshua Creek Arena	Install Solar Air Systems	2026	12.51	99,000	0	6,621
Arenas	Maple Grove Arena	Install Solar Air Systems	2026	2.39	46,200	0	1,263
Arenas	Sixteen Mile Sports Complex	Install Solar Air Systems	2026	15.85	107,800	0	8,385
Operations and admins	North Operations Depot	Install Solar Air Systems	2026	2.83	107,801	0	1,498
Operations and admins	Central Operations Depot	Install Carport 594 KW	2024	39.12	1,260,000	738,020	0
Operations and admins	Transit Facility	Install Carport 500 KW	2024	51.97	1,050,000	980,500	0
Operations and admins	Central Operations Depot	Install Rooftop PV 594 KW	2024	31.40	1,152,900	592,400	0
Operations and admins	Fire Station #3	Install Rooftop PV 120 KW	2024	5.37	233,100	101,300	0
Community Center	Glen Abbey	Install Rooftop PV 450 KW	2024	27.98	876,750	528,000	0
Arenas	Maple Grove Arena	Install Rooftop PV 90 KW	2024	5.51	178,500	103,900	0
Operations and admins	Transit Facility	Install Rooftop PV 950 KW	2024	64.18	1,890,000	1,211,000	0
Community Center	Community Center	Install PV 1,696 KW	2025	159.93	2,397,296	1,950,400	0
Operations and admins	Operations and admins	Install PV 1,396 KW	2025	131.64	1,973,246	1,605,400	0
Arenas	Arenas	Install PV 916 KW	2025	86.38	1,294,766	1,053,400	0
Others	Others	Install PV 472 KW	2025	44.51	667,172	542,800	0
Town of Oakville	Town of Oakville	Install Carport 4,480 KW	2025	422.46	6,332,480	5,152,000	0
Community Center	Community Center	Install PV2,376 KW	2030	193.97	2,613,160	2,731,940	0
Operations and admins	Operations and admins	Install PV 1,675 KW	2030	136.78	1,842,720	1,926,480	0
Arenas	Arenas	Install PV 917 KW	2030	74.87	1,008,700	1,054,550	0
Others	Others	Install PV 512 KW	2030	41.80	563,200	588,800	0
Town of Oakville	Town of Oakville	Install Carport 5,480 KW	2030	447.43	6,027,780	6,301,770	0
Community Center	Community Center	Install PV 4,410 KW	2040	436.19	4,608,868	5,071,960	0
Operations and admins	Operations and admins	Install PV 3,909 KW	2040	386.58	4,084,696	4,495,120	0
Operations and admins	Arenas	Install PV 2,749 KW	2040	271.88	2,872,705	3,161,350	0
Others	Others	Install PV 1,378 KW	2040	136.28	1,440,010	1,584,700	0
Town of Oakville	Town of Oakville	Install Carport 12,446 KW	2040	1,230.93	13,006,279	14,313,130	0
Community Center	Community Center	Install PV 5,090 KW	2050	503.40	4,759,150	5,853,500	0
Operations and admins	Operations and admins	Install PV 4,188 KW	2050	414.19	3,915,780	4,816,200	0
Arenas	Arenas	Install PV 2,749 KW	2050	271.88	2,570,315	3,161,350	0
Others	Others	Install PV 1,418 KW	2050	140.24	1,325,830	1,630,700	0
Town of Oakville	Town of Oakville	Install Carport 13,445 KW	2050	1,329.71	12,571,075	15,461,750	0
Town of Oakville	Remaining Buildings	Various Energy efficiency improvements	2022	25.59	202,995	103,744	11,068

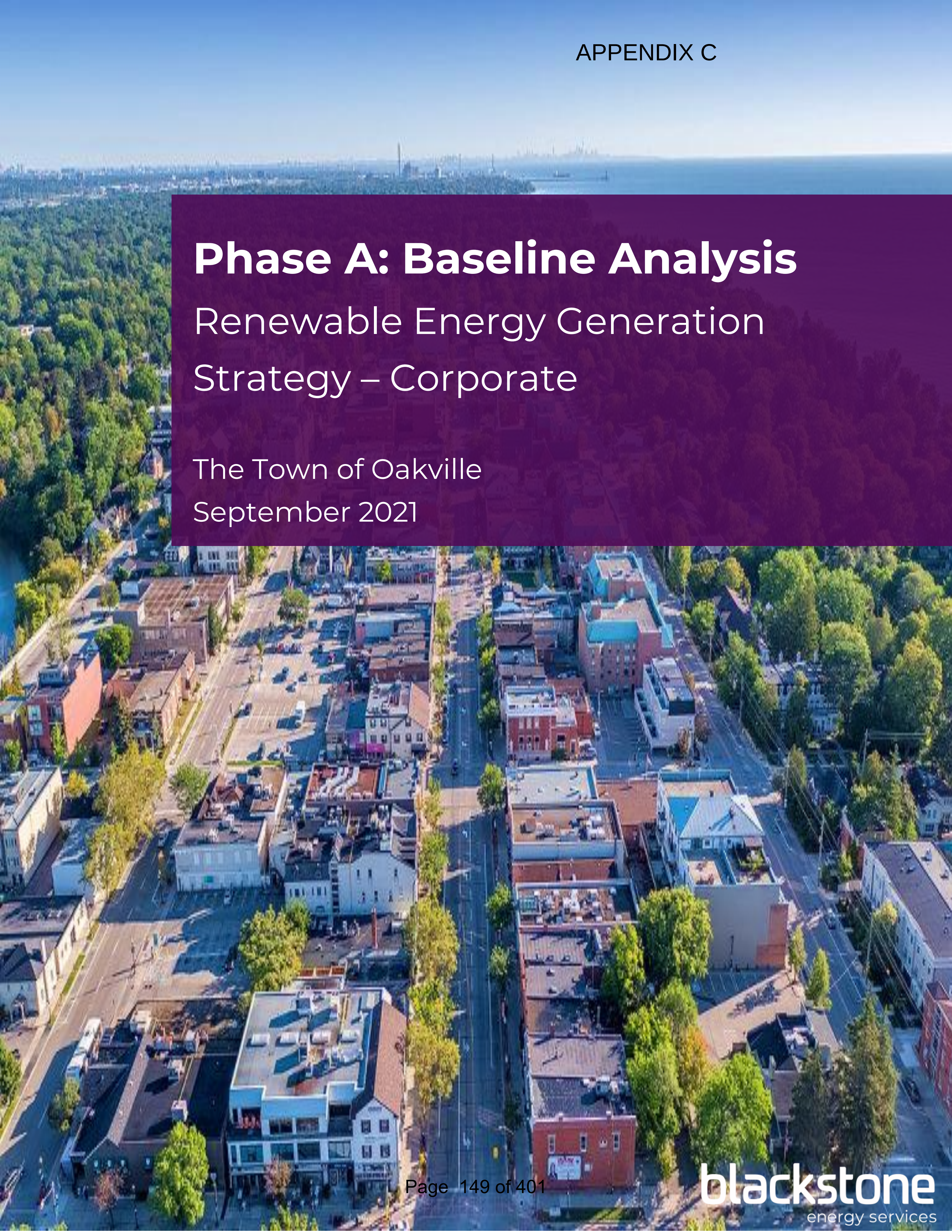
APPENDIX C

Phase A: Baseline Analysis

Renewable Energy Generation Strategy – Corporate

The Town of Oakville

September 2021



blackstone energy services

Contents

Executive Summary

The Town of Oakville ("The Town") has engaged Blackstone Energy Services ("Blackstone") to develop a Renewable Energy Generation Strategy for their corporate buildings. Throughout this strategy Blackstone will present measures that guide The Town to meet their goals that:

- ✓ Review and adjust baseline year as required to ensure it reflects the best year for on-going and future comparisons.
- ✓ Establish best practices and guidelines that promote renewable energy generation at their buildings.
- ✓ Present approaches for integrating renewable energy and low carbon solutions into new construction and major renovations/deep energy retrofits.
- ✓ Outline the foundations for the preparation of business cases to be used when a new capital project is underway.
- ✓ Suggest renewable energy contributions.

In 2015, The Town of Oakville adopted short-term and long-term GHG emissions targets for corporate operations. The long-term goal being a corporate GHG emission reduction of 80% below 2014 emission levels by 2050, with the short-term goals including a corporate greenhouse gas per capita emission reduction of 20% below 2014 levels along with the following targets.

- ✓ 30% per capita reduction in Building Emissions from 2014 levels by 2020
- ✓ 10% per capita in Fleet Emission from 2014 levels by 2030
- ✓ 40% per capita reduction in Street Lighting Emissions from 2014 levels by 2030

The RE Strategy will help The Town prepare for reaching the GHG goals through on-going conservation and increased electrification of natural gas loads (using heat pumps). By increasing the electricity generation on-site (and possibly with power purchase agreements in the future) The Town can "offset" the increase in electrical loads while reducing the GHG footprint. Using a staged installation of solar power, The Town (corporately) can reduce the increase electrical loads over the next 20-30 years, leading to the 80% GHG reduction and possibly net-zero by 2050.

Introduction

While The Town has made great strides towards accomplishing their targets, there is still work that needs to be done for The Town to reach their long-term commitments and goals. An effective renewable energy strategy should be integrated with an energy and carbon management plan that analyzes the impact of increased growth, productivity, cost, energy and GHG reductions available to The Town. By addressing systems design and energy conservation prior to implementing renewable energy technologies, the remaining loads can be effectively targeted for substitution with renewable energy.

The first step in reducing carbon emissions is establishing a baseline. A Baseline Analysis Report is the first deliverable in the RE Generation Strategy and will become the foundational data for the final strategy report presented. The baseline development process began with a desktop analysis of historical utility data to establish benchmarks based on pre-determined building archetypes. This data informed our walk-though site audits, which provided our team with the insights into all energy-consuming systems to identify opportunities for conservation, operational efficiencies, and renewable energy integration. Concurrent with our facility analysis, our methodology also includes a review of existing policies and procedures supporting renewable energy. This process results in a gap analysis that informed a summary of proposed policy adaptations that would promote renewable energy technology integration.

Archetypes were defined for the building uses and representative buildings selected for each type. The selections cover approximately 82% of the corporate gross floor area and more than 90% of the total energy use. These archetypes are community centres, operations and administration, arenas and “other” (parks, swimming pads, streetlights, parking lots). The conceptual RE solutions are based on these selected buildings within the archetypes and can be used to estimate opportunities at other sites.

With the site visit information and RE solution estimates, strategies can be prepared and presented. The main objective is to determine the path that reaches The Town’s goal of GHG levels 80% below that in 2014 by 2050.

Policies, Procedures, Law & Guideline Gaps

The Town has a culture of environmental sustainability ingrained into many policy and guideline frameworks. The vision to make The Town the "most livable town in Canada" is a testament to the ideals of community-based wellbeing, sustainable growth, strong economy, and efficient operation.

The Town has shown sustainability leadership initiatives within their own operations through climate emergency recognition, net-zero targets, community engagement, existing conservation and demand management projects, energy efficient guidelines, and renewable energy systems.

This section reviews currently posted (2020) energy and sustainability policies and guidelines with a view toward enhancing them to achieve the goals in general and renewable energy systems application specifically. Some of the policies have updates scheduled which would be opportune times to refresh the guidelines and reinforce The Town's goal of becoming increasingly sustainable, resilient, and livable.

Blackstone reviewed several policy documents found on The Town's website and also provided to us during data collection. The documents reviewed were:

- Official Plan (Livable Oakville)
- Community Energy Strategy
- Corporate Energy and Water Conservation Policy
- Environmental Sustainability Strategy
- Sustainable Design Guidelines
- Community Sustainability Plan
- Energy Conservation and Demand Management Plan

The policy and guideline documents discussed here are not a complete compendium of all but reflect the direction toward the increased adoption of renewable energy (RE) across The Town. For example, though not technically a part of the corporate portfolio, the Transportation Report promotes the use of electrification, which offers significant reductions in The Town's GHG presence and would benefit with RE integration that the Facility group can help implement. The Town has a centennial program called "Vison 2057" that collects the major policies into a single location. The policies related to renewable energy and low carbon applications have been reviewed below and discuss suggested improvements to encourage RE strategies.

The Town approves policies and by-laws that give guidance for growth and development. Some policies and guidelines are adopted by Council. The policies and guidelines reviewed refer to or are relevant to the integration of RE in the corporate assets and summarized in the following discussions.

Official Plan (Livable Oakville)

The Town of Oakville Official Plan – Livable Oakville (The Plan) contains the "goals, objectives and policies established primarily to manage, and direct physical change and he effects on the social, economic and natural environment of the municipality". In the case of The Town, the Plan 'establishes the policies and land use designations that implement the Town's vision "to be the most livable Town in Canada"'. It is to be used for 'setting priorities and making decisions' and includes specific comments around to 'manage growth and development in a sustainable manner'.

The path to this vision could be seriously impacted if resiliency and climate change readiness are not enforced in the planning and monitoring required to meet the goals. The Plan is well positioned to define how renewable and alternate energy systems are included in developments. The Plan recognizes that the main driver for climate change is greenhouse gas emissions and includes initiatives that:

- ✓ Minimize The Town's ecological footprint
- ✓ Encourages energy generation from renewable sources as well as district energy
- ✓ Promotes increased levels of transit usage and active transportation modes
- ✓ Establishes targets for reducing greenhouse gas emissions and improving air quality
- ✓ Encourages energy efficient, sustainable green buildings and community designs
- ✓ Implements an energy management strategy

The Plan, written in 2009 and updated in 2018 with a mandated update scheduled for 2023, is the guiding document for growth and development. The Plan anticipates population increases and focuses on intensification in six growth areas as well as consideration for infill, redevelopment, grey field, and brown field areas.

In the chapter "Achieving Sustainability – Section 10 – Sustainability", we read that "The Town is committed to sustainable development to achieve environmental sustainability". Included in this section is that the Town "shall encourage proposals for alternative energy systems and renewable energy system"'. The Plan allows for cogeneration facilities and encourages new development to connect to district energy facilities. Cogeneration >25MW requires an amendment to The Plan. Section 10.6 – Green Buildings says the Town "will encourage … renewable energy systems such as wind, geothermal and solar power installations".

These statements along with others within The Plan (e.g., section 6 "Built Form") related to conservation and design practices are encouraging for the use of renewable energy and green technology solutions. The Plan, at the current edition and until the update in 2023, uses words such as "should" and "encouraged" when sustainable initiatives are mentioned. Given the power of The Plan in achieving the growth directions and plans the opportunity for The Town is to empower these initiatives in The Plan through more rigorous statements of intent. This recommendation is described in the suggestions section below.

Suggested Policy Improvements

1) Consider referring to renewable energy and other energy and GHG reduction measures as “low carbon solutions” throughout policy statements to broaden the technology application base.
2) Require low carbon energy system applications be reviewed, and favoured, for all new designs and renovations.
3) Revise baseline year for all energy and emissions targets to 2015 to avoid GHG reduction credits due to Ontario grid removing coal fired electricity generation in 2014.
4) Include GHG targets into the Master Plans and formalize as a part of the Plan.
5) Formalize low carbon system contribution targets as percent of total energy use corporately to be achieved by 2030 to 2050.
6) Develop building archetypes to be used for target setting and design standards that reflect all corporate facilities.
7) Develop forward thinking energy and GHG performance design standards based on absolute indices that step with increasingly more efficient targets for a range of building archetypes within the Corporation. (see BC Step and Toronto TGS standards for examples).
8) Require energy/GHG performance targets are met for a site plan to be approved. Require energy/GHG performance estimates be submitted for approvals.
9) Strengthen the currently used words “should” and “encourage to “shall” in ” in policies, tender or design documents with respect to low carbon adoption.
10) Facility & Construction Management (FCM) to participate in the development of growth areas and promote low carbon options for district energy and community energy hubs using life-cycle cost comparisons that include the cost of carbon.
11) Empower and formalize the FCM as the evaluation entity for low carbon systems review and recommendations at site planning stages..
12) Adopt and enforce a life cycle cost analysis for all energy related systems. See Procurement Policy By-law 2017-095 for renewable and alternate energy systems evaluation.
13) Incorporate climate change adaptation measures when making policy decisions, such as thermal autonomy, temperature extremes, rain surge, heat island effects, wind tunnel effects, passive energy use, etc.

Community Energy Strategy

The Community Energy Strategy was completed in early 2020, and is the collaboration of community, business, educational and municipal stakeholders. Though not a direction required by the FCM group, coordination with this strategy will help to make sure there is little (to no) confusion about what The Town wants to achieve. A distinction needs to be made that this group does not speak for the Corporate Facilities group. This community energy planning report, the result of two years of consultations, is designed to promote action and implementation of priority projects for the first five years (2019 – 2024) through the following documents:

- ✓ Community Energy Strategy (final summary document)
- ✓ 2019 Analytical Report
- ✓ 2019 Engagement Report

The Analytical and Engagement Reports informed the preparation of the Community Energy Strategy.

Source: Community Energy Strategy, 2020
Figure 1: Town of Oakville Segments of Community Energy Strategy Report

The Analytical report presents the data for the rationale; the Engagement report describes the consultation process. This review covers the final Strategy report and how it impacts the use of renewable and alternate energy systems.

An important result of this process was a governance and delivery plan which includes the Energy Task Force (formed in January 2019) whose role it is to act as an advocate for the Energy Strategy and strategy realization through a proposed Implementation Management Office. As a member of the Task Force, The Town, through the FCM group is in the position to advise the policies that can complement the activities of the corporation. This collaboration is an opportunity to showcase the community and Town share resources and facilities and that there is a co-existence between the corporation and community in reducing energy and carbon footprints in a positive way.

Strategic Direction 1 – Home and Building Efficiency points out that energy conservation is a primary energy "resource" and recognizes the fact that "the built environment is the third largest emitting sector and most of today's homes and commercial and institutional buildings will be in operation in 30 years". Approximately 40% of the Town's emissions (2016) are due to the built environment. This strategy promotes increased efficiencies in existing homes and buildings throughout the Town suggesting a 30% residential efficiency gain by energy retrofits in 80% of the existing homes. They also suggest a 30% efficiency gain for 60% of existing commercial and institutional buildings, by 2041 for both sectors.

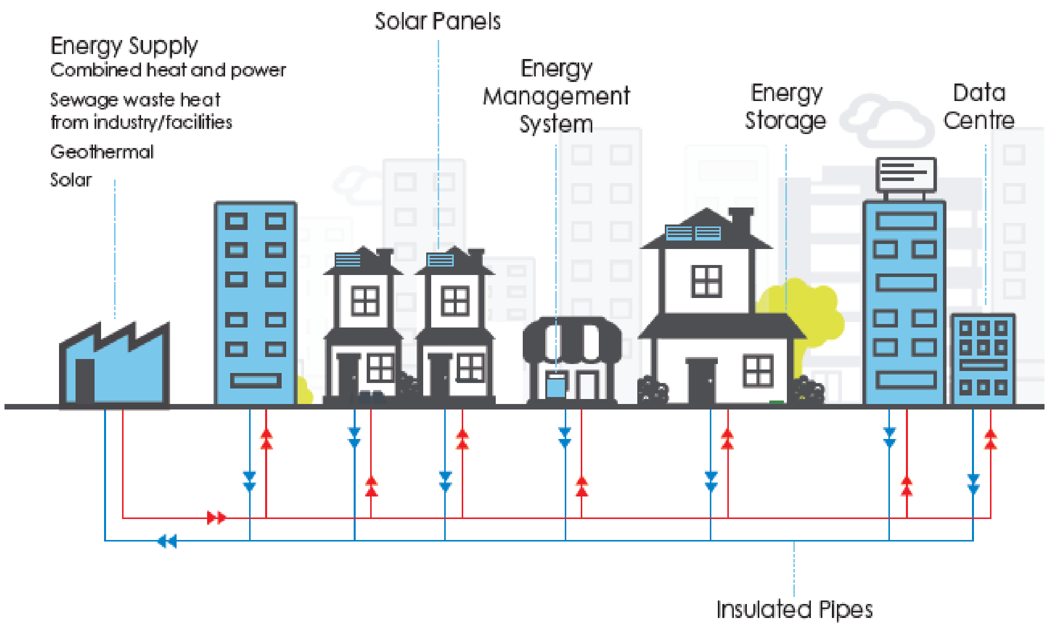
The community and Town share many facilities (libraries, arenas, community centres). Having a coordinated approach to promoting and implementing conservation plans that benefit both will be beneficial to the community. It will be in the best interest of the community and corporation to share their activities and promote energy conservation and GHG reduction. Collectively a strong corporate and community case can be made to collaborate and present opportunities to Council that will impact a significant cross section of the Town.

Strategic Direction 2 – Industrial Efficiency recognizes the importance of industrial activity within The Town and that energy and GHG profiles are often defined by best practices of the particular industry as well as "corporate-wide emissions standards responding to both customer and public opinion". The report also points out that The Town's industrial sector "demonstrates better energy and emissions performance when compared to global best practices". With these in mind, this strategic objective proposes to increase the spread of best practices across all local industry and achieve a 20% efficiency gain by 2041.

The FCM group can encourage efficiency in all aspects of The Town and showcase how they are targeting a low carbon future within the Corporation. They can also partner with others where applicable and encourage the connection of community and corporate Town energy systems (district energy) and encourage cross-communication of sustainability initiatives.

Strategic Direction 3 – Local Energy Supply and Distribution is the policy that directly reflects the need to increase renewable energy systems. This strategic opportunity recognizes the value of generating and distributing energy locally to lower the GHGs due to heating, domestic hot water, cooling and large-scale centralized system losses. This strategic direction recommends designing community district energy systems that can take advantage of several low carbon energy sources such as solar thermal, combined heat and power, heat recovery, geoexchange arrays and boilers that use renewable electricity. This solution is well understood in Europe and starting to be applied in Canada (see Okotoks Solar Community, https://www.dlsc.ca/). With plans to grow in six intensification areas, the opportunity to plan around district energy hubs should be considered.

The Town is currently reviewing opportunities for community district energy systems. Though not directly associated with the Corporation, this is an opportunity to ensure any new or large renovations within The Town's portfolio participate in the discussions for a DES. There will likely be new (or renovated) facilities within new community DES that could take advantage of the efficiency of a DES and is encouraged. Cooperation with the community effort to develop DES would be facilitated with Corporate policy and standards that encourage DES-ready design features – e.g., low temperature heating systems, access to exterior DES loops.



Source: Community Energy Strategy, 2020
Figure 2: Town of Oakville Integrated District Energy System Concept

An example of the scale of implementing a strategic priority is to generate "significant amounts of solar power". The strategy presented is to increase the current local solar photovoltaic electricity generation from 0.1% of total electricity used in The Town to 54% by 2041, and ideally to ~70% by 2050. From a Corporate point of view, if this target were to be accepted by the Corporation, an additional ~22 MW of photovoltaics would be connected to corporate assets on top of the existing 1MW now installed.

Suggested Policy Improvements

1) Promote collaborative relationships between the community groups to align their targets and Corporation goals.
2) Propose baseline year is the same throughout. Recommended year is 2015 (after coal fired electricity was phased out in 2014).
3) Reference the Strategy in other related environmental sustainability policies, regulations, and processes to promote community awareness and involvement.
4) Introduce the Corporate PV strategy to encourage community support.
5) Coordinate with Procurement policies to ensure life cycle cost analysis is used to assess renewable and alternate energy systems application and that the cost of carbon is included.
6) Collaborate communication efforts to connect Corporate and Community energy conservation and GHG reduction plans and goals, include the importance of a coordinated approach, common themes, costing issues, life cycle costs, carbon costs, etc.

Corporate Energy and Water Conservation Policy

The Corporate Energy and Water Conservation Policy statement was proposed in March 2018. Though not formally adopted, it is an internal policy statement that focuses on The Town's energy and water targets with a view to GHG reduction goals. It is presented to the Council every year with a recommended 5-year update cycle. Its function is to support the sustainability goals adopted by The Town Council in 2015 (80% reduction in GHG emissions below 2014[1] for corporate facilities and operations by 2050). It was prepared by Town staff and a consulting firm that defines and justifies low carbon pathways to achieve the sustainability goals though it is not a formal policy. This report presents detailed analyses of energy and GHG breakdowns for The Town in 2014 (baseline) and proposes pathways to reach the goals. The proposals address the goals with three milestones, which are outlined below.

First Milestone – 2025

This ends with the CDM plan in 2025 and suggests reductions through a list of measures such as reduce electricity consumption in existing buildings by 20% over 2017 levels; pursue net zero design standards; more LED conversions; reduce natural gas consumption by 30% over 2017; to purchase offsets or the increased use of renewables such as solar panels to achieve targets. Many of these will benefit from the use of renewable and/or alternat energy systems, e.g., offset reduced LED electrical loads in streetlights with photovoltaics, offset space heating loads with solar thermal.

Second Milestone – 2030

This milestone reflects the emissions targets adopted by Town Council in 2015. The statements is for a corporate GHG emission reduction of 80% below 2014[1] levels by 2050. Corporate GHG per capita (intensity) emission reduction of 20% below 2014[1] levels by 2030, and the following sub-targets:

- ✓ 30% per capita reduction in building emissions from 2014[1] levels by 2030
- ✓ 10% per capita in fleet emissions from 2014[1] levels by 2030
- ✓ 40% per capita reduction in streetlight emissions from 2014[1] levels by 2030.

As in the first milestone, increased improvement in electrical efficiencies by 10% in existing buildings; pursue net zero designs and target 100% zero; reduce natural gas use by to 60% over 2025; switch to geothermal energy and renewable natural gas and solar thermal heating.

[1] Recommendation to use 2015 as the baseline year to avoid GHG reduction credit due to Ontario electricity grid shutting down coal fired electricity generation.

Third Milestone – 2050

This milestone takes The Town to the 2050 goal of GHG levels 80% below those of 2014[1]. As above, the path to this goal is based on converting heating from natural gas to electrical sources such as heat pumps. By this time, all new buildings will be net zero carbon. Again, this goal requires the use of renewable and alternate energy systems to be realized. By 2050 The Town will have reduced the equivalent energy loads by 48% and GHG levels by 81% below 2014[1]. The graphs below, from the Policy report, illustrates the results of the path proposals should they be adopted. Note that the baseline year has been defined as 2014[1] and projects to 2050.

Figure 5 – Energy Use Milestone Targets

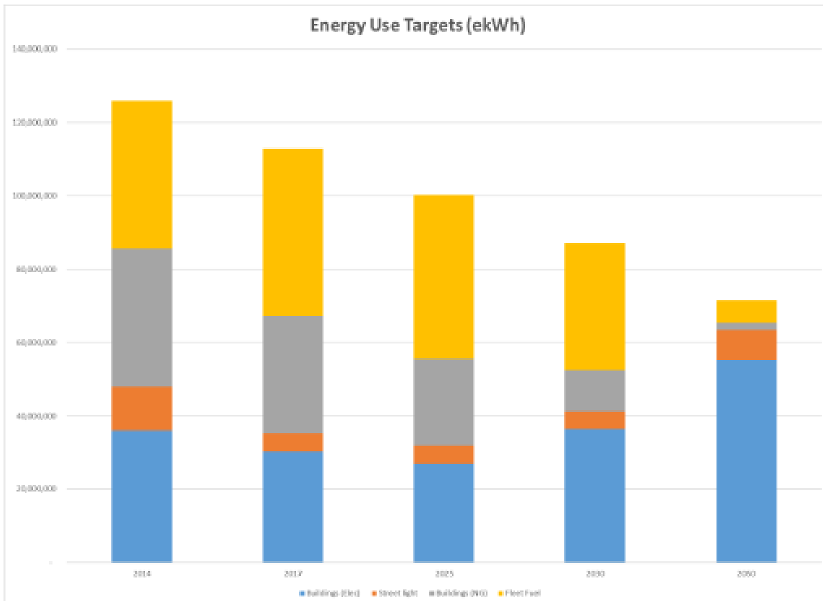
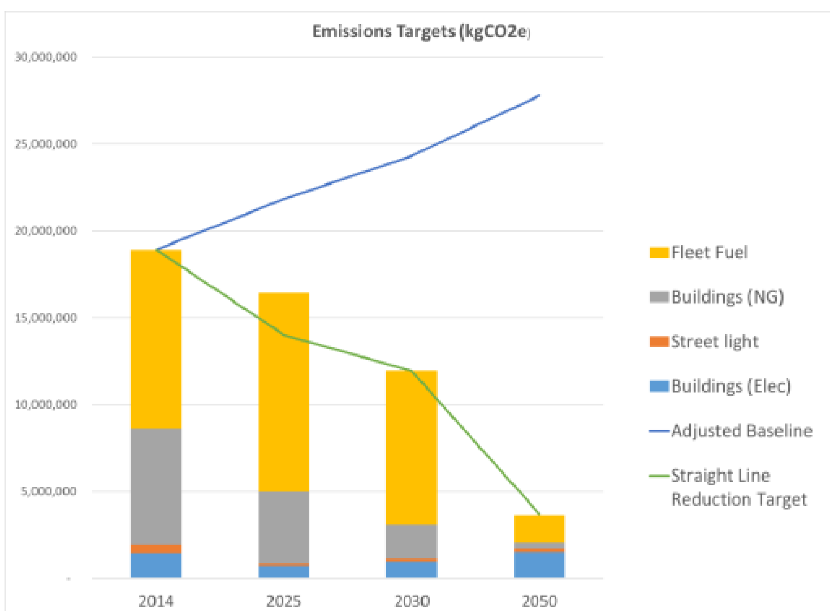


Figure 6 – GHG Emission Milestone Targets



Source: Corporate Energy and Water Conservation Policy, 2018

Figure 3: The Town of Oakville Policy Report Path Proposals

Suggested Policy Improvements

1) Develop a formal energy and water management plan that includes adaptation to near, short- and long-term climate impacts.
2) Connect this plan with proposed absolute energy performance design standards.
3) Request Town Council to review the recommendations in this policy study combined with Energy Group proposals. Recommend the enhanced policies are incorporated into a Town sustainability policy.
4) Include the revised and adopted plan into the "Preserve It! – Vision 2057" site.
5) Adopt the timelines described – Milestone 1, 2 and 3 as status points. Commit to a review of each one year prior to the milestone and prepare a gap analysis and adjust plans.
6) Develop a life cycle cost benefit analysis to further guide the Procurement By-law 2017-095, Schedule "J" for all renewable and alternate energy system applications. See sample graph below for LCA inputs and outputs. Ensure the cost of carbon is included in all life cycle cost analyses.

Figure 7 – Financial & Life Cycle Cost Benefit Analysis

Year of Project	Column1	0	1	2	3	4	5	6	7	8	9	10
Project Costs		$ 22,523				$0			$0			
Incentive to Offset Project Cost		$ 11,581										
Inflation Rate	2.0%											
Annual Project Energy Savings	$	$ 9,653	$ 9,846	$ 10,043	$ 10,244	$ 10,448	$ 10,657	$ 10,871	$ 11,088	$ 11,310	$ 11,536	$ 11,767
Annual Project Water Savings	$											
GHG Reduction	Tonnes	48	48	48	48	48	48	48	48	48	48	48
Annual Project Maintenance Savings	$	$ 100	$ 102	$ 104	$ 106	$ 108	$ 110	$ 113	$ 115	$ 117	$ 120	$ 122
Non Energy Benefit	15%	$ 1,448	$ 1,477	$ 1,506	$ 1,537	$ 1,567	$ 1,599	$ 1,631	$ 1,663	$ 1,696	$ 1,730	$ 1,765
Carbon price		$ 20	$ 30	$ 40	$ 50	$ 50	$ 50	$ 50	$ 50	$ 50	$ 50	$ 50
Carbon Credit		$ 959	$ 1,439	$ 1,919	$ 2,398	$ 2,398	$ 2,398	$ 2,398	$ 2,398	$ 2,398	$ 2,398	$ 2,398
		$ 12,160	$ 12,864	$ 13,572	$ 14,285	$ 14,522	$ 14,765	$ 15,012	$ 15,264	$ 15,522	$ 15,784	$ 16,052
Net Cash Flow		($10,941)	$12,864	$13,572	$14,285	$14,522	$14,765	$15,012	$15,264	$15,522	$15,784	$16,052
Cumulative Cash Flow		($10,941)	$1,923	$15,494	$29,779	$44,301	$59,066	$74,078	$89,342	$104,864	$120,648	$136,700
Discount Rate	3.0%											
Financial Metrics						Other Factors to be considered						
Simple Payback		2.33	years				Borrowing Interest Rate					
Comprehensive Payback		0.90	years				Reinvestment Rate					
Internal Rate of Return	IRR	122%					Replacement Value					
Modified Internal Rate of Return	MRR	31%					Residual Vale					
Net Present Value	NPV	$ 111,000					Depreciation Rate					
Savings to Investment Ratio	SIR	4.29					Tax Rates					
		Information entered by project manager										
		Factors provided by finance.										

Source: Corporate Energy and Water Conservation Policy, 2018
Figure 4: The Town of Oakville LCA graph

Environmental Sustainability Strategy

The Environmental Sustainability Strategy was approved by Council in 2005 for the planning period of 2018-2022. The first plan was prepared and approved by Council 2005 and refreshed in 2011. The plan describes ways the community stakeholders can do to "protect and improve their environment" and "provide and overarching environmental sustainability vision". It was renamed the "Environmental Sustainability Strategy" in 2018 and is updated every five years. New activities and actions are defined at each five-year cycle start.

This document describes a sustainable environment as "taking actions to protect and enhance our biodiversity, urban forest, waterways, and air quality. We strive for low impact development and act to reduce and manage the impacts of climate change". The final is directly relevant to the use of renewable and alternate energy systems and policies. The Strategy develops actions to improve the environmental sustainability objectives which are tracked and reported on annually to show progress toward achieving The Town's goals. The action plans are organized around four categories:

- ✓ Sustainable Environment
- ✓ Sustainable Households
- ✓ Sustainable Communities
- ✓ Sustainable Government

Within each of these are sub-themes into which actions are created and tracked. For example, the Corporate Operations inside Sustainable Government recommends net-zero readiness for new construction, increased use of renewables, partnerships for district energy hubs, updating sustainable building procedures and new development standards. These directives are also relevant for increasing the use of renewable and alternate systems. The Environmental Sustainability Strategy covers a wide range of sustainability issues and initiatives. As it tracks and reports on progress for set actions, it is a good process for keeping The Town informed and assisting in the direction for a low carbon future. The Environmental Sustainability Plan is referred to in the "Preserve it! Vision 2057" document.

Suggested Policy Improvements

1) At the next update, suggest resetting the baseline to 2015 to avoid the impact of removing coal fired electricity in 2014.
2) Adjust targets and timelines to reflect the proposed baseline as 2015 in the CDM planning schedule.
3) Encourage life cycle costing in corporate decision making on low carbon projects, including the cost of carbon as currently projected (base on Federal carbon cost plan) to 2030.
4) Emphasize and encourage the tracking of the use and performance of low carbon energy systems and report annually inside "Sustainable Government" theme.

Sustainable Design Guidelines

The Sustainable Design Guidelines was prepared in April 2010 jointly between FCM and Environmental Policy departments, is a set of guidelines for "the design, construction and preventative maintenance of The Town's facilities with sustainability as the core principle". It is a very comprehensive document that covers a wide range of sustainability issues. At the time of the writing the use of the design guidelines was mandatory for all construction projects, renovations, repairs, or maintenance projects. Any new facilities (over 500m²) must be eligible (no requirement to certify) current LEED Silver. The objectives of the guidelines are:

- ✓ Make sustainability core to minimize ecological footprint
- ✓ Achieve sustainable building and community designs
- ✓ Enhance the Town's air, water quality and night sky
- ✓ Increased operational efficiency and reduce energy consumption
- ✓ Establish and maintain an effective preventative maintenance program
- ✓ Achieve greater cost accountability.

The guidelines go on to define how to meet the requirements specified through design principles, performance specifications for new and existing sites. Topics include landscape, irrigation, tree canopy, lighting, rain and storm water and erosion. A Sustainable Design Checklist is defined, the use of which is mandatory and filled out by the staff managing the project, or consultants, for all building related construction projects. This document was approved by Council on July 1, 2010 and supports the Green Building Design Procedure EN-GEN-001-003 and Environmental Sustainability Policy EN-GEN-001. It is posted on The Town's website inside the Public Tenders, Bids and Contract page, however, during our analysis our team attempted to access the document and it was not accessible. The document makes comments to be followed that include concerns in addition to sustainability and the environment impacted by designs that meet the sustainability goals:

- ✓ Health and Comfort
- ✓ Carbon Impact
- ✓ Alternative Energy Sources
- ✓ Material Impact
- ✓ Waste Stream Impact
- ✓ Building Performance
- ✓ Performance Benchmarking

Certain design features specified affect renewable and alternate energy systems design and sizing such as window to wall ratios, daylighting, thermal comfort, air distribution. By following prudent design criteria, the renewable and alternate energy systems will have a more significant contribution to the overall energy an GHG footprint and are important to include and follow in the Design Guidelines.

Renewable and alternate systems are called out in the guidelines as “consider where such opportunities are available”. The options are to be discussed with the project team early in the design stages and include solar electricity, solar thermal and wind (they mention is “optics” oriented and looked at with care). It also mentions purchasing green power offsets.

Building Performance
The basis for new building designs is to exceed the building archetype’s benchmark performance as established by ≥40% measured in kWh/m^2 and m^3/m^2 (a relative measure). For existing buildings, (where possible) reduce the energy consumption measured in kWh/m^2 and m^3/m^2 after each retrofit compared against the EnergyStar™ rating for that facility and similar buildings in the Town (again, a relative measure). Energy specialists and commissioning agents should be engaged early in the design stages.

Though renewable and alternate energy systems are not mentioned specifically, pursuing high performance design criteria will make the contribution of low carbon solutions more significant. Some of the measures are prescriptive with minimum performance criteria (such as insulation). Alternate energy such as heat pumps are suggested as “where feasible”. Suggestions for this Guideline follow and are aimed at ensuring building performance achieve high levels to make the consideration of renewables and alternate energy systems more financially viable on a life cycle evaluation.

Suggested Policy Improvements

1) The Guideline should be updated as a “Standard” and re-issued to Council or Executive Management for approval and adoption.
2) Review and incorporate best practices low energy/carbon design standards to guide development of standards.
3) Standards to be enforced through permitting from site plan through to construction.
4) Make performance standards as “absolute” indices rather than relative or “better than” existing or current standards (e.g., do not use “25% better than OBC”). Absolute refers to defined performance and required indices versus those that are “better than” current code indices.
5) Suggest the latest Toronto Green Standards or the BC Step Program guidelines as template. These use industry recognized indices of “Total Energy Use Index (TEUI as $ekWh/m^2$), Total Energy Demand Index (TEDI as $ekWh/m^2$), and Greenhouse Gas Index (GHGI as kg eCO_2/m^2). Propose minimum and high-level tier performance indices[2].
6) Define building archetypes and absolute performance indices for each. Each will have unique indices that account for occupation, hours of use, typical building designs features. See the list of suggested archetypes below.

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[2] This report uses indices based on sq. ft^2. Most KPI’s are based on m^2 but can be whichever the Town is familiar with.

7) Coordinate with DES strategies to ensure low temperature designs are required for future connection to a DES.
8) Revise and post the Standards every four years and released no less than 6 months before each Ontario Building Code update. Revise standards as "step-wise" improvements in absolute performance indices.
9) Target net zero designs as standard for new corporate facilities starting in 2030.
10) Adopt renewable and low carbon energy systems as preferred designs to reduce the energy and GHG footprint. Enforce preparation of predicted annual contributions as part of energy performance modeling at the schematic design, detailed and construction design stages.
11) Consider thermal autonomy design features based on minimum 72 hours.
12) Consider defining buildings that could become "safe havens" during extreme weather conditions, such as community centres and ensure designs meet thermal autonomy and electricity back up needs.
13) Make the energy model and performance indices for both energy and GHG mandatory for site plan approvals.
14) Encourage adoption of enhanced building commissioning standards for all new buildings (as defined by the most current LEED specifications).
15) Consider Corporate asset measurement & verification plan and benchmarking program, updated each year and assessed for performance tracking.
16) Include requirement for "solar ready" design features (such as a plumbing chase or conduit with a fish from the roof to the mechanical room, avoid shading, consider structural roof capacity).
17) Prepare a training program to inform design teams and inspectors of the requirements.

The following building types are suggested archetypes for development of absolute energy and GHG performance targets, stepped with increasing performance indices each 3-4 years (typically at or before any OBC+SB-10 code upgrades).

1) Office & Administration buildings
2) Recreation, Culture & Library Facilities
3) Heritage Buildings
4) Operational Support Buildings
5) Fire Halls
6) Lease Buildings
7) Critical Facilities
8) Buildings less than 1,000 m^2
9) Vacant Buildings

Performance targets for each archetype shown above would be developed using industry standard KPI's – total energy use, total energy demand and GHG indices. Retaining an expert in modelling and energy use by building types is suggested to prepare a comprehensive energy performance standard that follows the current, staged, high performance standards.

Community Sustainability Plan

Oakville's Community Sustainability Plan is a community document developed and prepared to "foster creativity and spark action to make Oakville the most livable town in Canada". It is a platform to help the community to encourage and increase sustainability through ideas and initiatives that enhance the quality of life. It is also a part of the "Preserve it! – Vision 2057" framework. This plan refers to the Environmental Sustainability Plan but does not get into the details – it is a public facing document and easy to read. In the Environmental section rooftop solar is mentioned but again, without much detail. It is a good public facing document and should be maintained and upgraded as initiatives are brought online.

Suggested Policy Improvements

1) Include renewable energy and low carbon showcase examples with pictures and basic description of the systems, what they do and where they are.
2) Include description of adopted milestones for performance monitoring.

Conservation and Demand Management Plan – 2020

The 2020 Conversation and Demand Management (CDM) Plan is a document required by legislation under Ontario Regulation 507/18 (O. Reg. 507/18). These submissions file annual energy consumption and GHG emissions along with a five-year energy conservation and management plan to be completed every five years. The 2020 plan is a summary of the period from 2014 to 2019 with a projection plan to 2025. In this document two goals are defined (relative to 2014):

- ✓ 20% reduction in overall energy consumption.
- ✓ 30% reduction in GHG emissions.

The reports must be posted for public review. This report points out the fact that the most expensive utility used in buildings is electricity – 63% of total costs – but is only a small percent of the GHG emissions – 9%. Whereas natural gas accounts for 11% of the cost and 87% of the GHG emissions. Though renewables and alternate energy systems are not suggested to reach the targets, the existing systems are described in this report. It acknowledges that to achieve The Town's goals, low carbon solutions along with deep energy conservation must be integrated. The ECDM Plan is included into the "Preserve it! Vision 2057" master plan retrofits framework as the path to achieving The Town's energy and GHG emissions goals.

Suggested Policy Improvements

1) Include renewable and alternate energy as solutions to be combined with deep energy retrofits and district energy system discussions.
2) Ensure continued alignment of reduction targets with those adopted by Council for 2050.

General Recommended Policy Initiatives

Using the policies, guidelines and standards reviewed above and with insights from the Corporation, the following policies should be considered to encourage renewable and low carbon solutions. Many of the technologies we see today will improve in terms of efficiency, range of operating conditions, cost, and applications. The best policy scenario is one that allows future technologies to be considered and adopted as they evolve. For this reason, policies, guidelines, and standards will tend to be somewhat vague as they try to cover all scenarios.

1. To be flexible with on-going technology improvements, the policies, standards, and guidelines should be reviewed and adapted on a regular cycle, i.e., 3-5 years maximum.
2. Formalize Corporate Energy Team (within FCM) collaboration with Council reviews of RE development strategies, planning and standards – e.g. formal RE Strategy Committee that includes FCM staff to report to Council annually.
3. Recommend setting the baseline year for energy benchmarking to 2015 to remove the impact of changing the grid emissions carbon content due to the closing of the coal fired electricity generation plants in 2014/15.
4. Pursue electrification of natural gas heating loads (i.e., heat pumps).
5. Establish a minimum renewable energy fraction of Corporate facilities along with a timeline for implementation (see Report D for proposed contributions and timelines).
6. FCM to define Corporate facilities archetypes and renovation scale criteria.
7. Develop absolute energy and GHG performance indices based on Corporation building archetypes – new and renovation and stepped to increasingly higher performance on a defined cycle – e.g. every 3 years.
8. All new and large renovations require an energy/GHG use index calculation that show high performance standards are met at site planning stage.
9. Require a life cycle cost analysis for renewable energy system evaluation in all RES request for proposals. Include the cost of carbon based on Federal carbon tax plan to 2030.
10. Promote enhanced commissioning and follow up measurement and verification programs for all new buildings and large renovations.
11. Consider climate change impact adaptation and resiliency planning as a part of all designs and renovations.

Baseline Analysis

As part of the RE Generation Study process, the Blackstone team conducted a desktop utility analysis of The Town's corporate buildings to assess the energy use and greenhouse gas (GHG) emission baseline. For this analysis, we used recorded utility data provided by the town from the period of January 2018 to December 2019. Note that we have chosen to use energy and GHG indices based on square feet. To convert to indices based on square meters, multiply the indices by 10.76.

Energy

The energy used by the Corporate portfolio during 2018 and 2019 is summarized by archetypes below.

Table 1: Archetype Energy Summary

Annual Electricity Consumption for Build Archetypes (kWh)		
Archetype	**2018**	**2019**
Community Centres	10,912,501	10,350,117
Operations/Administrative	8,874,505	9,379,253
Arenas	7,631,480	7,275,954
Other	5,591,336	5,764,395
Total	**33,009,822**	**32,769,719**
Annual Natural Gas Consumption for Build Archetypes (m3)		
Archetype	**2018**	**2019**
Community Centres	1,637,917	1,573,614
Operations/Administrative	1,021,247	968,372
Arenas	536,328	554,934
Other	0	0
Total	**3,195,493**	**3,096,920**

The table above indicates the defined archetypes within the total Corporate portfolio used to evaluate energy use and low carbon solutions. These sites were selected as representative buildings across the portfolio and represent ~82% of the total corporate gross floor area and about 90% of the total facility use. These are also being studied for a parallel report that describes energy conservation measures and a GHG reduction action plan in general in more detail (see the Greenhouse Gas Reduction Roadmap & Action Plan). The GRRAP combined with this RE Strategy report illustrate the impact of ECMs with RE in achieving the GHG reduction goals.

The energy shown in this report is for these selected buildings – not the total corporate assets. The energy use for these selected sites is representative of the archetypes found in the whole portfolio and used to prepare the impact of low carbon solutions across the total of The Town's assets.

Please see Appendix A for the complete list of buildings selected for this analysis.

The share of energy use in equivalent kWh (ekWh) for all corporate buildings (including town lighting, parking meters and splash pads) are illustrated in Figure 5 below.

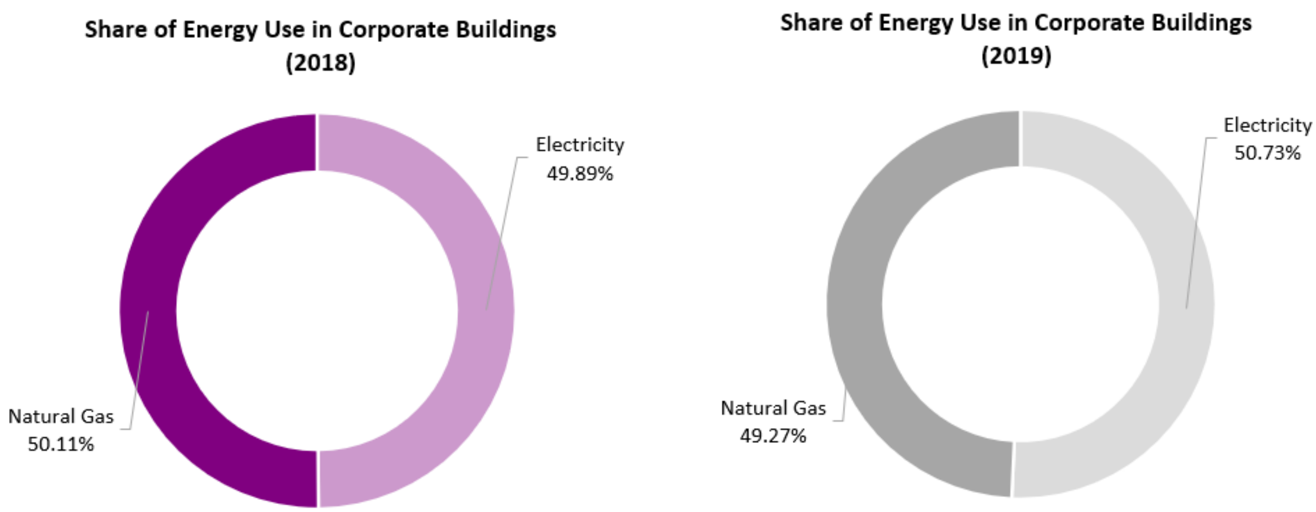


Figure 5 : Energy use share by utility, 2018 – 2019 for Corporate facilities

Figure 6 below provide the energy use intensity (EUI – energy use per sq. ft) for the specific building archetypes in The Town's portfolio of corporate buildings. "Other" does not have a floor area to calculate the EUI and not included. In general, compared to a Canadian median for these archetypes, the Community Centres (31 ekWh/sq. ft) and Operations & Administration (33.6 ekWh/sq. ft) are above the median of 28 and 26 ekWh/sq. ft respectively indicating room for conservation. The Leased and Arenas are close to the medians (within 10%) which illustrates conservation will bring these to higher performance at the lower quartiles.

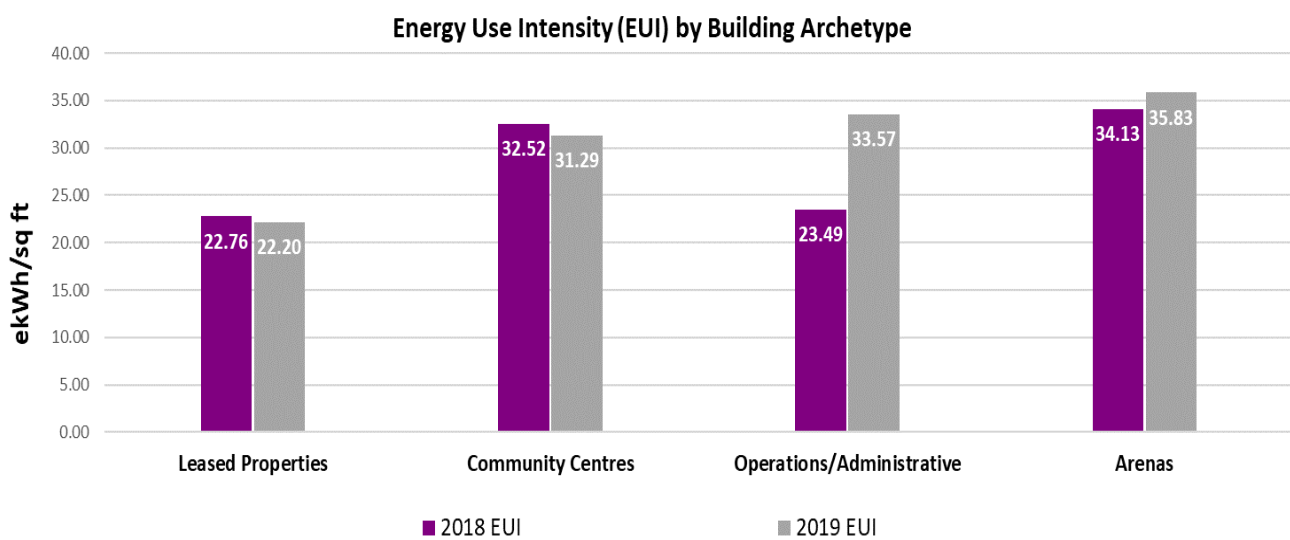


Figure 6: Energy use intensity (equivalent kWh/ sq.ft of floor area) for corporate archetypes, 2018 & 2019

Greenhouse Gas (GHG) Emissions

The Town has adopted a long-term goal of corporate greenhouse gas (GHG) emissions reduction of 80% below 2014 levels. To help The Town with achieving its GHG goals, we analyzed the GHG intensity (GHGi - tonnes per sq. ft) for the specific building archetypes in The Town's portfolio of corporate buildings. This is illustrated in the figure below.

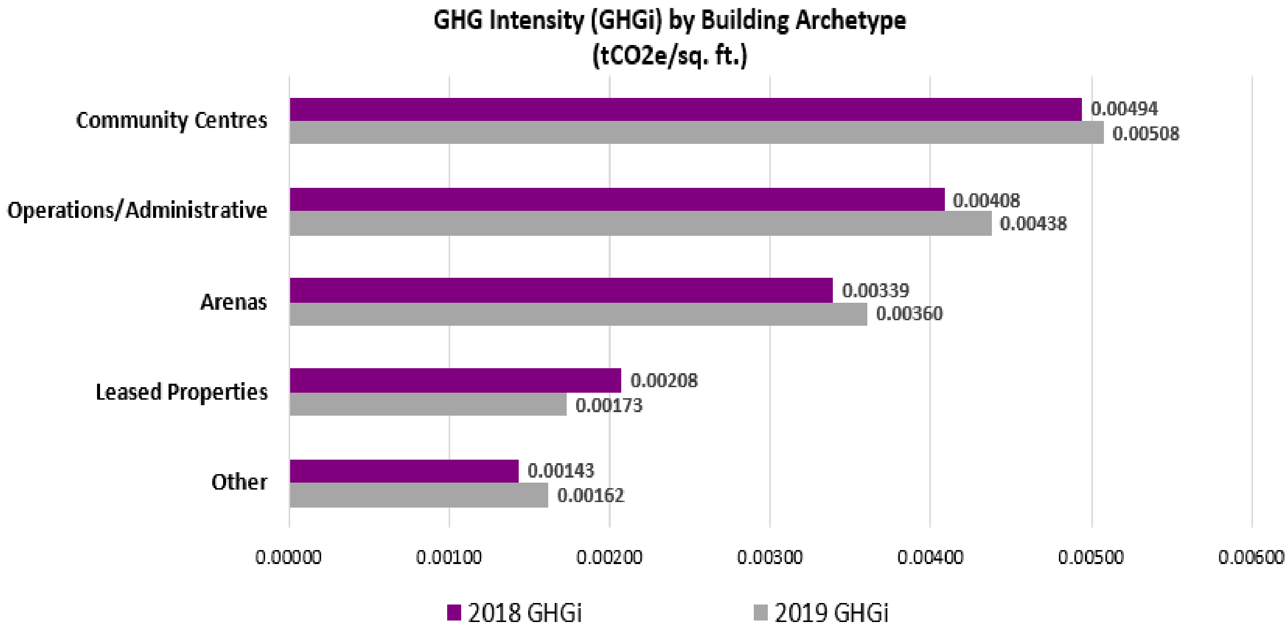


Figure 7: GHG Intensity for archetypes, 2018 and 2019, corporate facilities.

Figure 7 above indicates that the community centres are the most emissions intensive among The Town's corporate buildings, followed by operations and administration buildings, arenas, and leased spaces. In other words, when the building size is accounted for, the community centres use more energy per square foot compared to the other buildings. We are suggesting the community centres be the first sites for a PV installation program because of this fact.

Benchmarking

The renewable energy strategy for The Town will propose a measurable amount of energy be supplied to the Corporate facilities from renewable sources. The Community Energy Plan has proposed an 8% solar fraction from photovoltaics by 2041, but this is not being used as a benchmark for this analysis nor has it been an adopted target by The Town. As an example, if this solar target is applied to corporate facilities electricity consumption, The Town would require about 2.23MW of solar generation across its corporate buildings to meet that target. This is summarized in the following table.

Table 2: Estimated PV size to reach 8% of corporate electricity as of 2019

Assumptions for Solar Generation for Oakville	
Electricity Consumption in 2019 (kWh)	33,378,162
Solar Generation Required to meet 8% goal (kWh)	2,670,253
Estimated Annual Solar Output in Oakville (kWh/kW_{dc})	1,200
Estimated Solar Power Required (kW)	**2,225**

A range of PV installations has been prepared in the Renewable Energy Strategy report (see Report D). The targets presented in that report range from 10% - 70% of corporate electrical loads. The expansion of solar installations can be accelerated and facilitated by encouraging solar energy systems through The Town plans and policies documents.

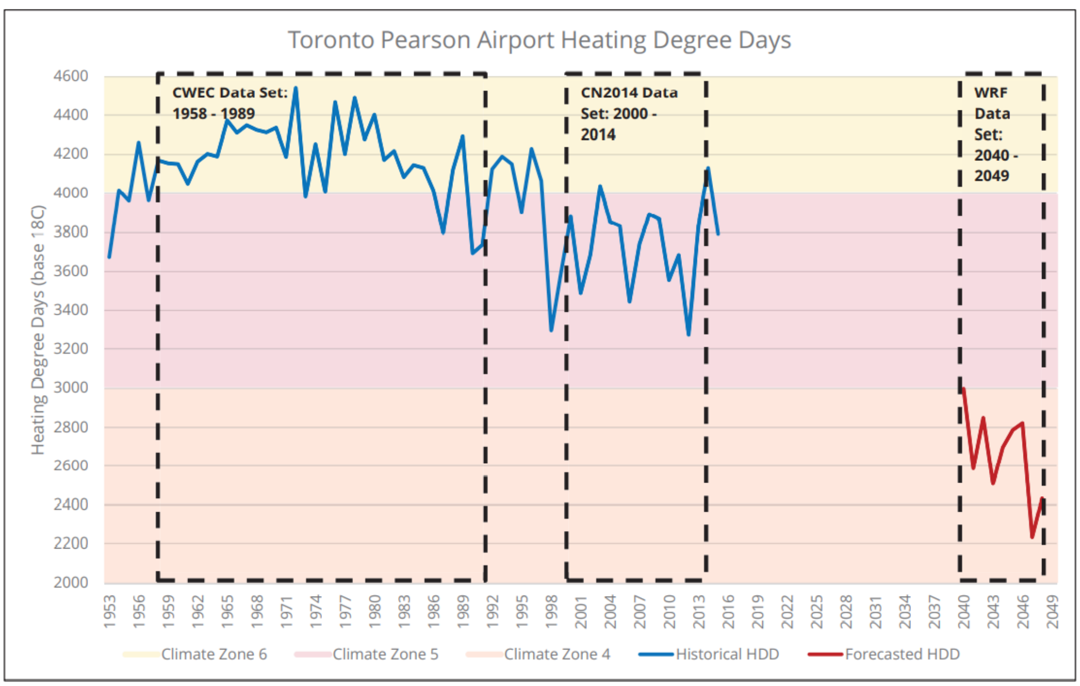
The general strategy for The Town's corporate facilities is to continue energy conservation and demand management plans with increasing levels of PV (as net metered PV and possibly PPA) to offset electricity use as natural gas is removed (electrification) and replaced with increased use of heat pumps. The milestones proposed are at 2025 (15%) to 2050 (70%). Please see the Phase D report for a more detailed description of the proposed PV implementation plan.

Impact of Weather

As the climate changes, which is a global concern, the local weather will also change. We have seen the impact of extreme weather changes recently and should expect this pattern to continue and likely become even more extreme through the year. Though there is conjecture around what the impacts will be, there is consensus that the summers will be warmer and more humid with heavier and faster rainfall events. We can expect generally warmer winters (fewer heating degree days) with shorter though extreme cold events. The Weather Research and Forecasting (WRF) model shown below illustrates the trend HDD is taking for the Toronto Airport weather files. This study pointed out:

- Increased temperatures throughout the year – increased number of Cooling Degree Days above 18° with an increased frequency and duration of heat waves and less heating degree days with increased cold events.
- Increased intensity of major rain events.
- Increased frequency of freeze-thaw events. This is a concern for resiliency as electricity supply would be impacted due to ice storms.
- Increased intensity of major storms.
- Trending toward an ASHRAE Climate Zone 4 from 5A (more like Washington, DC).

It will be important to keep this in mind when preparing standards and designing new and retrofitting buildings. Prepare for fewer heating degree days, more cooling degree days but with extremes that may last for days to even weeks.



(source: SENES Consultants Ltd., 2011, for City of Toronto)

Figure 8: Projected heating degree days trajectory to 2049, Pearson Airport.

Walk-Through RE Audits

In collaboration with The Town, Blackstone selected six representative buildings from the building representative list (see Appendix A) to audit with a renewable energy perspective. To maximize the benefits of a RE application, the selected sites were reviewed for energy use and conservation measures that will make the impact of the RE Strategy more significant. High level evaluation for RE solutions were prepared based on these site visits. These combined with the RE Strategy report will assist The Town in defining a strong and balanced RE plan going forward.

The walk-through audit, also known as a "screening audit" is a basic starting point for creating energy optimization and were the foundation for these in order to assess the impact of RE. It involves an overview of the facility's utility bills and related data, an abbreviated walk-through, and brief interviews with building operating staff.

The screening audits take advantage of preliminary energy-use and GHG benchmarks, included in this report, and look for RE opportunities in collaboration with the Phase B RE Strategy Report. The function of this audit is to illustrate high level ECMs, not to provide detailed energy conservation measures, though recommendations for follow-up investigation are suggested and will be assessed in the pending GRRAP report.

The sections below outline the details of the audits at each of the six sites identified. The selected buildings for the audits are provided in the table below.

Table 3: Selected facilities for site visits, representing one in each of the archetypes at the time of the study

Facility	GSF	2019 Energy Use Index ekWh/sq. ft			Function	Archetype
		Electricity	Natural Gas	Total		
Central Operations Depot	98,232	15.9	33.6	49.5	Storage, vehicle maintenance, machine shops, offices, meeting rooms, lunchroom	Operations & Admin.
Fire Station 3	15,629	25.3	17.7	42.9	Fire station, offices, storage, dormitory, meeting rooms, gym, kitchen area	Operations & Admin.
Glen Abbey Community Centre	149,484	14.1	26.1	40.2	Community Centre, ice rinks, pool, office, meeting rooms, gyms, library	Community Centre
Sir John Colborne Recreation Centre	9,065	13.9	36.1	50.1	Seniors Centre, gym, offices, meeting rooms, kitchen area	Community Centre
Sixteen Mile Sports Complex	196,000	26.0	17.6	43.6	Community Centre, ice rinks, meeting rooms, offices, shops, storage, pub, squash courts	Sports complex
Transit Facility	265,000	16.1	21.1	37.2	Bus storage, repairs, shops, offices, meeting rooms	Operations & Admin.

Central Operations Depot

Address: 1140 South Service Road

Facility Type: maintenance, equipment storage, offices, meeting rooms, lunchroom, locker rooms, high bay vehicle garage, workshops, high bay paint shop, maintenance sheds and training rooms.

Picture 1: Central Operations Depot – front of building (left) and section of roof (right)

This facility is generally in good shape. It consists of wings of different heights and functions to suit the activities including workshops, storage, garages. The HVAC consists of rooftop units that include natural gas fired heating and electric compressor cooling systems, delivering conditioned air to the related zones. There are some electric baseboard heaters. The filters seemed to be clean and dampers sealing. There are gas fired tube heaters in the garage areas. The exhaust systems are zoned according to activities. Many of them were off during the visit which indicates control when required. There are two A. O. Smith gas fired, natural aspirated domestic hot water tanks for staff showers.

The building automation system (BAS) is a Johnson Controls Metasys with an operation station in the facility operator's office. Staff can access this system with the appropriate level of control at their computers. This BAS controls and schedules the HVAC equipment. Thermostats seen indicated a set point of 18°C.

New LED lights have been installed in the west area of the building. Zone B (the administration rooms, vehicle high bay shop, tool room halls and screening room) are now LED fixtures, with Zones A and C to be done in 2021. The remaining areas of the building are T8 fluorescent and PL pot lights. Occupancy control was not noticed with lights switched and some zone control. There are roof mounted skylights, some of which were covered with mesh to control solar gains.

The envelope seems to be in good shape and the windows are all sealed double pane. Doors were in good shape though some need seal repairs.

Opportunities for Renewable Energy

There are multiple large roof areas on the main that could be suitable for photovoltaic arrays, even with the collection of HVAC equipment. A layout review with shadow study would establish the potential. The work sheds are clear of equipment, face south and are also good roofs for PV. The main roof seems to be in good shape. There is a vehicle washing station at the west end of the facility that could be a candidate for a solar hot water pre-heat system (8-10 modules with storage tank). The layout of the garage doors makes a solar wall air heating system impractical on the south wall. The west section wall at the paint shop could be a considered for solar air wall heating to pre-heat the make up air to replace the exhaust from the paint shop. Solar air heating also adds some insulation value.

Electric vehicle charging stations should be considered for staff and public parking areas and expands PV capacity to this facility.

The figures below illustrate early level estimates for roof and parking lot PV applications at the Operations Centre. The rooftop array consists of four sections that total 718 kW_{DC} (~594 kW_{AC}) set at 20° and facing south west. If all of these were to be installed, almost 593,000 kWh would be produced per year avoiding 25 tonnes eCO_2/year. The estimated performance considers DC to AC conversion, degradation, dirt, ambient temperatures, and other inefficiencies providing a conservative value. Without more detailed shading analysis, the final layout is estimated at about 70% roof coverage. Other design criteria not taken into account and would likely reduce the final power are distance from the roof edges and maintenance pathways.

A high-level cost estimate for the complete array would be on the order of $900,000. Connection capacity has been assumed though Oakville Hydro would be consulted at a pre-connection impact assessment stage for final capacity allowed.

Figure 9 shows a parking lot PV array consisting of six segments that total 679 kW_{DC} (~594 kW_{AC}). As with the roof array, system inefficiencies with some derating have been taken into account and connection capacity has been assumed. With this array approximately 738,000 kWh would be generated per year, avoiding 32 tonnes eCO_2/year.

Between these two systems (1,188 kW_{AC}) ~1,334,000 kWh of electricity would be generated annually into the facility. At electricity loads in 2019; 1,566,731 kWh, this PV energy represents ~85% of the building electricity. The system would avoid 57 tonnes eCO_2/year.

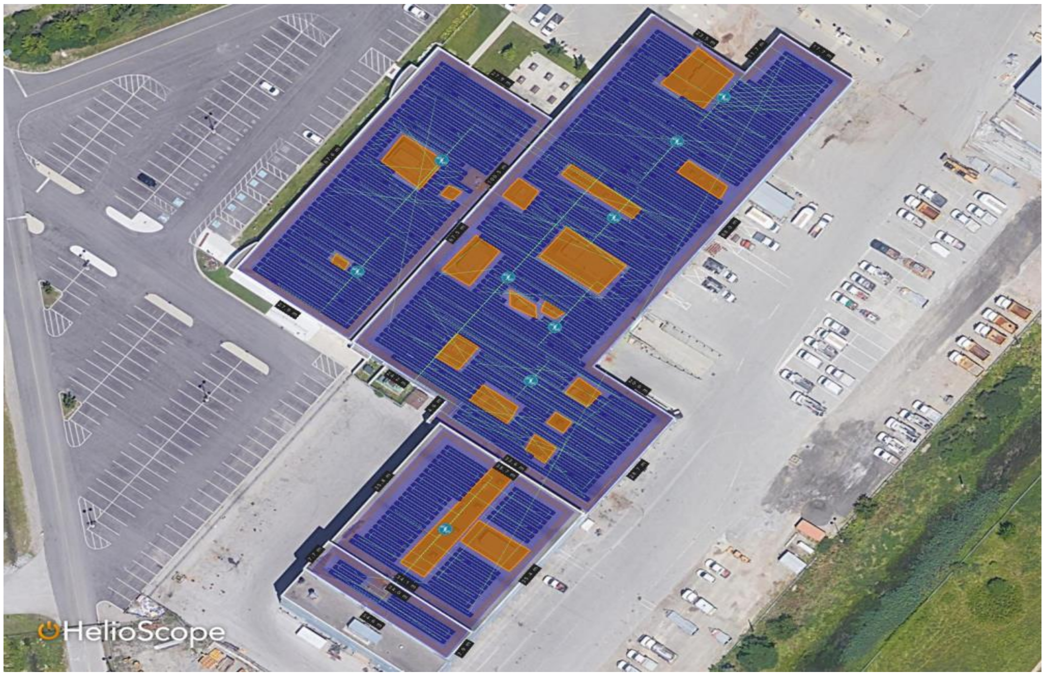


Figure 9: Conceptual roof PV array at 594 kW_{AC} (718 kW_{DC})

Figure 10: Conceptual layout for parking lot PV at 594 kW_{AC} (679 kW_{DC})

Fire Station #3

Address: 168 Kerr Street

Facility Type: Fire hall, offices, meeting rooms, small museum, lunchroom, dormitory, high bay garage, gym, light maintenance services and storage


Picture 2: Fire Station 3 - front of building (left) and section of roof (right)

This station is in good shape. It has rooftop energy recovery ventilator units with electric heating. There are electric baseboard heaters. The lighting is LED throughout and a combination of switched and a Lutron control system. Domestic hot water is provided from a natural gas fired, controlled vent tank. The building automation system is by Johnson Controls, Metasys. The doors and windows are in good shape with good seals.

Opportunities for Renewable or Alternate Energy

The roof is clear and would be a good candidate for a solar PV array. The wall enclosing the rooftop units would be suitable for a small solar wall air pre-heating system. The domestic hot water loads could be supplemented with a small solar hot water array (4-6 panels, ~5 m^2) which would supply on the order of 40% of the annual hot water loads.

Figure 11: Conceptual for Firehall #3 PV array at 121 kW_{DC} (120 kW_{AC})

The parking area is not very large and would be shaded from the building to the west making a parking lot PV system unlikely. EV charging spots (approx. 2-3) for the staff should be considered.

Figure 11 above shows a concept for PV on the roof at Firehall #3. The rooftop array consists of two sections that total 121 kW_{DC} (~120 kW_{AC}) set at 20° and facing south west. If all of these were to be installed, almost 101,300 kWh would be produced per year avoiding 4 tonnes eCO_2/year. The performance estimates consider DC to AC conversion, degradation, dirt, ambient temperatures, and other inefficiencies, giving a conservative value. Other design criteria not considered, and would likely reduce the final power, are distance allowances from the roof edges and maintenance pathways.

A high-level cost estimate for the complete array would be on the order of $170,000. Structural and connection capacity has been assumed, though Oakville Hydro would be consulted at a pre-connection impact assessment stage for final capacity allowed.

Glen Abbey Community Centre

Address: 1415 Third Line

Facility Type: Community centre, 2 x ice rinks, pool, gyms, library, offices, meeting rooms, maintenance rooms, existing rooftop 190kWAC photovoltaic array

Picture 3: Glen Abbey Community Centre - front of building (left), section of available roof (middle), and existing PV array (right)

The facility is good shape. The heating is a combination of hot water, electric baseboards, and rooftop units. The ice rink does not currently have compressor heat recovery in one of the rink compressor room to heat the ice melt pit. Lighting is predominantly led throughout including the gym and rink. There is a large parking lot area.

Opportunities for Renewable or Alternate Energy

There is a 190kWAC photovoltaic array on the roof now. It is fastened to the standing seam roof deck, horizontally. There is a large amount of roof area available if the opportunity to expand the array arises. High level review indicates a further 100 kW could be installed. The pool make-up water and DHW loads could be supplemented with solar heated water as the mechanical room is in the top of the facility. There may be a chance to use a solar wall air pre-heat on the south wall for the pool and rink area ventilation. This would require more investigation as it would alter the “look” of the wall significantly.

The parking lot areas are free and clear for PV, thought the roofs offer a large area for arrays. EV charging stations should be considered and located close to the front door (preference for EV parking). If the parking lot is due for repairs in the future, a ground source heat pump array should be considered to inject energy into the hot water loop and support cooling in the summer. Parking lot areas can support angled boreholes and would provide a large array to support a large heat pump application.

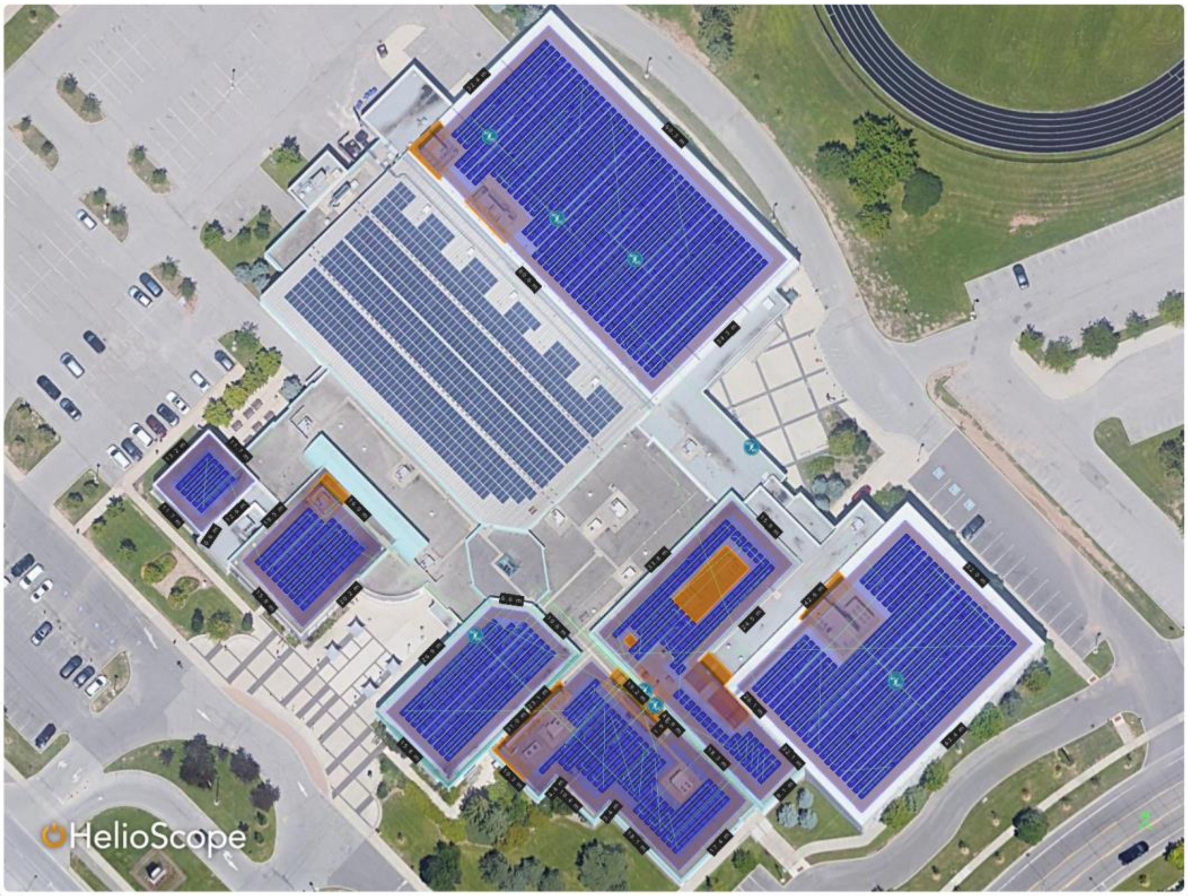


Figure 12: Conceptual PV arrays at Glen Abbey complex, total 504.7 kW_{DC}(450 kW_{AC})

Figure 12 above illustrates a concept for a large PV array at this facility taking advantage of many rooftops. Assuming all of these can be installed, there is capacity for seven segments totalling 504.7 kW_{DC} (450 kW_{AC}). These are mounted at 20°from horizontal and face roughly south-east. This would produce about 528,000 kWh/year, avoiding 23 tonnes eCO_2/yr and represents ~25% of the facility electricity loads (2019). A high-level cost for the full array as shown would be on the order of $700,000.

This facility has loads that are typically well suited for solar hot water and air pre-heat systems – there are consistent domestic hot water loads, pools for solar hot water applications and arenas that can use pre-heated air. Both of these systems reduce natural gas use.

For example, a 40-module vacuum tube solar hot water system would inject about 70 mmBTU/yr into the hot water loads (~55 m^2 of panel area, about 120 m^2 of roof area) representing almost 2,500 m^3. These systems are mounted at between 35 and 45° from horizontal. For this system a 750 L storage/buffer tank is required with a heat exchanger as the heat transfer fluid will be polypropylene for freeze protection. Without a more accurate estimate of the actual hot water use it is difficult to estimate the savings and performance though based on a daily load (average through the year) of 3,600 L/day this array would supply close to 40% of the annual hot water loads. A high-level cost estimate for this scale of vacuum tube array is $150,000.

Sir John Colborne Community Centre

Address: 1565 Old Lakeshore Road

Facility Type: Seniors community centre, gym, offices, meeting rooms, kitchen, atrium meeting area

Picture 4: Sir Jon Colborne Community Centre - sections of parking lot (left), section of roof (right), and front of building (bottom)

This facility is generally in good shape. It has had a few modifications to the air distribution lately but still has issues with hot/cold calls. It is heated/cooled by two rooftop units with some electric baseboard heating. The doors and windows are still in good shape with seals. It sits among mature trees.

Opportunities for Renewable or Alternate Energy

There is a section of sloped roof that would be good for a small PV array (30-50 kW). The roof area to the west would be shaded for much of the year and not a good candidate. The parking lot would be a suitable for car port PV. Consider 2-4 EV charging stations located near the front door. If the parking area is replaced consideration should be given to a ground source heat pump system to offset the use of the natural gas fired rooftop heating. There is a small kitchen service including dish washing that could be supplemented with a small (4 solar panels) solar hot water array.

Sixteen Mile Sports Complex

Address: 3070 Neyagawa Boulevard

Facility Type: Community centre, 4 x ice rinks, gym, squash courts, membership gym, maintenance rooms, storage rooms, offices, meeting rooms, pub, photovoltaic array

*Picture 5: Sixteen Mile Sports complex - f*ront of building (left) and existing roof PV (right)

This is a very large sports complex and generally in good shape. It is a multifunction facility that is used regularly. The lighting is predominantly LED and there is a Johnson Controls Metasys BAS. It is a prestigious ice rink for high caliber skating and hockey programs – with an Olympic sized rink and three NHL-sized rinks. It is surrounded by large parking lot areas and clear to the south and west. The heating is predominantly gas fired hot water with heat recovery used from the compressors. The change rooms have underfloor heating. There was talk of installing a new Olympic scale pool on the grounds to the east and using the heat from the rink compressors to pre-heat the pool. This plan has been shelved for now. There is a large 458kWAC photovoltaic system in place now.

Opportunities for Renewable or Alternate Energy

The existing PV array is ~490 kW. There is considerable roof area for an expansion which must be verified with the LDC. There is a large amount of parking lot area to the west of the facility that would be suitable for a ground source heat pump array, to offset the natural gas boiler loads. A west and south facing wall should be considered for a solar wall air heating system to pre-heat the air for the rinks and gyms. Solar hot water should be considered for the ice melt pit and DHW loads. EV stations should be considered (8-10 units initially).

Recent Application for Net-Zero Renovation Funding

A Federal Government funding program for deep energy conservation and GHG reduction implementation was released in June/July 2021. This Federal program, called the Green and Inclusive Communities Buildings (GICB) program, is a 5-year $1.5 billion fund to make municipal and community buildings "more efficient, low carbon, more resilient and higher performing".

The FCM group and Blackstone prepared an application for funding to renovate the 16 Mile Sports Complex to achieve a net-zero carbon facility by 2050. The proposed project would implement significant thermal and electrical modifications to set the facility on a path to net-zero by 2050. The bulk of the measures are based on converting to low temperature heat sources from heat pumps plus large PV arrays that would offset the conversion from natural gas to electrical HVAC. The exercise putting together the proposal illustrated the scale required to take a large and multi-use facility to net-zero. Most of the measures required are low carbon systems.

Figure 13 below shows the additional PV for on the roof. This 400kW$_{AC}$ would provide ~551,000 kWh/year that would offset ~80% of the electricity required for proposed conversion of gas fired rooftop units to heat pump and new ground source heat pump.

Figure 13: Additional rooftop PV array concept at 16 Mile, 400 kW$_{DC}$

Figure 14 below illustrates the carport PV concept. In this suggestion, a portion of the parking is covered with PV arrays on the order of 660 kW_{AC}, producing about 888,000 kWh/yr. This would fully offset the electricity due to conversion of the HVAC from natural gas with surplus to offset the electricity of the facility.

Without knowing what measures would be implemented it is difficult to assess the impact of these PV arrays though if both (roof and carport) were installed they would contribute ~35% of the total facility electricity yearly.

Figure 14: Concept for parking lot PV arrays at 16 Mile Sports Complex, 660 kW_{DC}

Transit Facility

Address: 430 Wyecroft Road

Facility Type: Transit system storage and maintenance hub, high bay repair shop, maintenance shops, offices, meeting rooms, training room, bus wash, ground source heat pump system

Figure 15: Transit Facility - roof area (left) and heat pump supply system (right)

This is a large maintenance and service hub for the bus system. This facility is used for 18- 24-hour per day. It has combination large rooftop unit with electric heat for zones within the large volume service areas. A Johnson Controls Metasys BAS monitors and controls most HVAC. There is a bus washing station that uses some reclaimed water and a gas fired heater that has been disconnected. They also capture rainwater for service washing water loads.

The bus service area is open to the outside which makes the space very cold in the winter. There is a ground source heat pump system used for the administration area. This has not been working well in particular during the heating season. Looking at this during the site visit did not determine the reasons though it was noticed the glycol lines to the rooftop units are distant from the pump room. It was also noted that one of the compressors was cycling stages constantly. Initial review points to a small cooling load which would not recharge the ground with heat. As a result, the system will not have sufficient thermal energy to keep up with heating loads. This needs to be investigated further and may need control sequences to allow back-up heat as the outside air temperatures fall below a (as yet undetermined) certain point. The facility is predominantly lit with LED fixtures.

Opportunities for Renewable or Alternate Energy

The roof is covered with TPO which is cooler than a darker ballasted or asphalt membrane roof. This makes this roof a very good choice for a large PV array. There is clear solar access and given the barn is difficult to keep warm, a solar thermal system (air or water to air) would be a good consideration here – efforts should be made to reduce the air flow at the garage doors, i.e., air blades, curtains. The GSHP system needs to be assessed and recommissioned to see if the current layout can provide the flow required at the rooftop units. Consider solar hot water for DHW loads and as a supplementary source for the GSHP boreholes during the summer.

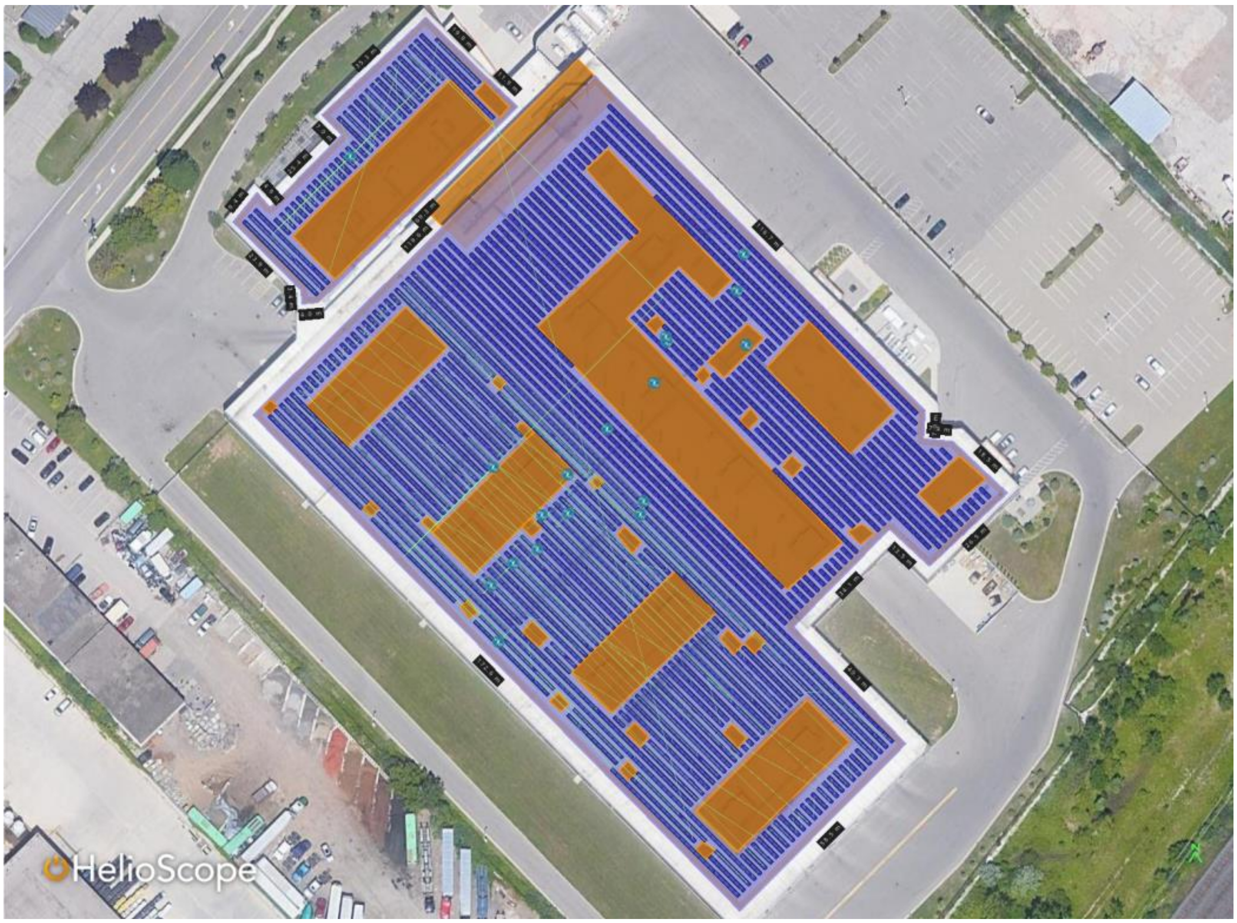


Figure 16: Conceptual layout for PV at Transit, 1.13 MW_{DC} (950 kW_{AC})

This is a large PV array and would require more layout design including shading studies given the quantity of equipment on the roof. As a concept, this illustrates the scale possible on a large a relatively open roof area. In this application there are two segments and a small section on the maintenance shed to the north. The total capacity is 1.13 MW_{DC} (950 kW_{AC}). The main building array is mounted at 20° from horizontal and faces approximately south west. The total generation is ~1,211,000 kWh/year which represents ~28% of the electricity used in 2019. A high-level cost estimate, assuming there is connection space and the roof is structurally capable is on the order of $1,525,000. This scale will require early discussions with Oakville Hydro.

Maple Grove Arena

Though not selected for RE site review, a Helioscope analysis was done at this site to show a smaller system at a relatively smaller facility. In this case, the roof area is smaller than those shown above but illustrates the concept at a smaller scale and how it would impact the electrical use.

Opportunities for Renewable or Alternate Energy

This system consists of two segments totalling 99.8 kW_{DC} (90 kW_{AC}), mounted at ~20° from the roof deck surface, aiming roughly southwest and south east. This array would produce ~104,000 kWh/year; about 24% of the 435,291 kWh/yr (2019).

This array is estimated to cost about $140,000. As with all PV system concepts, the roof must be assessed for structural capacity first. Then a connection impact study is needed before deciding if the system is possible.

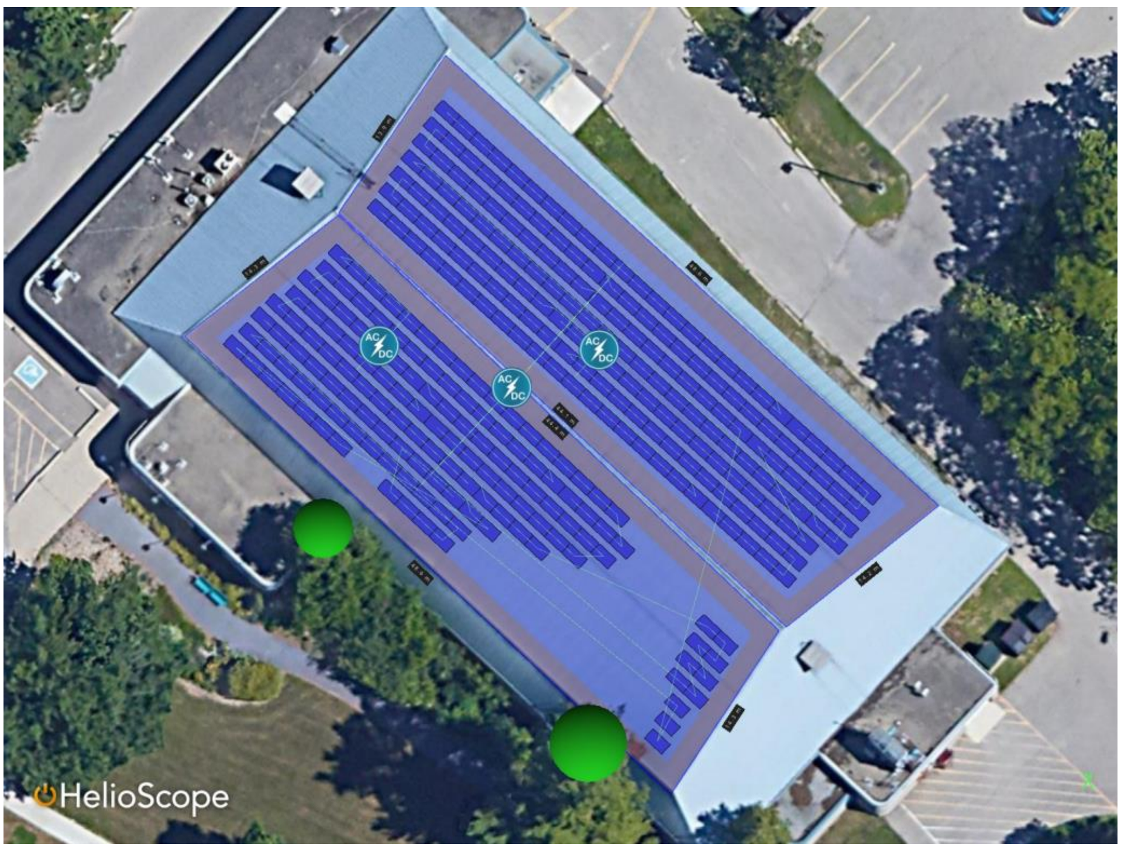


Figure 17: Conceptual rooftop PV, 99.8 kW_{DC} (90 kW_{AC})

Summary of Conceptual PV Arrays

In the sections above, some conceptual layouts for PV arrays have been briefly described. These are high level to illustrate the concepts, scales, costs, and potential performance scenarios.

The table below summarizes the concepts presented in the section above. Of note is that these, if they were all installed, would bring The Town very close to the proposed PV installation target of 15% of corporate electrical loads by ~2025. At 15% the Town would have installed 4,481 kW of PV. The arrays shown in these sections, at 4,331 kW, is 97% of the goal. The electricity generated using PV will offset a significant portion of any electrification of HVAC from natural gas to electricity (i.e., heat pumps) which is how the GHG reductions will be achieved to reach The Town's GHG reduction goals.

Table 4: Summary of Conceptual Designs for PV Arrays

Site	Array size, kWdc	Est output, kWh/yr
Transit Centre	1,130	1,211,000
Maple Grove Arena	99.8	104,000
16 Mile Sports Complex*	1,060	1,439,000
Glen Abbey CC	504.7	528,000
Firehall #3	121	101,300
Operations Centre*	1,415	1,331,000
Totals	**4,331**	**4,714,300**

Existing Renewable Energy Infrastructure

Introduction

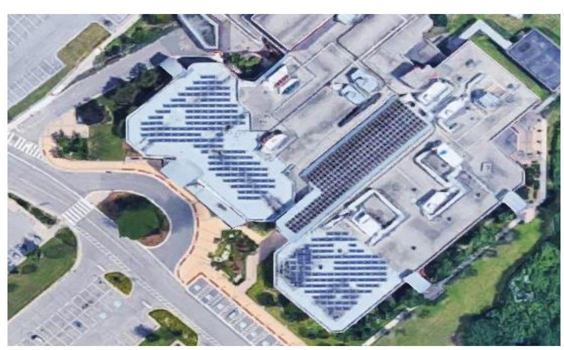
The following is an analysis of the existing renewable energy generation infrastructure at The Town as it pertains to Solar PV Energy Systems. Blackstone and our solar PV electrical contractor, Toews Power Inc. visited the following four (4) Town of Oakville solar PV systems on September 30, 2020:

- ✓ Glen Abbey Community Centre
  1415 Third Line, Oakville

- ✓ Sixteen Mile Sports Complex

- ✓ River Oaks Community Centre
  2400 Sixth Line, Oakville

- ✓ Oakville Town Hall
  1225 Trafalgar Road, Oakville



Picture 6: Existing RE Sites

Overall Recommendations

Overall Conclusions

- Good clean sites that were built properly.
- While operating well from the information we have and generally in good condition, it appears the sites may not have been maintained regularly.
- Three main sites (Glen Abbey, Sixteen Mile, River Oaks) were built by same entity.

Solar Production Performance

Glen Abbey

There was some performance degradation noted; preventative maintenance program recommended. Include panel cleaning.

Sixteen Mile

There was some performance degradation noted; preventative maintenance program recommended. Include panel cleaning.

River Oaks

There was some performance degradation noted; preventative maintenance program recommended. Include panel cleaning.

Town Hall

Not applicable as there is no data available.

Overall Production Performance

- It is notable that 2019 was a very poor production year for all projects. All three projects for which we were provided data experienced the same low production values relative to expectations.
- We can only conclude that the Oakville sites may have witnessed a lake effect that pushed production down in 2019 or that there was a maintenance issue that was not addressed during this time period.
- We have cross-referenced the three Oakville projects for which we have production data against other Ontario solar project data, with the geographically closest similar projects being in Georgetown.

Overall Recommendations:

- More granular production data: production data should be available on a per hour basis (presently, we were only provided monthly summary data).
- Inverter and/or production alarms should be sent via email or text to notify owner immediately of production issues.
- Site specific issues were limited; they are noted in the following site-specific sections.

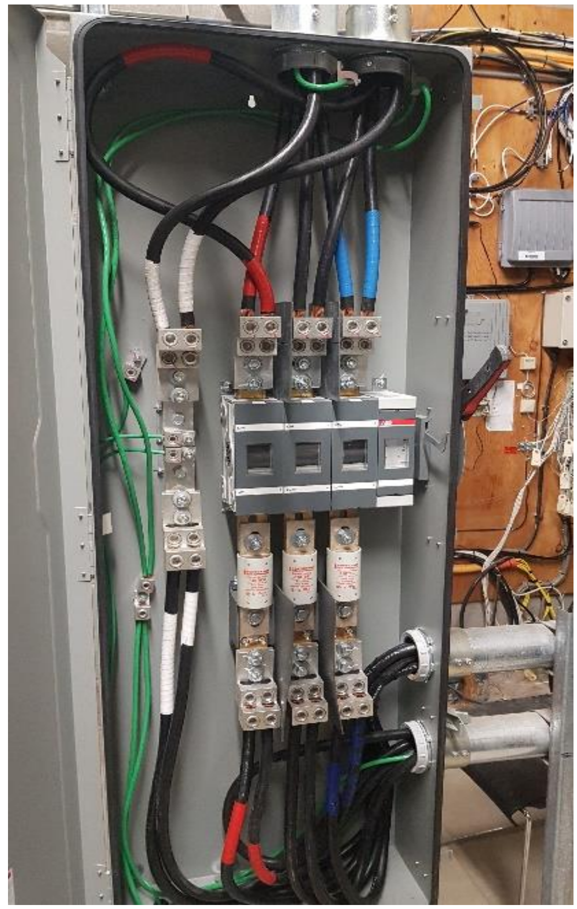
Glen Abbey Community Centre

Conclusion

- A clean site using reputable equipment that was installed properly, except for a few minor oddities.

Observations

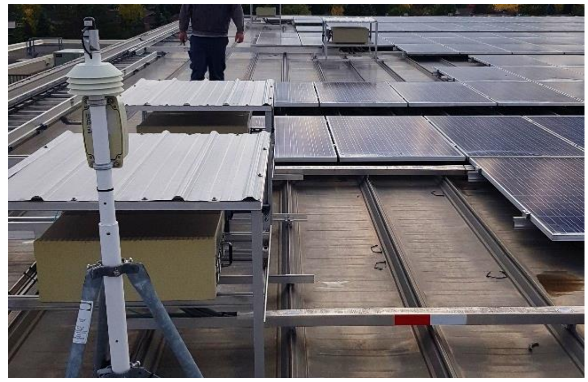
- Sungrow inverter, Hanwha solar panels – typically regarded as solid equipment.
- The underlying roof is flat with a standing seam metal roof. The subsequent solar project is also a flat roof system, meaning no tilt on the system, which will lead to snow piling in the winter affecting production.
- The flat system noted above will not generate as much kilowatt-hour production as a tilted system would, given Oakville's latitude. Ideally, the system would have a 30° tilt to maximize solar production. However, the cost the create that 30° tilt would be very substantial, so the existing layout is as expected.
- Visit was made day after/morning of a rainstorm; some pooled water observed but nothing out of the ordinary.
- The electrical setup and installation were performing well both on the roof and in the electrical room. Clean site.
- The electrical disconnects are good and clean as is all electrical room wiring. *(see picture to right)*



Picture 7: Electrical Room Wiring

- NOTE: for new solar installations, electrical code requires that an externally viewed disconnect is required so that the utility can have rapid verification is system is connected to grid in case of a power outage. This appears not to have been a requirement of Oakville Hydro at the time, possibly due to their ability to access Town-owned sites.
- Monitoring system: the monitoring equipment is supplied by Deck, while the actual monitoring software is Also Energy. While we have seen issues with Deck equipment, Also Energy has a good reputation of energy monitoring software.
    - It would be useful to see the actual instantaneous or 15-minute data that Also Energy's software platform provides to verify observations and production.

Installation Issues



Picture 8: Inverters Installation

- Inverters have been installed on their side and covered to protect them from the elements. This does not appear to be an operational problem but makes it very difficult to easily gauge operational functionality. *(see picture to right)*

Maintenance

- There is some slight discoloration on some of the solar panels, indicating a degradation in production. While not ideal, this is not necessarily atypical for solar projects over five years old. Production will be verified in solar production analysis.
- Solar panel end clamps appear to be all intact meaning the integrity of the panels to racking structure remains in good shape.
- The system appears to have been maintained fairly well, although we did observe some hanging PV wire between panels (not taut); this tends to happen overtime if the system has not been regularly maintained.

Issues/Oddities

- Only a quarter of total roof space has been used; opens the door to add further solar generation
- This site unfortunately is an established hangout for seagulls. Their guano dirties the panels. Regular cleaning (annual minimum) recommended.
- Guano dirtying typically does not have a large impact on production (unless there is a collection across a string of cells). This will be verified in the solar production analysis. More importantly, maintenance checks should be made to system to ensure the seagulls are not nesting in and around the PV system wiring, which could cause disruption to system operation. *(see picture below)*

Picture 9: System Operation

Engineering Review

Blackstone provided the Glen Abbey Issued for Construction (IFC) drawing package dated April 24, 2015 to F2 Engineering for their review of the solar project electrical design. F2 Engineering concluded the design appears to follow Ontario Electrical Safety Code requirements and good engineering practices in place at that time. Please see Appendix B for F2 Engineering's report.

Production Performance

As per documentation provided to Blackstone from The Town, the expected performance for this system was to be 1,000 kWh/kW installed/year. As the graph below indicates, this target has been mostly reached although, it is notable that 2019 was a very poor production year for this project.

The Georgetown project used as a cross-reference did not witness the production reduction that was experienced in Oakville.

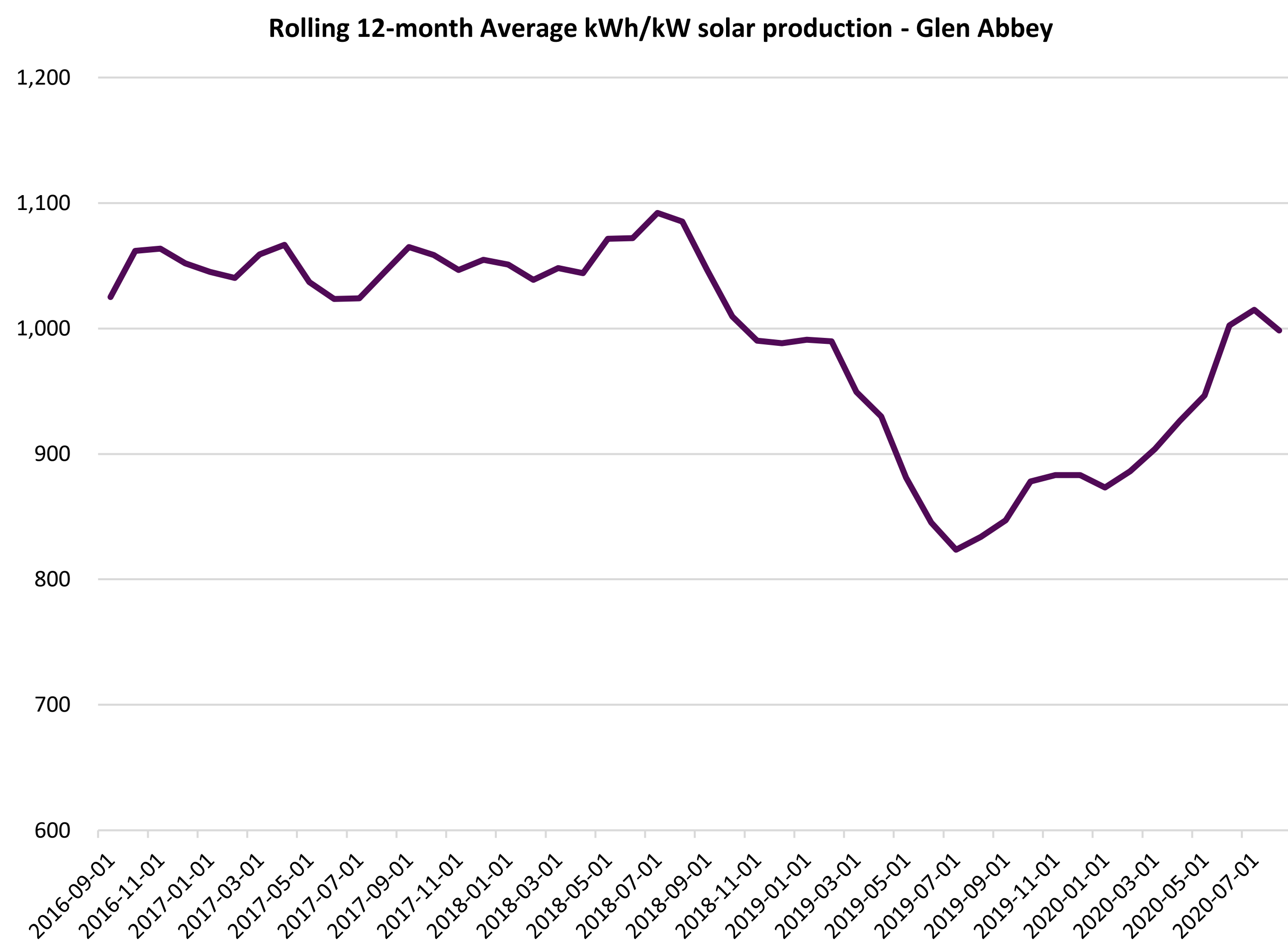


Figure 18: Summary of average kWh/kW solar system performance

Sixteen Mile Sports Complex

Conclusion

- A clean site using reputable equipment that was installed properly, except for a very few, minor oddities. *(see picture below)*

Picture 10: PV Site

Observations

- Sungrow inverter, Hanwha solar panels – typically regarded as solid equipment.
- The underlying roof is flat with a standing seam metal roof. The subsequent solar project is also a flat roof system, meaning no tilt on the system, which will lead to snow piling in the winter affecting production.
- The flat system will not generate as much kilowatt-hour production as a tilted system would given Oakville's latitude. Ideally, the system would have a 30° tilt to maximize solar production. However, the cost the create that 30° tilt would be very substantial, so the existing layout is as expected.
- Visit was made day after/morning of rainstorm; some pooled water observed but nothing out of the ordinary.
- The electrical setup and installation were performed well both on the roof and in the electrical room.
- The electrical disconnects are good and clean as is all electrical room wiring.
- NOTE: for new solar installations, electrical code requires that an externally viewed disconnect is required so that the utility can have rapid verification is system is connected to grid in case of a power outage. This appears not to have been a requirement of Oakville Hydro at the time, possibly due to their ability to access Town-owned sites.
- Monitoring system: the monitoring equipment is supplied by Deck, while the actual monitoring software is Also Energy. While we have seen issues with Deck equipment, Also Energy has a good reputation of energy monitoring software.
    - It would be useful to see the actual instantaneous or 15-minute data that Also Energy's software platform provides to verify observations and production.

Installation Issues

- Inverters have been installed on their side and covered to protect them from the elements. This does not appear to be an operational problem but makes it very difficult to easily gauge operational functionality.

Maintenance

- There is some slight discoloration on some of the solar panels, indicating a degradation in production. While not ideal, this is not necessarily atypical for solar projects over five years old. Production will be verified in solar production analysis.
- Solar panel end clamps appear to be all intact meaning integrity of panels to racking structure remains in good shape.
- The system appears to have been maintained fairly well, although we did observe some hanging PV wire between panels (not taut); this tends to happen overtime if system has not been regularly maintained.

Issues/Oddities

- Only half the total roof space has been used; opens door to add further solar generation.

Engineering Review

Blackstone provided the Sixteen Mile Issued for Construction (IFC) drawing package dated April 27, 2015 to F2 Engineering for their review of the solar project electrical design. F2 Engineering concluded the design appears to follow Ontario Electrical Safety Code requirements and good engineering practices in place at that time. Please see Appendix B for F2 Engineering's report.

Production Performance

The expected performance for this system was to be 1,000 kWh/kW installed/year. However, we did note during our site visit that the Sixteen Mile PV system does benefit from a panel tilt of about 5-10° to the west relative to the flat systems at Glen Abbey and River Oaks. For that reason, we would expect kWh/kW/year production at Sixteen Mile to be in the 1,050-1,100 range. As the graph below indicates, this target has been mostly reached although, it is notable that 2019 was a very poor production year for this project. The Georgetown project did not witness the production reduction that was experienced in Oakville. Given this is a large system, an annual maintenance program should be implemented that includes cleaning and monthly performance reviews.

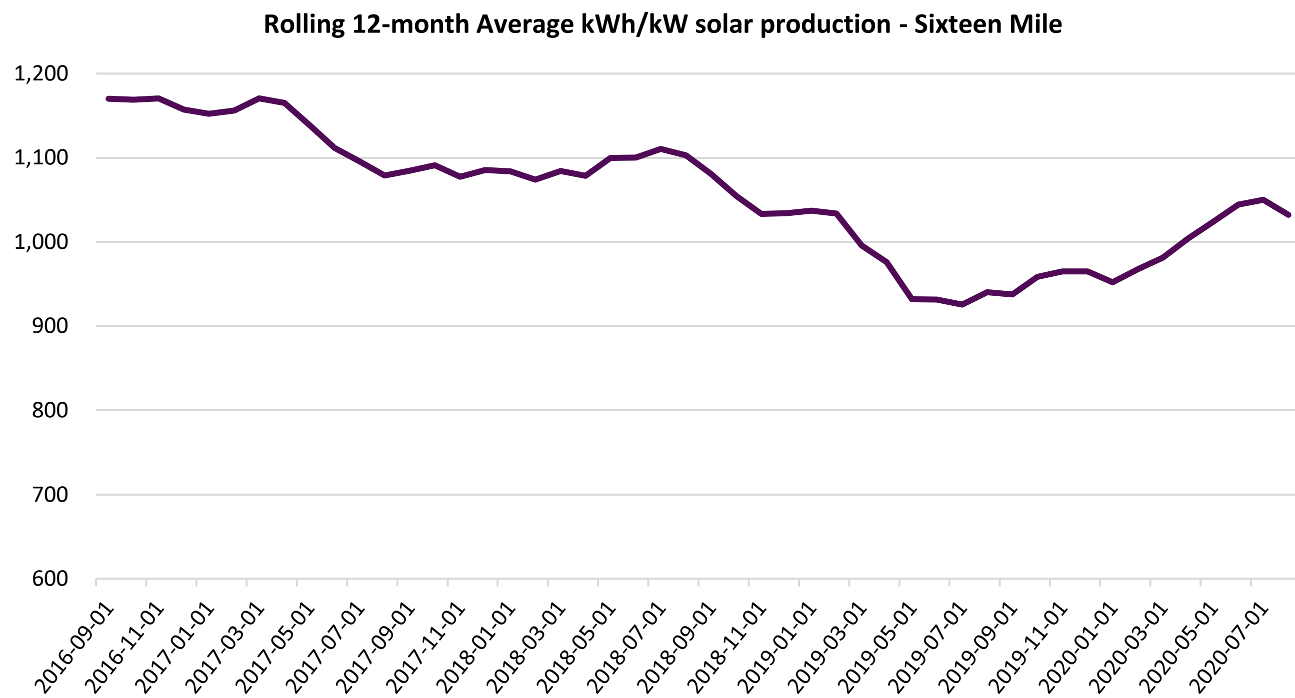


Figure 19: Summary of performance at Sixteen Mile, kWh/kW installed

River Oaks Community Centre

Conclusion

- A clean site using reputable equipment that was installed properly, except for a few, minor oddities, or installation irregularities.
- Recommend annual maintenance program including cleaning and performance reviews.

Observations

- Sungrow inverter, Hanwha solar panels – typically regarded as solid equipment.
- The underlying roof is flat with a standing seam metal roof. The subsequent solar project is also a flat roof system, meaning no tilt on the system, which will lead to snow piling in the winter affecting production.
- The flat system will not generate as much kilowatt-hour production as a tilted system would given Oakville's latitude; ideally, the system would have a 30° tilt to maximize solar production. Having said, the cost the create that 30° tilt would be very substantial, so the existing layout is as expected.
- Visit was made day after/morning of rainstorm; some pooled water observed but nothing out of the ordinary.
- The electrical setup and installation were performed well both on the roof and in the electrical room. Clean site.
- The electrical disconnects are good and clean as is all electrical room wiring.
- NOTE: for new solar installations, electrical code requires that an externally viewed disconnect is required so that the utility can have rapid verification is system is connected to grid in case of a power outage. This appears not to have been a requirement of Oakville Hydro at the time, possibly due to their ability to access Town-owned sites.
- Monitoring system: the monitoring equipment is supplied by Deck, while the actual monitoring software is Also Energy. While we have seen issues with Deck equipment, Also Energy has a good reputation of energy monitoring software.
    - It would be useful to see the actual instantaneous or 15-minute data that Also Energy's software platform provides to verify observations and production

Installation Issues

- The "home-run" wiring leading into the inverters on this site are being held in place with duct seal, which is not of high quality and is cracking throughout. This is odd in that the Sixteen Mile and Glen Abbey sites use steel conduit to fasten the home-run wiring into the inverters. (*see picture to right*)
    - So far, the inverters appear to be operating normally and there has been low impact to the inverters as they are covered; however, we advise that the duct seal should be replaced preferably with steel conduit to ensure consistent, long-term operation.
- Inverters have been installed on their side and covered to protect them from the elements. This does not appear to be an operation problem but makes it very difficult to easily gauge operational functionality.

Picture 11: Home-run Wiring

Maintenance

- There is some slight discoloration on some of the solar panels, indicating a degradation in production. While not ideal, this is not necessarily atypical for solar projects over five years old. Production will be verified in solar production analysis.
- Solar panel end clamps appear to be all intact meaning integrity of panels to racking structure remains in good shape.
- The system appears to have been maintained fairly well, although we did observe some hanging PV wire between panels (not taut); this tends to happen overtime if system has not been regularly maintained.

Issues/Oddities

- None reported

Engineering Review

Blackstone provided the River Oaks Issued for Construction (IFC) drawing package dated April 24, 2015 to F2 Engineering for their review of the solar project electrical design. F2 Engineering concluded the design appears to follow Ontario Electrical Safety Code requirements and good engineering practices in place at that time. Please see Appendix B for F2 Engineering's report.

Production Performance

As per documentation provided to Blackstone from the Town, the expected performance for this system was to be 1,000 kWh/kW installed/year. As the graph below indicates, this target has been mostly reached although, it is notable that 2019 was a very poor production year for this project. The Georgetown project used as a cross-reference did not witness the production reduction that was experienced in Oakville. An annual maintenance program including cleaning should be implemented along with monthly performance reviews.

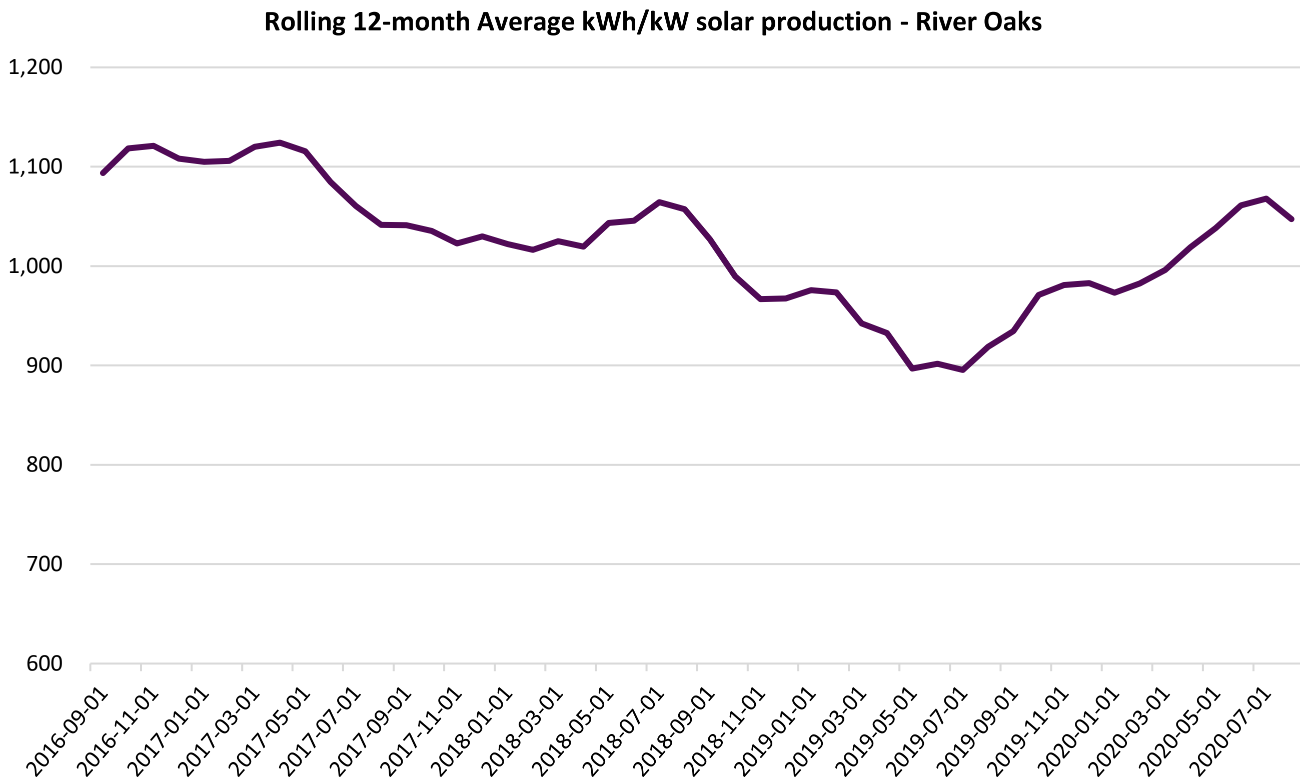


Figure 20: Summary of PV performance at River Oaks, kWh/kW installed

Town Hall

Conclusion

- The Town Hall site is clean solar project, which uses reputable equipment that was installed properly, except for a few, minor oddities or installation irregularities
- An older site than the other three Oakville installations
- Recommend annual maintenance program including cleaning and performance reviews.

Observations

- Fronius inverter, MEMC solar panels – typically regarded as solid equipment.
- Note that 2/6 Fronius inverters were not operating when we observed them in the electrical room.

Picture 12: Fronius Inverters

- Good due south 180° azimuth configuration that maximizes production.
- Panel tilt is approximately 15°, which is adequate for year-round generation.
- While not specific to the solar panel installation, we noted the Town Hall has a variably flat, slightly wave-like surface; the site visit was made day after/morning of rainstorm; some pooled water was observed on the roof surface.
- The bottom edge of the solar panels (heel) in their racking configuration is close to the roof surface, which could lead to snow buildup in the winters as snow is not able to drift through. This will be exacerbated by the wind-guard at the back of the racking structure which was likely installed to minimize wind uplift. Snow collection along a string of cells will degrade performance significantly when snow slides off the modules.
- Solar panels are in great shape with little or no discoloration.
- Wiring is in reasonable shape.
- Panel string combiner boxes are a little old but appear to be functioning.

Installation Issues

- While not critical, home run cables leading to electrical room are placed on rubber blocks, not cable tray
- Cable tray is preferred to protect cables from bottom side and to prevent any cable sagging, which can occur over time. (*see picture below*)

Picture 13: Cable Sagging

Maintenance

The system appears to have been maintained well, although we did observe some hanging PV wire between panels (not taut); this tends to happen over time if system has not been regularly maintained. (*see picture below*)

Picture 14: Hanging PV Wire

Issues/Oddities

There are no issues or oddities to report.

Engineering Review

Not applicable as there was no engineering documentation provided.

Production Performance

Not applicable as there is no production data available. A performance review program is recommended. If snow buildup is noted to be an issue, investigate the benefits of clearing the snow after a heavy snow and snow slide buildup has happened. Note that the modules are installed in "landscape" format so when the bottom row of cells is covered, there will not be a large impact (as compared to "portrait" format when the snow covers all of the cell strings in the module, causing a more significant loss).

Appendix A: List of Buildings

The Oakville corporate portfolio consists of facilities and infrastructure that were categorized into 4 different archetypes. These respective archetypes are arenas, operations & administrative, community centers and other. The total square footage of the Oakville corporate portfolio is 2,014,153. For this study Blackstone evaluated predetermined buildings from each archetype in the Oakville corporate portfolio. The total square footage that was studied sums to 1,656,891.

Facility	Address	Archetype	Square Footage (sq ft)	Square Footage (%)	2018 Data		2019 Data	
					Electricity Consumption (kWh)	Natural Gas Consumption (m3)	Electricity Consumption (kWh)	Natural Gas Consumption (m3)
Centennial Pool	120 Navy Street	Community Centers	17,640	1.1%	256,590	102,302	296,405	94,388
Central Library	120 Navy Street		47,220	2.8%	936,030	123,934	770,104	130,038
Glen Abbey CC*	1415 Third Line		134,500	8.1%	2,103,998	383,535	2,104,325	353,953
OCPA	130 Navy Street		24,720	1.5%	638,732	57,862	598,126	48,452
Iroquois Ridge CC	1051 Glenashton Drive		69,282	4.2%	1,616,290	359,124	1,618,758	311,548
QEPCCC	2302 Bridge Road		145,760	8.8%	2,191,173	214,609	2,067,005	218,849
River Oaks CC*	2400 Sixth Line		113,028	6.8%	2,121,958	231,137	1,803,511	218,048
Sir John Colborne	1565 Old Lakeshore Road		9,065	0.5%	147,845	18,010	126,718	30,906
Trafalgar Park CC	133 Rebecca Street		62,875	3.8%	899,884	147,405	965,166	167,431
Oakville Trafalgar CC	325 Reynold St		41,200	2.5%	-	-	-	-
Central Operations	1140 South Service Road	Operations & Administrative	98,232	5.9%	1,471,791	268,271	1,566,731	136,563
Fire Station 3 (new)	168 Kerr St		15,629	0.9%	152,814	15,665	371,771	24,521
North Ops	3250 Neyagawa Boulevard		17,909	1.1%	457,306	66,400	400,420	62,403
Town Hall*	1225 Trafalgar Road		162,092	9.8%	3,024,328	201,584	2,783,692	207,140
Transit Facility	430 Wyecroft Road		265,000	16.0%	3,768,266	469,326	4,256,639	537,745
Joshua's Creek Arena	1663 North Service Road East	Arenas	73,400	4.4%	1,301,598	171,441	1,290,459	165,526
Kinoak Arena	363 Warminister Drive		21,000	1.3%	463,873	21,098	457,369	8,448
Maple Grove Arena	2237 Devon Road		28,971	1.7%	427,303	31,471	435,291	31,583
16 Mile Sports Complex*	3070 Neyagawa Boulevard		196,000	11.8%	5,438,706	312,318	5,092,834	349,377
Park Lights	-	Other	-	-	378,202	-	427,384	-
Parking Meters	-		-	-	37,789	-	37,789	-
Parks Outdoor Washrooms	-		17,756	1.1%	410,806	-	422,756	-
Public Parking Garage	300 Church Street		89,165	5.4%	188,590	-	191,111	-
Sand & Salt Structure	1025 Cornwall Road		6,447	0.4%	6,339	-	12,171	-
Splashpads	-		-	-	70,908	-	69,162	-
Streetlights	-		-	-	3,945,324	-	4,056,654	-
Traffic Lighting	-		-	-	553,378	-	547,368	-
		Total	**1,656,891**	**100.0%**	**33,009,822**	**3,195,493**	**32,769,719**	**3,096,920**

*Sites with existing PV arrays

Appendix B: F2 Engineering's Report – Oakville Solar Review

F2 Energy
Energy Engineering Services

SOLAR PROJECTS REVIEW

Oakville, ON

Prepared for:

Corporation of the Town of Oakville
1225 Trafalgar Rd.,
Oakville, ON
L6H 0H3

Prepared by:

Frank Farkas P. Eng.

October 2020

Project No.

20-0923

Revisions

Revision No.	Date	Description	Author	
0	Oct 16, 2020	Draft Report	FF	
1	Nov 11, 2020	Final Report	FF	

Table of Contents

1 Introduction

The Corporation of the Town of Oakville retained Blackstone Energy Services to perform a technical review of three rooftop solar PV projects located within the town of Oakville. F2 Energy reviewed the technical documentation supplied from an electrical design perspective and the comments are provided in this report.

1.1 Project Names and Locations

River Oaks Community Centre
2400 Sixth line,
Oakville, ON
L6H 3M8

Glen Abbey Community Centre
1415 Third Line,
Oakville, ON
L6M 3G2

Sixteen Mile Sports Complex
3070 Neyagawa Blvd,
Oakville, ON
L6M 4L6

2 Project Description and Comment

2.1 River Oaks Community Centre, Oakville ON (185 kW AC, 220.21 kW DC)

This solar PV distributed generator (DG) is connected to the utility via the existing 750kVA, 27.6kV/16kV/0.600kV/0.347kV Yg-Yg interface transformer. A dedicated 400A DG main system disconnect is connected to the transformer secondary via a line side tap made within the main facility load service switchboard upstream of the 1200A main service breaker.

After reviewing Issued for Construction (IFC) drawing package dated April 24, 2015, the design appears to follow Ontario Electrical Safety Code requirements and good engineering practices in place at that time.

This DG systems utilizes a 225kVA, 480V/600V Yg-Yg intermediate transformer. The single line diagram indicates that both sides of this transformer is configured as a grounded wye connection. It should be confirmed on site that the wye point on the 600V side of this transformer is in fact ungrounded and the wye point on the 480V side is grounded. This ensures that the neutral is grounded at only one location on the 600V side and that the neutral is grounded on the separately-derived 480V side of the transformer.

2.2 Glen Abbey Community Centre, Oakville ON (190 kW AC, 226.01 kW DC)

This solar PV distributed generator (DG) is connected to the utility via the existing 1500kVA, 27.6kV/16kV/0.600kV/0.347kV Yg-Yg interface transformer. A dedicated 400A DG main system disconnect is connected to the transformer secondary via a line side tap made within the main facility load service switchboard upstream of the 1600A main service breaker.

After reviewing Issued for Construction (IFC) drawing package dated April 24, 2015, the design appears to follow Ontario Electrical Safety Code requirements and good engineering practices in place at that time.

This DG systems utilizes a 225kVA, 480V/600V Yg-Yg intermediate transformer. The single line diagram indicates that both sides of this transformer is configured as a grounded wye connection. It should be confirmed on site that the wye point on the 600V side of this transformer is in fact ungrounded and the wye point on the 480V side is grounded. This ensures that the neutral is grounded at only one location on the 600V side and that the neutral is grounded on the separately-derived 480V side of the transformer.

2.3 Sixteen Mile Sports Complex, Oakville ON (458 kW AC, 549 kW DC)

This solar PV distributed generator (DG) is connected to the utility via the existing 2000kVA, 27.6kV/16kV/0.600kV/0.347kV Yg-Yg interface transformer. A dedicated 800A DG main system disconnect is connected to the transformer secondary via a line side tap made within the main facility load service switchboard upstream of the 2000A main service breaker.

After reviewing Issued for Construction (IFC) drawing package dated April 27, 2015, the design appears to follow Ontario Electrical Safety Code requirements and good engineering practices in place at that time.

This DG systems utilizes a 600kVA, 480V/600V Yg-Yg intermediate transformer. The single line diagram indicates that both sides of this transformer is configured as a grounded wye connection. It should be confirmed on site that the wye point on the 600V side of this transformer is in fact ungrounded and the wye point on the 480V side is grounded. This ensures that the neutral is grounded at only one location on the 600V side and that the neutral is grounded on the separately-derived 480V side of the transformer.

APPENDIX D

Phase B: Sustainability Report

Renewable Energy Generation Strategy – Corporate

The Town of Oakville

September 2021

blackstone energy services

Contents

Executive Summary

The Town of Oakville ("The Town") has engaged Blackstone Energy Services ("Blackstone") to develop a Renewable Energy (RE) Generation Strategy for their corporate buildings. This strategy is to assist The Town with actionable direction that will help to achieve their 2050 target to have GHG levels at 80% below that of 2014[1]. Along with dedication to on-going energy conservation and demand management initiatives, renewable energy, the use of low carbon, high performance solutions, and collaboration with the community this target can be possible. Throughout this strategy Blackstone will ensure that The Town is able to meet their goals to:

- ✓ Assist to reduce the corporate carbon footprint to 80% below 2014[1] amounts by 2050
- ✓ Establish strategies to provide increase renewable energy generation
- ✓ Describe approaches for integrating renewable energy generation into new construction and major renovations/deep energy retrofits
- ✓ Outline the guidelines for business cases including sizing and annual generation estimates and life cycle cost parameters
- ✓ Describe possible future scenarios with increased renewable energy systems application within the Corporation

Blackstone has completed a background review of renewable energy technologies appropriate for municipal settings, a review of surrounding peers, and the existing installations. Blackstone, in collaboration with the staff in Facilities and Construction Management (FCM) group at The Town has:

- Reviewed renewable energy technology applications in a municipal corporate setting
- Analyzed functionality, scale and specifications that result in successful implementations
- Developed project cost estimates for the renewable technologies
- Identified barriers and risks for implementation

The knowledge gained from this analysis was leveraged to identify and validate potential for applications and inform a renewable energy evaluation matrix. The matrix analyzes each renewable energy technology against the variables listed below:

- Technical suitability
- Performance assessment methodology
- Energy generation/saving potential
- GHG offset potential
- Paybacks/return on investments
- Procurement implication
- Existing vs. new building application
- Maintenance and operations impact

[1] It is recommended the baseline year be reset to 2015 from 2014 to avoid the impact on GHG emissions from closing the coal fired electricity generation on the Ontario grid.

Strategic Plan for Renewable Energy and Clean Technology

The Town has shown consistent attention to the environment over the years. They accepted the fact that the human induced greenhouse gases are causing significant climate degradation and passed a climate emergency statement in 2018. The Town has prepared several energy and carbon reduction measures through conservation and demand management plans since 2005 with the most recent one published for a plan from 2020.

The Town has targeted a 20% reduction of corporate energy and GHG levels by 2030 and 80% lower levels by 2050 as compared to 2014[1]. At that pace The Town could reach a net-zero carbon footprint by 2050 if they tackle their GHG footprint consistently over the next 30 years. Achieving this target, as daunting as it may seem, is possible with a coordinated effort among the corporation and community. This strategic planning report was requested to describe technology and policy scenarios that will manifest in a low to net-zero carbon Town by 2050. Even with the level of action and measures taken over the years, a coordinated and collaborative approach is the preferred way to tackle big issues such as a community-wide environment issues program. There are both community and corporate teams preparing and attempting to implement GHG mitigation programs.

The strategies presented in this report address the need for a coordinated plan with shared and shareable results. The benefits of a strategy and collaboration across The Town will be reliable and sustainable energy and GHG reductions that are realistic, timely, cost effective, long lasting and something The Town can be proud of.

The Why, What, How & When of a RE Strategy:

- The Town has embarked on a path to achieve or be close to carbon neutrality by 2050
- A Climate Emergency was approved by Council in 2018
- A strategy will gather and present reasonable standards, policies, measures, and timelines that can be applied across the Corporate portfolio and be coordinated within the Community as well
- Define technologies that can be integrated into the Corporate framework and how to take advantage of the strengths acknowledging that they will evolve over time
- Prepare business case foundations for the solutions that will show the benefits and costs for RE technologies as they are available now with projected benefits to 2050
- The strategy will suggest trigger events to right size and right time RE implementation

Renewable Energy Technologies Considered:

- Solar energy including photovoltaics (electricity) and thermal energy (heated air and water)
- Heat pumps including ground source, air source and waste energy
- Decentralized and district energy systems (energy nodes)
- Bio energy (wood pellets)
- Hydrogen (stationary boilers and transportation)
- Wind energy (urban scale and large off-site)
- Batteries (resiliency and demand shedding)

Renewable Energy Strategic Plan Summary:

Each of these categories is described more fully in this report. The ranking of the measures being proposed for The Town's RE strategy is summarized below.

1. Continue to encourage, develop, formalize, and monitor renewable energy system integration into The Town developments, renovations, standards, and policies.
2. Promote the use of passive renewable energy solutions, such as daylighting, wind shading, wind assist ventilation, solar towers.
3. Describe trigger events to initiate renewable energy projects, i.e., building renovations, incentive programs, new buildings, anticipated legislation, and funding opportunities.
4. Solar photovoltaics – It is the most recognized, understood, and practical of the RE technologies available. It can be applied across the corporate portfolio as rooftop systems of the order of 2 MW of generation making about 2.5 million kWh/year Cost metrics are favorable with ~12-year paybacks, and it will generate for >30 years. Prepare for opportunities for large scale virtual metering projects to offset from off-site generation.
5. Solar hot water – Recognized, understood and practical. This solar technology reduces the carbon from natural gas heating and best applied in large settings such as at pools and community centres with annual hot water loads. Due to low commodity cost of natural gas, the paybacks tend to be longer (~25 years) however when the cost of a carbon tax is included the paybacks will be reduced by about 25% (~16-18 yrs). These systems will produce energy for >30 years. These can be integrated into district energy systems (supplementary source) and combined with geoexchange systems (boost winter energy supply).
6. Heat pump technologies – Important enabling system for low carbon plans. They use the ground, water, air, and wastewater as an energy source, are well understood and readily available in a range of sizes. Key technology for conversion from natural gas to electricity-based heating. Opportunities exist for new and renovation projects.
7. District or distributed energy systems – Uses distributed energy nodes to supply heat, cooling and electricity to communities or facility campuses such as athletic complexes and community centres tied to local loads. Increases resiliency. Opportunity to integrate other RE such as PV and solar hot water into heat pump and geoexchange networks. Opportunity to collaborate with Community DES and neighbourhood intensification plans. Common and well proven in the EU.
8. Other technologies such as bioenergy, wind, batteries, hydrogen have been reviewed and indicated where feasible. We recommend that these and any evolving technologies be monitored and reviewed annually for opportunities as they appear.
9. Start early with subject experts to understand and assess renewable energy solutions opportunities. Engage the SME and collaborate with The Town Facilities and Construction Management (FCM) department.
10. Consider an annual renewable systems portfolio and resource evaluation report, coordinated through the FCM department, and reported to Council.

Introduction

The intention of this report is to help The Town reduce current and future energy and carbon loads for their corporate facilities. What are the options to decarbonize the thermal and electrical supplies for the facilities and optimize systems that are used? What technologies are most suitable now and in the near term? Are there pending developments that will help The Town reach their targets? Currently, most of The Town's energy comes from conventional sources – natural gas and electricity from central grids, with a small percentage from solar power and heat pumps. Using enabling technologies such as renewable energy systems, The Town plans to direct more energy supply from low carbon electrical sources. Low carbon energy solutions include active and passive systems.

For this report, and resulting strategy, the focus is on active technologies. Passive systems such as daylighting, induced ventilation, landscaping, site planning are necessary components for successful long-term energy planning and best addressed in building and community design standards. These are discussed in the policy section of the Phase A report of the full project.

Blackstone evaluated ten (10) renewable energy (RE) technologies options during this study. These represent the currently available and most common technologies in use at a municipal scale and will likely be applicable at some scale within The Town for the next 10 to 30 years. New technologies will evolve from these systems typically with higher efficiencies for the same footprint, lower capital costs, lower operating and maintenance costs, longer life cycles, end-of-life recycling, and integration possibilities.

The 10 technologies evaluated were:

- ✓ Solar - Photovoltaic
- ✓ District Energy Systems
- ✓ Geo-Exchange Heat Pump Systems
- ✓ Air Source Heat Pumps
- ✓ Hydrogen & Fuel Cells
- ✓ Bio-Energy
- ✓ Solar Thermal - Hot Water
- ✓ Solar Thermal - Air
- ✓ Energy Storage
- ✓ Wind Turbines

These technologies were used to create a RE Rubric as well as a workshop hosted by Blackstone with The Town staff to get a sense of the awareness and acceptance of RES's. The rubric consists of two matrices – the Technology Assessment Matrix and the Applicability Matrix and shown below.

The Technology Assessment Matrix evaluates and ranks the renewable technology options individually and the Applicability Matrix evaluates and ranks the renewable technology options based on their relevance and feasibility to The Town's corporate building archetypes and to the larger Oakville community.

A summary of the technologies analyzed in this study and their ranks for the technology assessment and applicability are provided below. The detailed matrices and the methodology for the rubric can be found in Appendix A at the end of this report.

Table 1: Technology Assessment Ranking

RE Technologies	Technology Assessment Rank
Solar Photovoltaic	1
Solar Thermal Water	2
Air Source Heat Pumps	3
Solar Thermal Air	4
District Energy Systems	5
District Energy Heat Pump Based System	6
Geo-Exchange Heat Pump Systems	7
Wind Energy	8
Bio-Energy	9
Energy Storage	10
Hydrogen & Fuel Cells	11

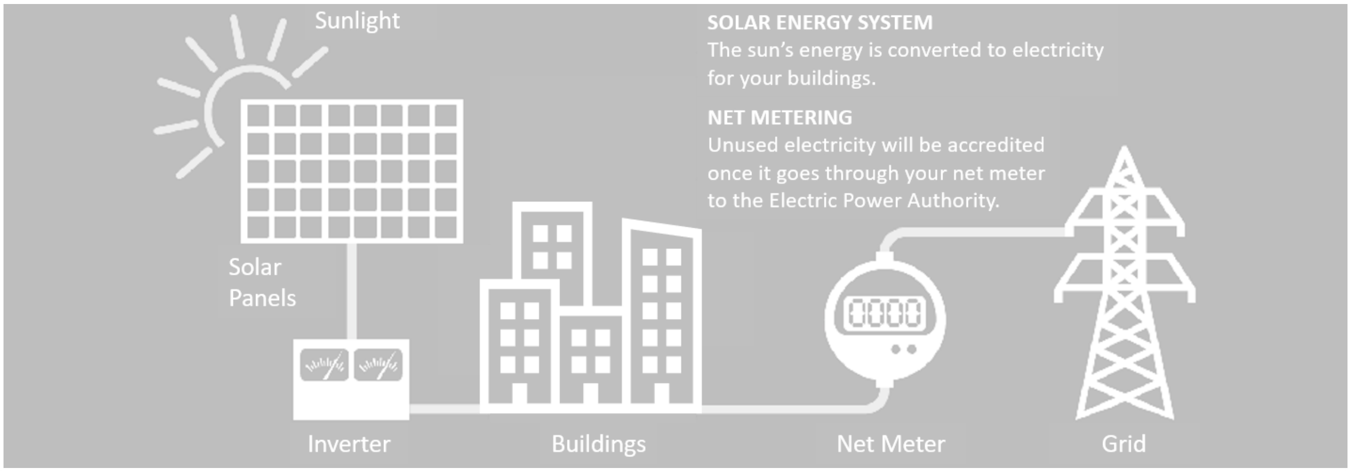
Table 2: Technology Applicability Ranking

RE Technologies	Technology Applicability Rank
Solar Photovoltaic	1
District Energy Systems	3
District Energy Heat Pump Based System	3
Air Source Heat Pumps	3
Solar Thermal Water	5
Geo-Exchange Heat Pump Systems	6
Solar Thermal Air	7
Energy Storage	8
Wind Energy	9
Bio-Energy	10
Hydrogen & Fuel Cells	11

1 Solar Photovoltaic

1.1 Product Background

Solar photovoltaic (PV) is the conversion of sunshine to electricity and is a mature technology. The solar modules generate power as direct current (DC). Grid connection is made via an inverter that converts the DC to alternating current (AC) that can be used in the buildings. A typical solar PV system is illustrated in the figure below.



Source: https://mozaw.com/grid-tied-solar-pv-system-installation/

Figure 1: Solar PV System

Installations are considered building application PV and building integration PV. BAPV include roof-mounted, with either direct structural connection to the building, or ballasted using concrete blocks or pavers and wall mounting though at reduced energy production as compared to roof mount but can provide window shading as awnings bringing added benefits. BIPV include PV that are a part of the envelope such as PV windows and exterior wall sections. BIPV may not seem financially viable in a classical payback model, but they are worthy of consideration given they integrate long life wall cladding with generation potential on available and underused production wall area and help buildings approach net zero energy performance. These applications are described in more detail later in this section.

Most modules installed over the past 30 years are made from crystallised silicon. Incremental improvements have pushed efficiencies to about 20% realizing more output capacity for the same size module thereby increasing a systems performance for the same array area. Common types of solar panels are categorized in the table below.

Table 3: Common Types of Solar Panels

Solar Panel Type	Efficiency	Advantages	Disadvantages
Monocrystalline	~20%	• High efficiency/performance • Optimized for commercial use • High life-time value	• Comparatively Expensive
Polycrystalline	~15%	• Low cost, most common	• Lower efficiency/performance • Sensitive to high temperatures
Thin-film	~7% to 10%	• Portable and flexible • Lightweight • Aesthetics	• Lowest efficiency/performance • Low life-time value

All components are standardised and subject to testing and certification practices by IEC/CSA/ULC with well understood performance metrics that are improving each design iteration. Design, engineering, installation practices and warranties have been refined with years of successful application for roof, ground and building integrated arrays making the performance well understood. Top tier suppliers carry limited performance warranties that specify that actual power output will be no less than 98% of the labeled power output in the first year. From years 2 to 30, the annual power decline will be no more than 0.45% and no less than 85% of the labeled power output. The supplier will either repair or replace the module with a version with the same power output as the original.

Installations in The Town will typically be roof-mounted, with either direct structural connection to the building, or ballasted using concrete blocks or pavers (BAPV). Ground mounted systems are possible and should be considered where large tracts of land are available such as brown fields or parking lots (canopies over parked cars).

1.2 Market Overview

Photovoltaics (PV) product design and installation is a recognized and mature market. The installation of PV is increasing globally (+22% in 2019) and expected to grow at an average of +15% to 2030. The Town has experience with PV applications now. The technology is at the point where non-technology costs (evaluation, engineering, wiring, labour) are as material to project economics as the modules. PV levelized cost of energy (LCOE) is at or below the price of grid electricity within the life cycle of the systems (i.e., the cost of a kWh from PV is at or below that for a purchased kWh from the grid). There are many PV component manufacturers producing at a significant scale with local representation for all required services. Product life cycles are increasing and covered by reliable warranties. The local distribution company (Oakville Hydro) is familiar with the application, inspection, and approvals process. The Town should be comfortable promoting the use of solar electricity on existing and new buildings and available land (i.e., brown fields, car ports) as a part of their low GHG future. Pending Federal incentive programs will favour renewable energy system applications which Oakville should be prepared to take advantage of. Having PV in the low carbon technology mix and plans within Oakville is recommended at ~35% of electrical loads by 2030. See Report D for more on the contribution scenarios for PV to the corporate grid.

1.3 Application to Building Portfolio/Grid Connectivity

Connection Impact Assessment

Every PV project requires a connection impact assessment (CIA) from the local distribution company (LDC) – Oakville Hydro. The CIA establishes if the proposed connection to the grid is safe, sufficient grid capacity, defines any infrastructure upgrades, and will not affect grid stability. Utilities set their own rules and standards for this process setting both application costs for the CIA process and upgrades required for connection. The LDC will typically preform a pre-CIA at the request of the developer which gives a high level "go/no-go" perspective and should be initiated early in the development.

The pre-CIA will indicate if the proposed system capacity is too large for the connection point which will guide the project maximum generation size. There may be a cost for the pre-CIA, depending on the address and available information.

Typically, the utility prefers systems that do not feed back into the grid but rather are used totally within the facility. Applications such as large ground or parking lot canopy projects are specifically meant to feed into the grid and should be discussed early to make sure all parties are aware of the design and connection needs.

All on-site generation systems require signage indicating there is a second source of energy on the premises for the safety of emergency crews. In keeping with that, safety disconnects are critical and must be easily accessed.

Installation Criteria

Solar PV is ideally installed at an angle of approximately 15-30° from the horizontal and facing within 45° of south to maximise PV annual energy generation. All solar is negatively affected by shading. A "shadow study" is recommended prior to final design and tender to verify annual shading effects from rooftop units, combustion flues, elevator sheds, other buildings, etc. The latest string and micro-inverter technologies make shading issues less of a concern, are safer and would be the preferred inverter solution. Existing rooftop equipment will require maintenance clearance - walk-around space is required at equipment and roof edges. In addition, row-to-row spacing requires module spacing to limit modules from shading another. Care must be taken to avoid window washing anchors. The final area available for solar will be less than that of the edge-to-edge roof area.

Building integrated and building applied PV systems (BIPV and BAPV respectively) where the PV systems are mounted either as a part of the structural wall (BIPV) or onto the exterior wall (BAPV) are the current facility installation methods. Examples of BIPV are when the exterior wall is made up of the PV panels like conventional glass curtain walls. These can also be skylights, awnings, roof systems (such as over train stations). These require the direction of an architect and structural engineer from the beginning design stages. They can be integrated into the “look” of the building readily. They are an expensive system when the existing wall must be removed.

Figure 2: Example of BIPV systems – the PV is the wall

BAPV is basically a PV array mounted onto a racking that is hung onto the outside wall. Though less expensive than the BIPV, they require a strong existing wall system. A structural engineer is required with a reputable solar system installer.

Figure 3: Example of BAPV – the PV is mounted onto the wall

Electrical connections need to be confirmed to ensure there is capacity at the grid connection and room for the required metering and equipment. Sometimes an interface transformer is required. The pre- and post project CIA will guide these needs and is coordinated through the local distribution company (Oakville Hydro). They must be contacted early in the decision process to make sure the capacity is available. All solar installations will require a structural assessment by a professional engineer to determine that the building (either roof or wall) is able to handle the additional weight. This step needs to be completed early in the development to make sure any further effort is worth the time and cost. Consider PV applications whenever the roof is being replaced.

Layout Limitations
Roofs with lots of equipment, existing pathways, or narrow roof areas will likely be low priority and ranked as such. The most cost-effective installation methodology for a flat roof is ballasting, where the racking is weighed down with concrete blocks or pavers. This is a very common way to place an array and well understood. The smaller the sections of array (i.e., < 50 sq. m.), require greater ballast mass to hold it down in the wind. A structural engineer will be able to assess and define the layout for any racking arrangement.

Vertically installed solar is an option where large areas of wall space are available and accessible (mentioned above – BIPV and BAPV). While some maintenance/inspection is required periodically, this should not eliminate wall mounted systems from consideration. Performance will be lower than a sloped/horizontal system, though it can be offset with larger areas. There are innovative ways to install vertical/horizontal PV arrays that provide shade over windows (i.e., awnings) providing a dual function – energy generation and high sun shading in the summer months.

For tall buildings, it can be difficult to run wires from a roof to the electrical room. Consideration must be made for a visible power disconnect at or near the street level which may require long wiring runs. For ground mounts such as parking lot canopies, it may be difficult to get access to a connection point inside a building. The design team will be able to evaluate these concerns early in the development and prior to committing to a system installation. In all cases a structural engineer will be required to stamp the designs for any PV array. In some cases, the installer can arrange to have the designs stamped by a professional engineer. An EPC (engineer, procure, construct) contract can provide all the services required for a full PV array installation from design through to commissioning.

Portfolio Sustainability
PV installations for buildings typically connect as "net-metered" – in effect "slowing down" the main electrical meter. Depending on the system size, these rarely feed back into the grid and for some LDC's is the preferred sizing criteria. The main limitation would be the availability of appropriate roof, wall, or ground surface area and connection capacity. Life cycle economics should govern financial suitability. PV modules come with 25 to 30-year production warranties so long-term life cycle costing should be applied. The Town is reviewing policies and standards that will promote renewable and alternate energy system applications including "solar ready" designs. These measures will increase the opportunities for solar PV on more of The Town's portfolio.

Ground Mount Systems
The Town has policies in place that define setbacks and suitability in any given area for generation systems, including solar arrays which will need to be reviewed for a ground mount (i.e., grey field, brown field, parking lots). An opportunity for large array applications on the ground are solar-covered parking structures (canopies). Ground mount systems tend to be less expensive on a $/kW installed basis compared to roof mounts given the large scales and number of developers who engineer, procure and contract ground mount. A typical carport solar system is shown in the figure below.

Source: https://www.constructioncanada.net/designing-for-solar-pv/2/

Figure 4: Carport Solar System Example

Currently, costs for car ports are in the region of ~30% higher than building installed systems ($/kW installed) though there are more vendors joining this growth which should lower the costs as applications increase. The visibility and marketing potential of canopy PV is an important consideration. There is also the potential combination with electric vehicle charging stations with parking lot PV which is expected to grow significantly and become a part of a distributed energy system concept in the near future.

Virtual Power Plants

As Ontario shutters the nuclear power stations at Pickering through to 2025, and as a tax on carbon comes into effect, hydrocarbon emissions from natural gas power stations will carry increased costs to and beyond 2030. While maximizing on-site renewable power will be essential to offset the increased electrical loads due to electrification, Ontario will also need to expand large solar and wind farms to meet Provincial demand needs. PV will be an important element of The Town’s path to a low carbon future.

A common method to develop and source this renewable power (predominantly solar and wind) is through power purchase agreements (PPA), contracted between consumers and independent power producers. These PPAs are deemed “virtual” (VPPA) because the power plant is not located on the consumer’s site; rather the power plants are large and “virtually” deliver power to multiple consumers, contracted through a VPPA.

The method described above allows for the free market to determine who wants to buy power from the renewable power plant: those motivated to buy the renewable power will do so at an agreed upon price per kWh over a set time (typically 12 – 15 years); those unmotivated will not. As renewables have variable production, the concept of net metering (whereby excess renewable power generation can be “banked” with the local distribution company) for on-site and VPPAs is being considered for Ontario. This is referred to as Virtual Net Metering and is the concept of how power would be delivered/billed to disparate consumers of power generated from large, renewable power plants.

Assuming Ontario allows this methodology, to meet its GHG emissions goals, The Town of Oakville, its residents, and businesses will need to enter into VPPAs with independent power producers. As a piece of good news, the cost of large renewable power generation continues to drop, and this translates to low commodity prices for consumers. For instance, a 100 MW solar or wind project in Ontario would likely have a resulting commodity price of about 7 cents per kWh, a significant drop from the 13-14 cents per kWh currently being charged to Class B consumers in Ontario. Note also that these are usually restricted to MW-scale plants.

Blackstone has recognized this future and is developing large-scale renewable power projects to help meet its clients' needs in the 2024-2025-time frame. We recommend The Town investigate this concept further and consider the opportunity to partner with a VPPA provider to offset the increased electrification to meet their GHG reduction targets for 2030 and beyond.

See Section 1.10 – Strategic Direction, for examples of PV sizing to meet a range of GHG levels.

1.4 Application as Retrofit vs. New Construction/Major Renovation

Solar energy works well for both new construction and retrofit/renovations. A south-facing pitched roof of 20-45° is considered ideal though most large areas within The Town tend to be flat rooftops. The common racking system is a ballasted array which tend to be at 0°to 15°from horizontal which reduces the ideal performance by ~10% which is not much considering the reduced cost of a ballasted system versus a 45°rack mount. The array should face within 45° of south for the best annual performance. Systems facing due east (90°) and west (270°) are not uncommon – roofs with this solar access should not be avoided but also not priority sites. For a flat roof, ensure the arrays are clear of mechanical equipment and other shading. In all cases, structural and connection capacity must be taken into consideration. An existing roof may not have the structural capacity or may have recently been re-roofed. The roofing company should be contacted for guidance to ensure any warranties are maintained. Roofs that are due for reroofing should consider a PV system. An advantage of a ballasted system is that the panels can be moved for reroofing later. Comments in the Policies section within this report propose that all new buildings and renovation include, at a minimum, "solar ready" design features (e.g., plumbing, and electrical chases, room for meter cases and connections in the electrical room, structural capacity).

All PV systems will require electrical safety authority and LDC approvals before, during and after a system is installed.

1.5 Economics

Solar installation prices have been declining steadily since 2010. The following chart shows the estimated price for solar panel installations in Ontario.

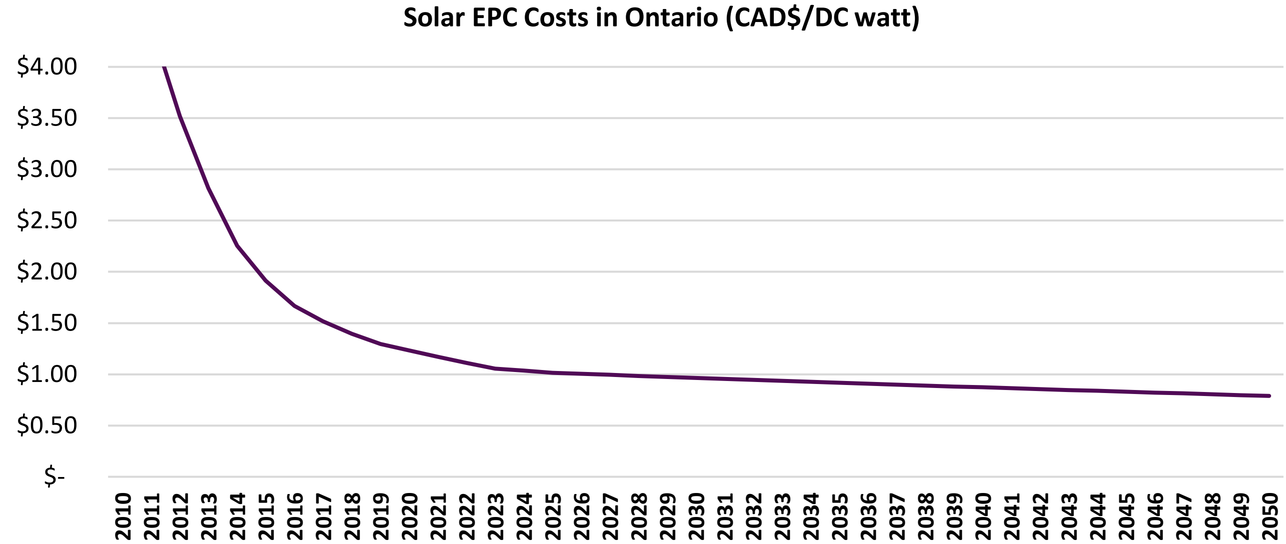


Figure 5: Summary and projected cost of PV systems, total installed, $/DC watt

All commercial-scale system of about 150kW$_{DC}$ and upwards in size would cost ~$1,400 per installed kW$_{DC}$ including soft costs, varying with system size, racking, roof type, and distance to the meter room (total cost ~$210,000). Each installed kW$_{DC}$ would develop approximately 1,100kWh/yr., this equates to at $0.14 per kWh about $23,000/yr., for the 150kW$_{DC}$ array at $0.14/kWh. Each kW$_{DC}$ of modules requires about 10m^2 of roof space so the 150kW system referenced here will need about 1,500m^2.

An advantage of net-metering is that the system displaces electricity at the rate for the time it is generating into the building, which tends to be during peak energy demand periods of the day. This is also the time when the grid tends to depend on natural gas fired peaker plants so the effect of the PV array is to reduce the need for high GHG electricity when it is most needed for air conditioning loads. (Note: this GHG marginal emissions factor is not currently taken into consideration by the utilities but should be tracked by The Town for future reference).

Annual maintenance costs are approximately 0.3% of the construction cost, consisting of a spring and fall inspection. PV module performance is affected by dirt – cleaning of an array should be planned at least annually to optimize generation and is a good time to inspect the system.

The costs and generation information for a typical 150 kW$_{DC}$ system, based on the specified assumptions, is summarized in the following table.

Table 4: Example of PV system costs and performance (2020 costs)

Metrics for a typical 150 kW Solar PV System	
System Size (kW_{DC})	150
Space Required (sq. m)	1,500
System Cost ($)	$210,000
Estimated payback	<10 years
Estimated Annual Generation (kWh/yr)	165,000
30 year levelized cost of elect ($/kWh)	$0.03
Maintenance Cost ($)/yr	$1,050
Annual GHG Offset (tCO_2e/yr)	7.74

A carport system will cost more due to the structure and wiring to the building or grid connection point. An estimate is that for the same size system in kW_{DC} as a ballasted roof system will be ~2-3 times and produce ~5-10% less energy annually. They are very visible and provide shade which is of value though not easy to assess.

The value of carbon is expected to increase during the life cycle of the PV array (>30 years). At Federal carbon levy rates for 2021, a 150kW array will avoid ~$310 in carbon costs; in 2030 it will be $1,316. As The Town increases their GHG reductions, these savings will accumulate across the renewable and alternate energy systems portfolio. The Town (through the FCM) should include carbon savings with attendant costs for all renewable projects and considered in all life cycle cost assessments for 25 years.

An advantage of solar PV is that it generates power during peak sun and typically when the grid uses gas fired peaker plants. This means PV will offset more GHG's at an hourly resolution than the annual GHG emissions factors currently being used for on-site generation. Though not accepted for carbon accounting, The Town should track "marginal emissions" for all PV (and renewable energy) both for promotion of the success story and in case these savings are allowed in the future.

PV systems have a productive life expectancy of 30+ years, with some electrical equipment replacement/repairs (inverters typically) expected during that lifecycle. Modules once installed are essentially maintenance free (other than cleaning) and rarely fail. Panel warranties guarantee the output to be at 80% of nameplate in year 25. Inverter warranties are typically 10 years under normal use. Replacement of the inverters should be carried every 12 years in the life cycle cost analyses.

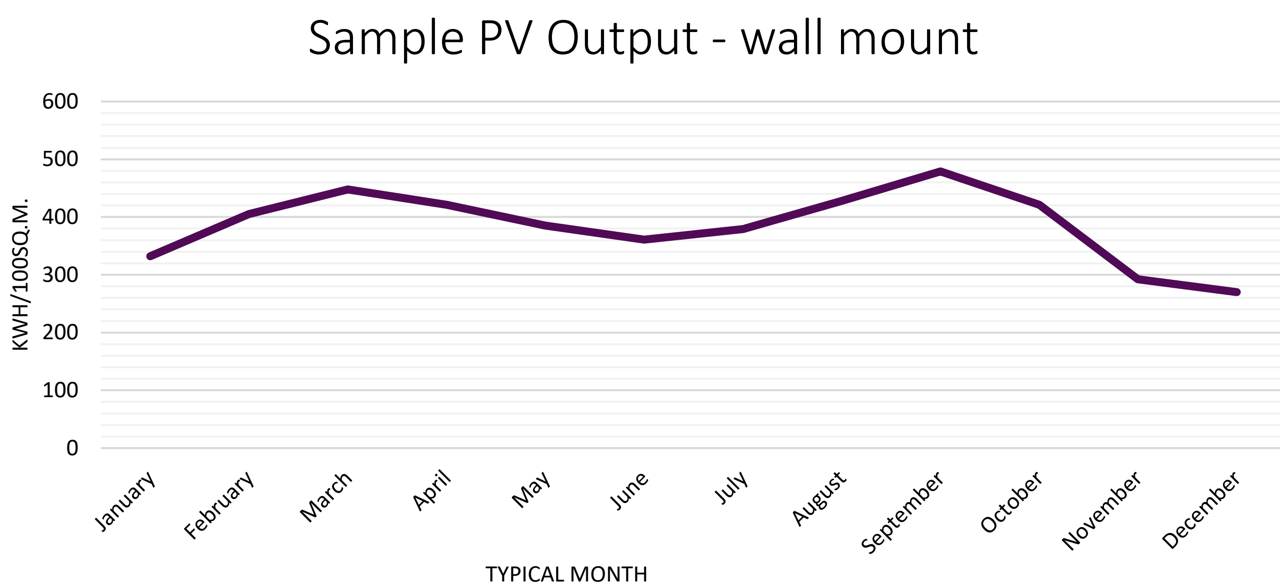


Figure 6: Estimated performance for a 5.7 kW wall mounted BIPV array

The graph above illustrates a sample of BIPV performance, vertical, 100 m^2, and 5.7 kW and 0% transmission (opaque from inside to outside), producing about 4,000 kWh/yr. At increased transmission (opacity), the output goes down as the light transmission goes up. At 15% transmission, the system would be 3.5 kW and produce about 2,800 kWh/yr.

Of the BIPV applications, a fully integrated PV envelope will be more expensive due to the structural elements required to complete the wall. Though a sample has been shown above for 100 m^2, most BIPV systems are at or above 1,000m^2 before the benefits of scale are available. An estimated cost for a full BIPV wall can be expected to be between $1 million and $1.5 million depending on the fastening system. As a result, the paybacks tend to be at ~20 years without the cost of carbon included.

A wall mounted BAPV (basically an array mounted on racking onto an existing wall) can be expected to cost about half of a BIPV but is more dependent on the structural integrity of the existing wall and will not produce as much electricity as a roof system due to its vertical aspect. The paybacks are therefore less than a fully BIPV, but more than a roof mounted, ballasted system.

As for any PV system, the connection must be evaluated before making the decision to go forward with an installation. This is done early in the design process in coordination with the local distribution company.

1.6 Energy Modelling

Commercial grade software, properly used, can calculate the expected energy generation to about 95% accuracy. Note also that year to year weather variations can result in production swings of about 5-10%. Helioscope, PVSYST, PV-Sol, and RETScreen are well known simulation tools. There are also very good shading study tools that help to fine tune the performance potential and should be included in a PV project development.

We recommend any modelling include a long-term performance timeline (i.e., 30 years) and include GHG avoidance metrics (both annual and marginal emissions). Models should include best estimates for electricity and GHG costs for the life cycle. We recommend the levelized cost of energy calculations be prepared that include estimated replacement/repair costs for inverters as well as annual cleaning.

Early evaluation of a site can be done by the FCM using relatively easy to use software such as RETScreen which can reveal if a site is worth more investigation. The services of a professional modelling team should be retained for more detailed site assessment (they typically also complete shadow studies and can offer structural services).

1.7 Procurement

Given the robust market for PV systems, The Town will have access to quality suppliers, consultants, and products. There is not expected to be any issue with sourcing multiple competitive quotes for this work through normal procurement processes. Retain the services of subject matter experts to assist with the development of request for proposals and to help with the evaluation of the responses. Tender scope should include site assessment, shadow studies, structural, electrical, performance, pre-CIA, CIA services.

Procurement polices in place now and those being recommended encourage life cycle cost analyses. For generation systems this is the preferred way to evaluate a project and leads to the levelized cost of energy (LCOE) comparisons. There are many jurisdictions adopting a cost/kW installed as the vendor selection tool. This can be achieved if the tender defines the minimum array size (kW_{DC}) to compare vendor submissions evenly.

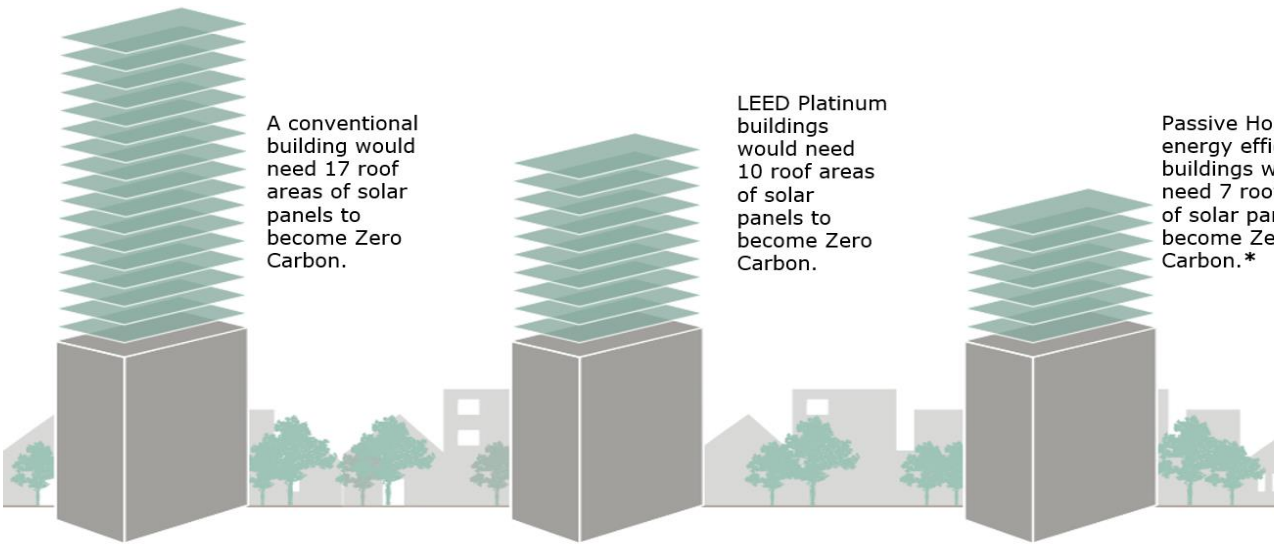
A good understanding the site will affect the overall capacity, layout, and technology choice. The report provided by each respondent will illustrate a suggested PV array layout from which the cost/watt and annual kWh can be shown. This information is included in the evaluation matrix along with a ranking for vendor PV application competency tests and experience. As technologies are improving constantly, it is recommended to specify product performance that is at the upper end of the efficiency range (i.e., maximize kWh/kW_{DC}). All assumptions, technologies and efficiencies should be listed for comparison amongst the vendors.

1.8 Barriers to Implementation

Space Requirement

Based on the technology review of solar PV, one of the key barriers for implementation will be the shade free space requirement. A typical solar PV system would require about 10 sq. m of space per kW installed (0.8-1 $kW_{DC}/10m^2$ roof area). When considering the use of PV technology, it should be noted that the more energy efficient the building is, fewer solar panels are required to make it zero carbon.

The figure below shows the correlation between energy efficient building design and future renewable energy requirements in terms of solar panels. The image also references the total amount of roof space that would be required to accommodate the solar panels required for Oakville's buildings to reach zero carbon.



Source: New Buildings Institute: Net Zero and Living Building Challenge Financial Study: A cost comparison report for buildings in the District of Columbia

Figure 7: Illustrating the impact of building efficiency on PV size to bring a building to net-zero carbon.

Other Considerations

Barriers will typically be related to structural, solar access, connection capacity, and costs, then by Town policy, accepting life cycle cost models and possibly public reticence to renewable energy (the "look"). Structural and connection capacity are critical and usually cost prohibitive to overcome if a site is not suitable due to these reasons. When this is the case, The Town should direct the efforts to more pragmatic sites using an evaluation/ranking matrix that compares LCOE, longevity, costs, and public value for each site.

Town policies and building design standards can be used to ensure renewable and alternate energy systems are considered as a normal component in developing a project, both new and retrofits. Sometimes (though rarely for PV of late) the public perception of alternate energy is against it as "unusual" or "too different" to be taken seriously. This attitude can derail an otherwise solid generation concept and is best dealt with through awareness and education of the benefits. New developments in the planned intensification growth areas should include solar energy as a default consideration when site preparation can be included from the beginning.

1.9 Current/ Future Implementation in Municipalities & Equivalent Organizations

Solar PV has been installed across numerous municipalities, including multiple projects within The Town itself. The City of Toronto, Guelph, Hamilton, and other near-by communities have robust build out programs across their building portfolios. Municipalities have considered financing models such as:

1. A roof lease model, whereby an annual lease payment to the building owner is made by a private developer who then owns, operates, and maintains the system for a set lease term, selling electricity directly to the grid.

2. Ownership model with costs paid directly to a solar contractor based on prevailing procurement policies. An annual maintenance agreement could then either be signed with the contractor, a specialist maintenance contractor, or the system may be maintained in-house staff.

3. Local infrastructure cost (LIC), green bonds and property tax-based financing are concepts that have been used in many jurisdictions and can be considered to finance the projects.

4. Canadian tax code (CRA 43.2) allows for certain depreciation schedules that benefit renewable technologies and could be offered to entities that can use the value of the depreciation to offset income taxes.

1.10 Strategic Direction

Solar energy is an accepted technology, lasts a long time and showcases the use of renewable energy very well. The direction would be to promote the installation of PV wherever feasible and aim for a minimum contribution to the corporate electrical loads from solar power by 2030 and beyond. This will be a balancing act between the low carbon electricity grid, though high cost, versus the low cost and high carbon of natural gas. The tables on the page below illustrate the scenarios for offsetting only the electrical loads for the corporation and the potential if The Town were to go to full electrification and use PV to offset the net carbon that results.

PV system applications be investigated at all new construction and major renovations, in particular when roofs are being upgraded. Net metered systems are recommended and should be driven by minimum energy performance milestones. Be prepared to enter into a virtual power plant application as they emerge, and pilot project opportunities appear.

The following tables describe the scale of PV required to achieve a range of electricity contributions to the Town's grid purchases (2019) for a selection of properties. An electrification path combined with offsets from PV as natural gas heating is reduced. The table below outlines the sampled facilities in the four archetypes.

Table 5: List of buildings used to estimate PV array options – representative of complete Corporate portfolio

Cultural & Recreation	Operations & Administration	Arenas	Other
Oakville Trafalgar Community Centre	Transit Facility	Maple Grove Arena	Salt & Sand Structure
Trafalgar Park Community Centre	Town Hall	Kinoak Arena	Public Parking Garage
Queen Elizabeth Park Culture and Community Centre	Central Operations Depot	Sixteen Mile Sports Complex	Parks Outdoor Washrooms
Glen Abbey Community Centre	Fire Station 3 (new)	Joshua's Creek Arena	Parking Meters
River Oaks Community Centre	North Operations Depot	-	Parks Lighting
Sir John Colborne Recreation Centre for Seniors	-	-	Splash Pads
Central Library	-	-	Street Lights
Oakville Centre for the Performing Arts	-	-	Traffic Lighting
Centennial Pool	-	-	-
Iroquois Ridge Community Centre	-	-	-

Table 6: Illustrating the contribution from PV for electrical portion loads only

Building Type	Electricity Only (2019)		PV req'd for 10% GHG reduction (kW)	PV req'd for 20% GHG reduction (kW)	PV req'd for 40% GHG reduction (kW)	PV req'd for 80% GHG reduction (kW)
	tonnes	kWh				
Culture & Recreation Facilities	413	10,327,889	898	1,796	3,592	7,185
Operations/Administrative	379	9,464,000	823	1,646	3,292	6,584
Arenas	291	7,268,539	632	1,264	2,528	5,056
Other	216	5,397,088	469	939	1,877	3,754
Total	**1,082**	**32,457,516**	**2,822**	**5,645**	**11,290**	**22,579**

Here we see the PV sizes to meet a range of GHG reductions for the corporate electrical loads only, based on 2019 electricity. The estimated area required for the PV array sizes will be about 10 times the kW value in square meters, i.e., 898kW will require ~8,980m^2 of roof/ground space.

The following table shows the estimated PV sizes required if all thermal loads were met with electricity then offset using a range of contribution per centages by PV arrays. This is a high-level exercise to show the approximate scale of the PV systems to offset the increased electricity for the sample buildings shown above. This does not cover the complete Corporate portfolio.

Table 7: Full Electrification Scenario and the Impact of PV to offset

Building Types	Natural Gas (2019)		Electrification of all Natural Gas – sample sites				Est. PV kW to offset % of GHG/yr – sample archetypes			
	Quantity	GHG	Electricity (2019 base)	Electricity (HP+Elec boiler)	Total Electrification	Electrification GHG	10%	20%	50%	80%
	m3	Tonnes	kWh	ekWh	ekWh	Tonnes	kW	kW	kW	kW
Culture & Recreation (10 sites)	1,495,746	2,827	10,327,889	8,333,444	18,661,333	746	1,696	3,393	8,482	13,572
Operations/ Admin. (5 sites)	1,057,469	1,999	9,464,000	5,891,614	15,355,614	614	1,396	2,792	6,980	11,168
Arenas (4 sites)	504,674	954	7,268,539	2,811,755	10,080,293	403	916	1,833	4,582	7,331
Other	9,008	17	5,397,088	50,187	5,447,276	218	-	-	-	-
Total	**3,066,897**	**5,796**	**32,457,516**	**17,087,000**	**49,544,516**	**1,982**	**4,009**	**8,018**	**20,044**	**32,071**

This assumes that natural gas loads are met using a combination of heat pumps (75% of total load) and electric boilers (25% of total and for peaking) of the annual heating loads. The base electricity will stay and represents ~50% of the equivalent energy profile, with natural gas, as ekWh., ~50%. The effect of the heat pumps is to provide a large portion of the heating (~75%) at an annual COP of ~3.5. This is a full electrification scenario. For example, at the Culture & Recreation sites, to replace the heating by natural gas with electricity would be ~16,308,148 kWh and add ~746 tonnes CO_2, however, avoiding a net ~2,081 tonnes CO_2 (2,827 – 746). An array of ~1,696 kW would offset 10% of this new CO_2 level. The impact of PV for each archetype, within the sample, with increasing amounts of PV from 10% to 80% is shown.

The tables above assume the electrical loads in The Town for these sites stay about the same as in 2019. The PV array sizes range from between 4,009 kW (10%) to 32,071 kW (80%). Recall that the area required is estimated at ~10 times the kW required in square meters (i.e., 3,370 kW needs ~33,700 m^2 of ground/roof area). For reference, the PV system at Glen Abbey is ~226 kW_{DC} and covers ~1,800 m^2; the system at 16 Mile is 549 kW_{DC} and covers ~5,000m^2.

The Culture & Recreation Facilities and Operations/Administration buildings offer the most opportunity for GHG reductions through electrification. The "Other" row includes streetlights, parking, splash pads, etc., with no to very low natural gas use and why the GHG reduction is negative. This group is not included in the calculations that follow.

The following table illustrates estimated cost performance for the Culture & Recreation sites, estimated costs (2020), using an electrical escalation of 2%, a PV panel degradation of 0.55%/yr. and actual GHG costs/tonne to 2030, again at the range of PV system contributions.

Table 8: Estimated PV array performance to 2030

Culture & Recreation	PV system size kWdc	Est Cost	Est Energy Generated kWh/yr.	Est Value $ 2021	Elect CUSUM $ value 10 yrs.	Tonnes/ yr.	GHG CUSUM value 10 yrs.	Total value $ 10 yrs.
10% from PV	1,483	$2,817,700	1,683,205	$252,481	$2,752,896	72	$72,258	$2,825,154
20% from PV	2,965	$5,633,500	3,365,275	$504,791	$5,336,060	145	$144,467	$5,480,527
50% from PV	7,413	$14,084,700	8,413,755	$1,262,063	$12,107,596	362	$361,192	$12,468,788
80% from PV	11,860	$22,534,000	13,461,100	$2,019,165	$21,344,239	579	$577,868	$21,922,107

The recommended strategic direction includes:

1. Anticipate and estimate electrification of natural gas heating of The Town's corporate energy loads.
2. Estimate impact of electrification and consider offsetting the increase with PV.
3. Trigger PV opportunity reviews when roof upgrades and HVAC replacements are being planned.
4. Set PV contribution levels based on the assumption that electrification will occur over the next 20 years.
5. Target 80% of full electrification levels by 2050.
6. Encourage Town policy to meet these goals; include PV into revised building performance standards.
7. Investigate opportunities to participate in virtual power plant projects.
8. The table below suggests a PV installation schedule. * "Other" section energy is based on the electrical loads for that sector as natural gas loads are minimal. This illustrates the total electrical loads that could be offset by the PV in stages based on 2019 energy profiles.

Table 9: Proposed PV Installation Schedule to address GHG contributed from natural gas and electricity

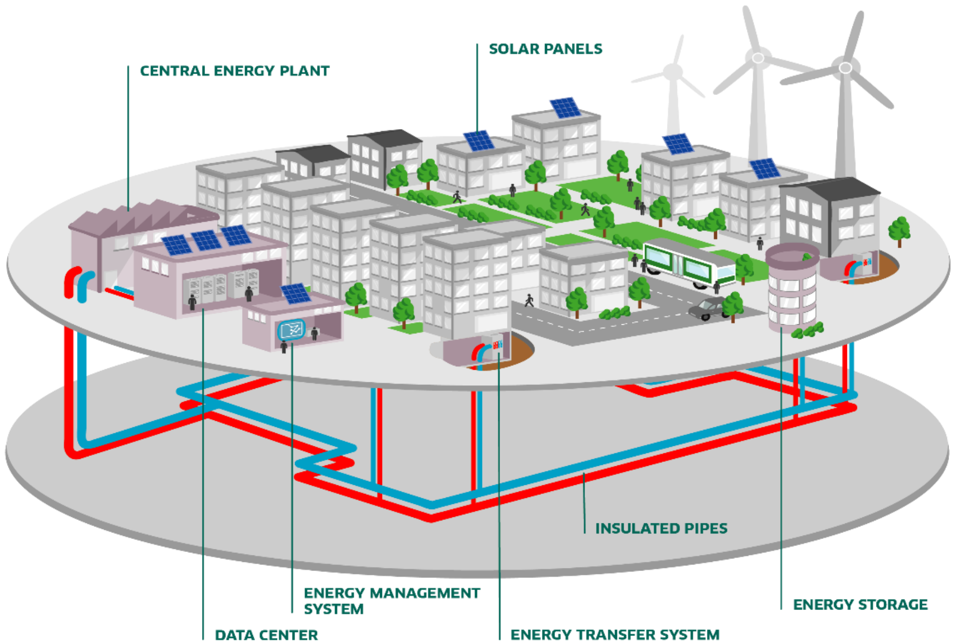
Building Types	2025	2030	2040	2050
	kW installed	kW installed	kW installed	kW installed
Culture & Recreation (10 sites)	1,696	3,393	8,482	13,572
Operations/Administrative (5 sites)	1,396	2,792	6,980	11,168
Arenas (4 sites)	916	1,833	4,582	7,331
Other	472	945	2,362	3,780
Total	**4,481**	**8,963**	**22,406**	**35,851**
Total estimated kWh/yr. contribution	**5,400,000**	**10,760,000**	**26,700,000**	**43,000,000**

The proposed system sizing shown above represent between 10% (2025) and 30% (2030) contribution to the corporate loads. It is possible the level of PV output at scales shown for 2050 could offset close to if not all of the corporate electricity loads. These systems can be installed on available roof areas (horizontal racking) or a combination of roof and parking lot/ground areas. Arrays proposed from ~2025 on would require large land-based and significant building integrated arrays.

2 District Energy Systems

2.1 Product Background

There are many projects that could be deemed as district energy. For this report we define it as multiple buildings connected through a network of pipes for heating and/or cooling, with energy provided by a centrally located generation plant. These are common in Ontario on universities, college campuses, and hospitals. A typical district energy system is demonstrated in the following figure.



Source: https://www.engieservices.ca/district-heating-and-cooling

Figure 8: Schematic of DES concept

By centralising generation equipment, individual buildings only have heat exchangers and localised pumping systems to distribute heating/cooling water. This has the following impacts:

- Showcases the community commitment to GHG reduction and energy efficiency
- Ability to specify high efficiency, modular and centrally located equipment
- Greater control of operations, energy use and price stability
- Reduced mechanical equipment within buildings
- Centralized, consistent maintenance and operation by dedicated staff
- Production and transmission within the community keeping utility value local
- Ability to partner for ownership and operation of the plant and distribution
- Energy price stability and bargaining power amongst energy users
- Ability to integrate renewable energy, e.g. solar thermal, geo-exchange, and other alternate sources
- Increased energy supply resiliency

2.2 Market Overview

Central plants and district energy systems (DES) are common in Canada and have been so for a long time. Equipment is no different from other heating/cooling applications, while controls systems are also commonplace. Technologies that can contribute to a DES are becoming more common such as wastewater energy capture with heat exchangers and heat pumps. There are an increasing number of energy-as-a-service companies entering the DES marketplace. These can provide the financing, engineering, design, and operations The Town can partner with, connecting to the DES development with a long-term energy supply and carbon credit contract. The Town brings certainty to the load profiles with well understood growth plans and the energy service provider has the engineering and staffing to maintain the DES with a vested interest in efficiency. This is now a conventional and mature market. There are design firms and consultants that can evaluate and prepare feasibility studies and plans for community scale DES making competitive bidding possible.

2.3 Application to Building Portfolio/Grid Connectivity

Scale

DES is best considered for new developments where thermal off-takers (facilities that will contract to take the thermal energy from the DES) can be designed into the plan for the DES from an early stage. Retrofitting an existing community for the switch to DES, unless a major street level upgrade is planned and a central plant possible, is typically too disruptive and costly to consider. Money is better spent replacing old heating/cooling systems and upgrading the envelopes and other conservation measures for existing building stock with a view to high performance designs.

Any new Town developments where a DES is considered should discuss the connection of Town facilities early in the design stages. The Master Plan includes six intensification areas that could include district energy systems combined with renewable and alternate energy technologies. These will be more efficient than decentralized systems and offer the Town corporation sites opportunities for increased system efficiencies, lower carbon energy sources and smaller mechanical rooms. Combined with upgraded building energy standards, developing with a DES plan will ensure the net increase in energy and GHG levels are reduced across the Town.

When available, the Town should approach a DES from a life cycle cost perspective. Comparing a DES with multiple conventional systems over a full life cycle should be used and include the costs/benefits of reduced GHG emissions. When a DES is being considered within the Town, FCM should facilitate a feasibility study to fully understand all the opportunities a DES could bring to the corporation including a partnership ownership/operation model with long term energy and carbon credit contracts.

Currently, The Town is reviewing DES models for community level projects. The Corporation, coordinated through the FCM, should be engaged with these assessments as many of their properties will be included inside the new and/or refurbished communities. Any DES developments where Corporate facilities can join should be considered where possible either at early design, large renovation, or the opportunity to participate. Most DES arrangements look for thermal off-takers to help make them feasible – the Town would provide a DES developer with certainty and a long-term contract that are desired.

Low Energy Building Design

Low energy buildings designs should be pursued, consistent with long term conservation planning, and discussed further in the policies section of this report. This is in keeping with The Town's long-term goals and reduces the carbon footprints of new and renovated facilities. With low energy designs the DES would be sized accordingly and improve the life cycle cost metrics. It is important for the success of the application of a DES concept that realistic loads and profiles are taken into consideration as well as the potential for growth in the community.

Developing and enforcing low energy/high performance designs should apply to both new and existing buildings. The Town should target energy performance KPI's that are staged in line with current low energy design standards such as the Toronto Green Standard at a minimum. In fact, it is recommended the Town adopt higher performance standards for new and renovations. The FCM is tracking energy performance now and should continue to do so and actively search for energy conservation measures. Efforts to reduce the thermal loads should be pursued when ever possible, thereby making them more applicable for future DES connections which favour lower temperature sources for heating.

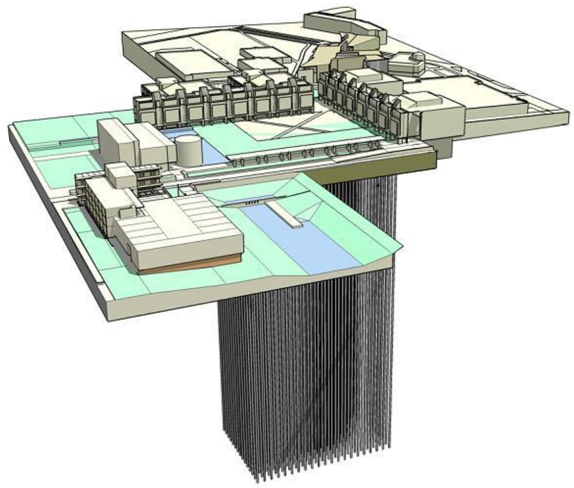
District Energy Plant Type & Heat Pumps

While gas boilers and electric chillers have been the default technologies employed, heat pumps with a geo-exchange storage system are a technically viable and low carbon option. Consideration for peak heating during extreme low outdoor temperatures (which occur ~2% of the winter heating hours each winter), and the fact that weather patterns are shifting to less heating days is prudent for any DES developments.

DES plants are typically designed to supply lower supply temperatures than common in conventional heating systems as they increasingly incorporate heat pump technologies for heating. Therefore, it is even more important to ensure high performance building designs are enforced in new building designs and efforts made to reduce thermal loads in existing buildings to allow for low carbon, low temperature designs (i.e., 40 – 60 °C) to satisfy the heating loads most of the year.. A complete DES review, feasibility and design process will determine the best combination of low temperature services and peak heating supply systems and still maintain an efficient and low carbon facility (e.g., see the discussion above in the PV section around a combination of heat pumps and electric boilers).

These are complicated designs and require design expertise offered by consulting firms familiar with DES concepts.

Please see the geo-exchange heat pump section for more detail. The following schematic shows the geo-exchange system that is at the core of the UOIT central plant in Oshawa to show the scale of a heat pump system.



Source: https://shared.uoit.ca/shared/faculty/feas/images/pictures/BHTES-model.jpg

Figure 9: sample of deep borehole configuration for a large ground source heat pump DES

2.4 Economics

A long-term life cycle cost analysis is required for a DES development. The costs for a DES are dependent on the application, size, location, fuel mix, off-takers, maintenance, and operations therefore difficult to predict without a better understanding of the buildings and loads. Consideration for the use of individual energy systems against the benefits of a DES for energy and GHG factors should be used. A DES allows some certainty around utility rates and maintenance over long contract terms. Because of the long-term nature of a DES operation, alternate energy systems that would otherwise have long paybacks can be considered as they will be a part of a long-term utility contract. This allows the benefits of solar thermal and waste energy capture to be considered and help keep utility costs low. A DES will have a lower GHG footprint than multiple heating/cooling plants which reduces the exposure to carbon costs later.

As indicated above, The Town should consider a third-party ownership model for the DES which will use a long-term financial model for analysis and a business case. A central plant is a reliable energy supply, stable and predictable cost, and low carbon that is shared among the clients which could include the Town's facilities. There are several factors and variables to consider (energy cost projections, GHG costs, growth, product costs, installation, maintenance, etc.) and that will be assessed by a feasibility study. The FCM is well positioned to steer such a study and ensure the facilities are well represented.

2.5 Carbon Offset Potential

There is more opportunity for precise control of the total energy delivered with a DES and therefore better control of energy use and emissions. In addition, the cost and operational efficiencies for integrating a large geo-exchange or renewable energy system would be significant for a large central plant system. There is the potential for improved long-term efficiency and lower carbon operation if given that centralised maintenance and operation is more consistent than for distributed heating/cooling plants. The case for micro-grid energy systems can be utilized where possible. These are well suited for locations where annual thermal loads are present which can be shared through the year. Using a DES in the planned intensification growth areas would offer the opportunity to plan for reduced GHG levels compared to conventional heating systems.

Geothermal Systems Combined with Solar

One area for consideration is the use of solar thermal energy in combination with a DES when a geo-exchange system is included. This combination further reduces the energy and carbon footprint of a geo-exchange system and the DES network in general. This concept is used in Europe and successful in Alberta at Drake Landing Community Solar (see description later in this report including a link to the site).

In discussion above (Photovoltaics) combining PV with a heat pump based thermal distribution can offset a large portion of the net GHGs.

2.6 Energy Generation Potential

Employing heat pumps combined with solar thermal (or photovoltaics) have energy generation potential. Please see the two separate sections for these technologies within this section. A DES by itself is not a renewable energy system but one that reduces the carbon load compared to a distinct energy plant in each building.

2.7 Energy Modelling

It is critical to understand both the peak and annual energy consumption profiles for each building connected to the district energy system to size the central plant and to balance loads. This is completed for new construction and renovation projects using an hourly energy model of loads and utility profile analyses with an understanding of the building occupancy loads. Though the long-term simulation of a district energy system is relatively complex (hourly with multiple variables), the process has been developed and implemented by several consultants familiar with the application.

The modelling for new developments will require assumptions around future building loads and growth that will be defined by The Town in collaboration with the consultants. It is prudent to assess a DES under low, medium, and high growth scenarios. Heat pumps and solar thermal will be addressed elsewhere in this section.

Engineering consultant's expert in the development and assessment of these types of systems and the integration of various energy resources should be retained early in the development stages.

2.8 Procurement

The Town has procurement polices that will address the requirements for selecting the consultants and general contracting partners. The Town, through the FCM, should be made aware of any DES feasibility studies and developments. Procurement policies within The Town include life cycle cost analysis protocols and should be enforced for any new energy system development.

Should The Town consider third party ownership/operation, procurement policies and the terms of the contract need to be defined for such arrangements, reviewed, and made appropriate for that ownership model that typically run for many years. This type of ownership/operating model can have long term cost benefits for The Town and should be reviewed when a large DES is considered. There are firms that will take on the ownership and operation of these assets. The FCM should be involved with any discussions around DES opportunities from an early stage.

The FCM should connect with any community group efforts for DES developments and participate in the evaluation of the possibilities and ensure procurement policies that affect the corporation are taken into consideration.

2.9 Barriers to Implementation

The major barrier is scale and location. Without the necessary building density, district energy is rarely a viable economic option, given higher first costs and operational management requirements. The Town's planned six intensification developments should include DES evaluation when they are being designed. Currently, there is a community effort to assess a DES solution which should be considered when the corporation is considering a DES plan.

Though the Town is not planning to become a large electricity generator, they should be aware that The Master Plan defines setbacks for large generation projects and will need to be met or varied by Council for any DES plant. Any electrical generation will need to be discussed with Oakville Hydro if it is to be integrated with their grid.

2.10 Current/ Future Implementation in Municipalities & Equivalent Organizations

Town of Markham – Markham Energy District

The Town of Markham has owned an operated a district heating and cooling system on a new development site since the early 2000's. It serves both Town of Markham and private assets, including a YMCA and a hospital. Markham District Energy is wholly owned by the Town of Markham.

City of North Vancouver – Lonsdale Energy

Like Markham, this is a wholly owned subsidiary of the City. They operate multiple smaller plants serving over 7 million square feet of City, residential and private commercial developments. They state that they are committed to a move to non-carbon fuels 'when it is economical to do so'. One of the plants already has supplemental heat supplied by solar thermal.

EnerFORGE – Oshawa Power Inc.

This private company owns multiple district energy assets including the large GSHP-based plant at UOIT, Regent Park's central plants and a combined heat and power plant at Durham College.

2.11 Strategic Direction

The Town is planning to develop intensification neighbourhoods which could be candidates for a DES model. This is being studied now under a separate program within The Town. The corporation and FCM should maintain a connection with this effort to be aware of opportunities to design new buildings or renovations that can connect to a community DES. The community uses many corporate facilities now so it is very likely there will be a need for buildings within the developments that will come under the FCM.

Other DES opportunities within the FCM should be pursued when available, such as for large athletic facilities with multiple thermal off takers nearby. In all cases, renewable energy systems should be considered in the DES designs.

1. Connect with and participate with any community level DES developments
2. Ensure building performance standards (new and renovation) anticipate DES possibilities including designs that can use low temperature heating water and consideration for connection to a DES grid.
3. Encourage a life cycle cost analysis, including the cost of carbon, for evaluating a DES connection or campus for multiple Corporate buildings.
4. Ensure RE such as PV and solar thermal energy is considered during DES evaluation and design and target a RE contribution fraction in keeping with that suggested for PV to offset GHG from the DES, i.e., 10% for sites developed by 2025; 30% for facilities developed by 2030; 50% by 2040 and 80%+ by 2050.

3 Geo-Exchange Heat Pump Systems

3.1 Product Background

This refers to an electrically driven heat pump system that employs an underground energy storage system via an array of (typically) vertical boreholes. It does not use the ground as a source of "free" heat rather uses the ground to store heat exchanged trans-seasonally – the heat rejected from the buildings during summer cooling recharges the ground for wither heating. This is a critical design criterion for the success of any ground source heat pump system. The ground temperature is stable below about 20ft giving typical 650+ft deep borehole array access to a large bank of stored energy. Proper application of the technology requires balancing the energy flows between summer and winter to meet the loads for optimum performance. Heat pumps and geo-exchange at a range of scales are well understood and suitable for individual building and district energy designs.

Central to a geo-exchange system is a heat pump, which consists of an electrically-driven compressor which can upgrade low-grade heat in the ground (e.g. 60°F) to a usable higher grade heat (120°-140°F), which is suitable for heating, or reject the heat to the ground in the summer for cooling. The heat pump "switches" back and forth between heating and cooling according to the seasonal demands. Heat is transferred to and from the ground with a heat transfer fluid, typically food grade propylene glycol.

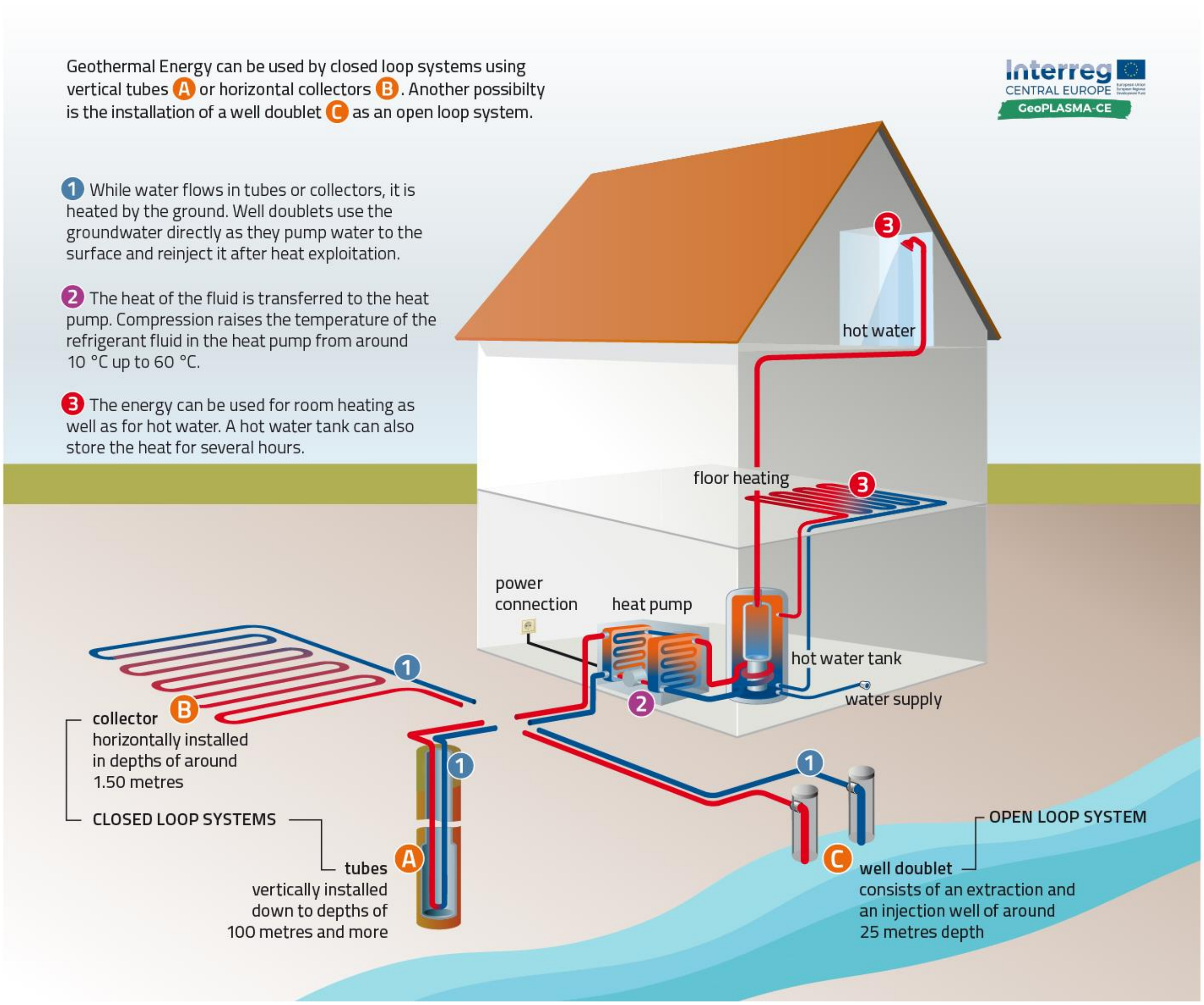
Trans-Seasonal Storage

In the summertime, waste heat that is normally ejected by a conventional air conditioner condenser or cooling tower is pumped underground through a series of piped boreholes (typically 650ft deep), warming the surrounding ground which has an ability to store this heat over time. During the heating season, this low-grade heat is extracted from the ground an upgraded by the compressor, making it appropriate for building loads. By removing this stored heat during the winter, the ground cools which then becomes available for cooling during the summer and the cycle repeats as the ground is re-warmed. A geo-exchange system is best thought of as a trans-seasonal energy storage system. Keys to its proper function are:

- A balanced load, whereby summer heat rejection is close to winter heat requirements. That way the ground's temperature is balanced, and heat pumps can operate throughout the year without short-changing any season.
- A good understanding of the ground's structure and thermal conductivity for the full depth of the boreholes. This dictates the number, depth, and performance of required boreholes.
- Accurate building energy simulations prior to design and construction to understand the annual (hourly) heating and cooling requirements. This drives overall system size and whether supplemental heating/cooling is required.
- Supplemental heating from solar thermal panels or other alternate energy sources can be designed into the system and either used directly or stored to reduce heat pump electrical consumption and increase overall system efficiencies at reduced GHG levels.

Considerations

The most implemented geo-exchange systems are closed loop systems. Closed loop geo-exchange systems use a mix of antifreeze and water which cycles through pipes buried in the ground to transfer heat – to the ground in the summer and from the ground in the winter. In special cases (and when permitted), groundwater can be used as a natural refrigerant to transfer thermodynamic energy as water is an excellent thermal conductor, and groundwater is naturally insulated and much closer in temperature to the surrounding ground. These are classified as open loop systems. The following figure depicts the differences between typical closed loop and open loop geothermal systems. The image shows a residence – the scale of collector and well size increases for commercial building loads.



Source: GeoPLASMA-CE – https://portal.geoplasma-ce.eu/
Figure 10: Typical water-based heat pump layout.

For a well or an aquifer to be used as an open loop, three criteria must be considered: well capacity, water chemistry, and pumping power costs – which are explored below.

Well Capacity

Many sites do not have enough water in the earth to satisfy the water flow rates of a geo-exchange heat pump. The amount of water required for the operation of a geothermal heat pump on an open loop is 1.5 gallons per minute, per ton of capacity. The temperature of the water may increase the flow requirements. During heating mode, if the water temperature is lower than 41°F, the flow must be increased until the leaving water temperature stays above the freeze protection settings. In warmer climates, during cooling mode, the water flow rates may need to be increased so the geothermal heat pumps efficiency will be acceptable.

The annual amount of water used by a 3-ton geothermal heat pump is about one million gallons a year. This is a very large amount of water, but since geothermal heat pumps don't change the water quality, only water temperature, all of the water used by a geothermal heat pump can be safely returned back to the earth without contaminating the ground/aquifers or wasting any water.

Water Chemistry

There are many factors that will determine if your water chemistry is satisfactory. Poor water chemistry can either scale or damage your piping and heat exchanger components. The mineral profile, pH, and temperature of the water must all be within the correct ranges for the well water to be compatible with a geothermal heat pump's water heat exchanger and system components.

Some types and amounts of dissolved minerals will scale heat exchangers over time. Scaled heat exchangers can be cleaned, but it is a significant maintenance consideration and can lower operating efficiencies.

Well Water Pumping Costs

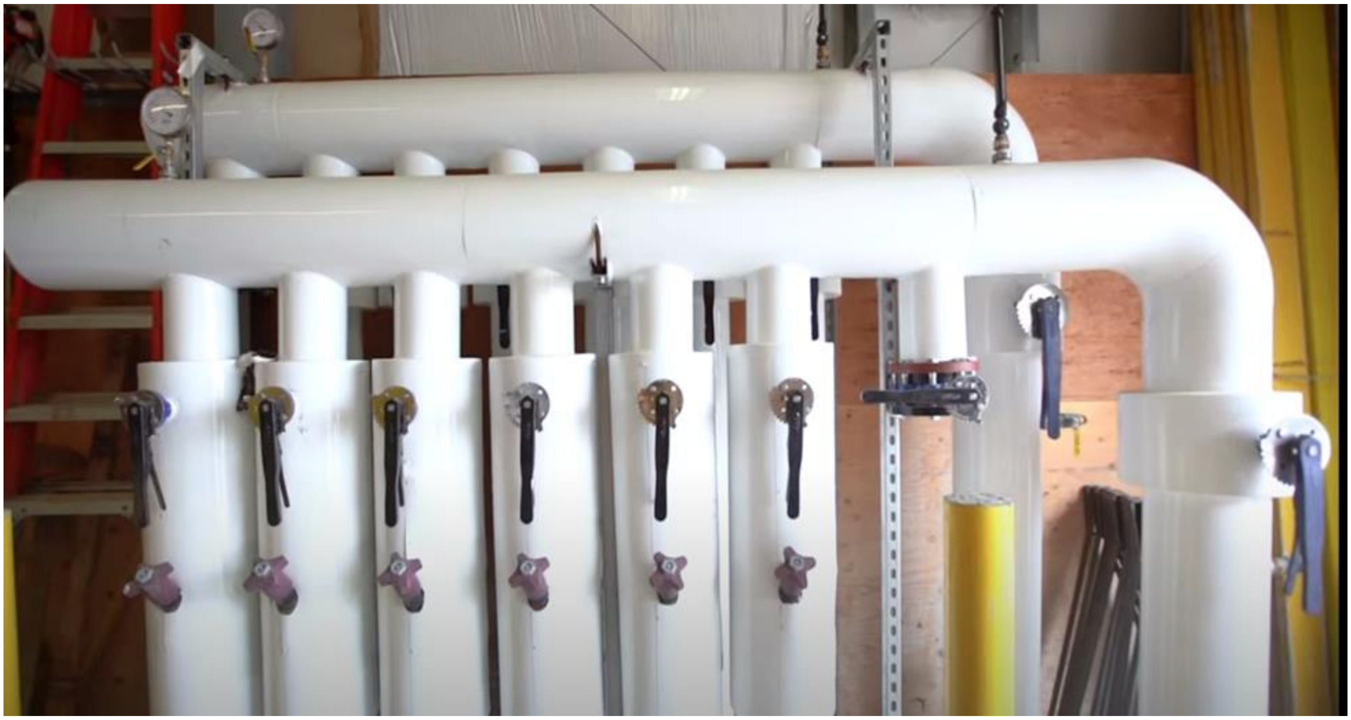
The costs of the well pump will also affect whether a well should be used for an open loop. The main costs of pumping well water the size of motors to overcome the total dynamic head of the well and the type of motor used in the pumping configuration. The cost of operation of the well pumping should be considered in the business case to determine the ongoing operating costs for the application.

An open loop geo-exchange heat pump is a very good option for building owner/operators to consider where lower upfront capital costs are desired and where there is sufficient ground water quality and capacity available. An open loop ground-source system can potentially create a capital cost reduction in the range of 30-70% when compared to the cost of a closed loop and often delivers the most energy efficient performance available. This solution is recommended where applicable.

Efficiency >100%

The key benefit of using heat pumps is their ability to generate more heating/cooling energy than the electricity used to drive its compressors. Through the vapour compression cycle, a geo-exchange heat pump can generate on average approximately 3.5 units of heating energy for each unit of electricity consumed (known as the coefficient of performance or COP). A heat pump’s ability to compete on cost with natural gas is therefore purely driven by the comparison of the COP vs. the cost premium of electricity per delivered unit of heat.

Blackstone implemented a 250-ton Geothermal Heat Pump System and 500kW Solar Array at Conestoga College. These measures resulted in a reduction of Scope 1 GHG emissions by 90%. Additionally, the solar project generates 800MWh of energy annually. These solutions offset 315 tCO_2e respectively annually.



Picture 1: Blackstone Project – Conestoga College – 250-ton geothermal ground-source heat pump system

Current/Future Geoexchange Applications

Geoexchange applications are being used in more municipalities and communities across Ontario. The Town currently has two such systems; one at the Transit Facility and another at the Oakville Trafalgar Community Centre (each ~180 tons). All will go through the same criteria considered by The Town of Oakville to decide how to take advantage of this low carbon and energy efficient technology. Below is a list of samples where geoexchange has been used as a primary source of heating and cooling.

1. University of Toronto, St. George Campus: This downtown campus is installing multiple geoexchange systems to help them reach their 2030 GHG targets. The Landmark geoexchange system will be installed beneath a new ~300 spot underground parking garage to supply buildings around the Circle with ~350 boreholes, 650 ft deep. A second field is at The Huron Sussex neighbourhood with ~200 boreholes on ~5,400 m^2 of land, under a playing field. This will supply heating and cooling to existing buildings on the north west quad of the campus. These systems will replace high pressure steam energy and is combined with high performance energy conservation programs to make the buildings suitable for lower temperature heating for most of the year, with electric boilers as peakers.

2. University of Toronto, Scarborough Campus: Set in the east end of Toronto, the system supplies thermal energy to a Pan-Am aquatic centre using 100 boreholes under a parking lot (300 tons cooling) and another at the new Science Building, 100 boreholes under the quad, and a third one, 67 holes, 200 tons cooling under the foundation of the building. All of these are 650 ft deep.
3. Conestoga College: This system can supply both heating and cooling simultaneously. It consists of 130 boreholes that are located under parking areas, about 40,950 ft^2 of space required.

3.2 Market Overview

Large scale geo-exchange systems are common with more than 100,000 systems in Canada. They are well understood from design through to operation and maintenance. They can be designed for a large range of application sizes including single, central systems and multiple units that can be staged.

Most major HVAC/refrigeration companies sell heat pumps. All heat pumps are covered in detail by various codes and standards. High performance specifications (many are listed with Energy Star) should be used for all designs.

The borehole drilling and connection is completed by specialist contractors of which there are a number in Ontario. Borehole drilling technology has improved and now can bore "directionally" making some locations a candidate whereas before they could not be accessed (e.g., some are now being installed under parking garages).

Cadillac Fairview Pacific Centre
Geothermal In-place urban retrofit (400 ft deep)

Figure 11: Example image of borehole rig for use in underground parking areas

Permitting is similar to HVAC applications except for the borehole component that includes concerns such as water use and storm drain loading which must be dealt with separately.

3.3 Application to Building Portfolio/Grid Connectivity

The impact of the existing building's mechanical design requires careful review. Recall that heat pumps deliver 140°F water which is typically lower than original design conditions. That said, a low temperature source will satisfy a large portion of the heating loads for most buildings through the year so that in some cases, an electric (low carbon) boiler can be used as a "peaker". An audit and energy modelling of the building will determine if a low temperature source can be efficiently used for heating and to what degree without adding too much peaker.

Careful attention to the balance of energy transferred each season is important for the success of a heat pump application. If the cooling season does not "recharge" the ground with sufficient heat, the ground may not be able to support a full heating season, leading to an increased use of supplemental heat. The same for the cooling season – if heat is not removed in balance with the winter, the heat pumps will have to "work harder" and the COP will suffer.

Heat Pump & Mechanical Systems Implications

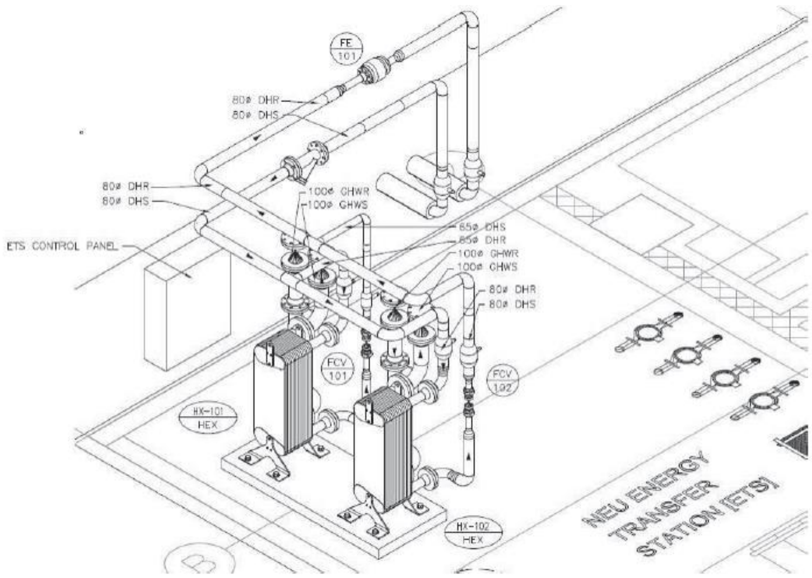
The key component within a geo-exchange system is the electric heat pump. They are available in both water to water and air to air types, meaning they can usually replace either a furnace-type HVAC system or a boiler/chiller hydronic system without much alteration.

Traditionally, the issue with heat pumps is the maximum temperature of heating fluid that can be delivered. A typical building running on a boiler loop using radiators and/or fan coils is designed to run on 180°F supply water temperature, to meet design winter heat loads. Heat pumps are currently able to reach temperatures in the region of 120°-130°F, which is not hot enough to provide adequate heat to most existing buildings. Any additional heating required to make existing terminal equipment work with lower grade heat would require the peaker (high efficiency boiler, electric heater). As indicated, a model of the building will determine the fraction of the year the heat pump will satisfy the loads and how much peaker is needed.

Electricity is about four times as costly for an equivalent kWh (ekWh) as for natural gas – about $0.12/kWh for electricity versus $0.03/ekWh at 80% efficiency, for natural gas. However, a heat pump will generate 3-4 times as much heat value for each kWh delivered so for an equally efficient building, a heat pump would be comparable to natural gas in annual energy costs. Electricity is far greener with almost six times less GHG than natural gas per ekWh delivered. This benefit is in keeping with The Town's goal to a lower GHG footprint for their assets. Using a heat pump to reduce the GHG presence is recommended as a measure to consider when a renovation is being completed and room for boreholes is available.

Note that the COP varies based on ground temperature, heat pump operating point, sizing to loads, refrigerant used etc. It is important not to focus only on the peak published COP, but the lower seasonal COP value and ensure the design teams are presenting solutions that meet the actual loads.

Recent product developments are toward high temperature grade-capable heat pumps, which will expand the range of retrofit opportunities. The Town should encourage the review and consideration of these higher temperature systems as they evolve and come to the market, which is expected to be more prevalent within 5-8 years. As this means replacing existing boilers and chillers, a retrofit will likely be complex, invasive, and technically involved project. A full life cycle cost analysis is recommended to determine the viability of converting to a geo-exchange and heat pumps in any given building or collection of buildings.



Typical energy transfer station for a geoexchange connection
Source: "City of Vancouver - Neighbourhood Connectivity Standards, 2014"

Figure 12: Example schematic of a heat exchanger transfer station for use with heat pump systems.

Borehole Installation

Even if the heat pumps are easy to install, significant site impact will be incurred with the drilling of boreholes and then routing piping into the building's mechanical room. Parking lots are a good place for this application and should be considered if the thermal loads exist nearby. The Town already has experience of borehole installation work and understands the scheduling and site preparation needs. Currently there are not many contractors that provide drilling for borehole arrays. This should be taken into consideration when planning for a borehole field. Of note is that, currently, borehole depth is restricted to 650ft. There is a chance this will be extended to 850ft which will reduce the number of boreholes for energy capture. The technology has expanded the potential sites with the capability of directional boring making it more possible to install boreholes where only vertical drilling was possible. Drilling requires a source of water which then needs to be routed to drain systems without over-loading them or introducing sediment.

3.4 Application as Retrofit vs. New Construction/Major Renovation

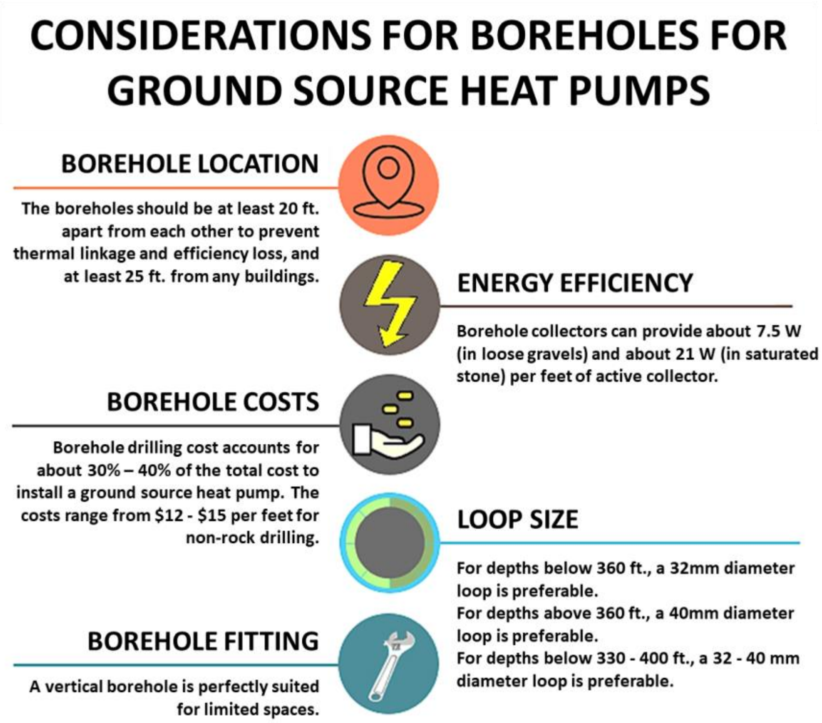
This is best applied to new construction, major renovations, significant end of life HVAC replacement, or a major lifecycle facility renovation. Available land is usually a major prerequisite though directional boring should be considered where possible. Heat pumps and geo-exchange versions will be a major solution for achieving low carbon design in the foreseeable future.

The low carbon benefits of heat pumps will make them an increasingly common solution for achieving GHG targets and recommended for use in new and renovation projects.

3.5 Economics

The costs for a geo-exchange system include engineering and other soft costs, drilling the boreholes, borehole liners, headers, and distribution, trenching to the mechanical connection points, mechanical room equipment to transfer the ground energy, heat pump equipment (central plant, distributed heat pumps), supplementary heating/cooling equipment if required and building distribution and terminal devices. A renovation will be more on a first cost ($/kWh delivered) given the need for internal design and system changes.

The costs for a typical geo-exchange field are between 30-40% of the total project cost and is fairly linear with the size of the array. Depending on the ground conditions, the ground source heat pump boreholes are drilled at about 20 feet apart from each other and about 25 feet from the nearest building. The depth is conditional on the property's characteristics (size, insulation, heating capacity) that require heating, the average being about 800 feet. The borehole requirements for any ground source system is provided in the figure below.



Source: greenmatch.co.uk (image adapted)

Figure 13: General considerations for ground source heat pump applications

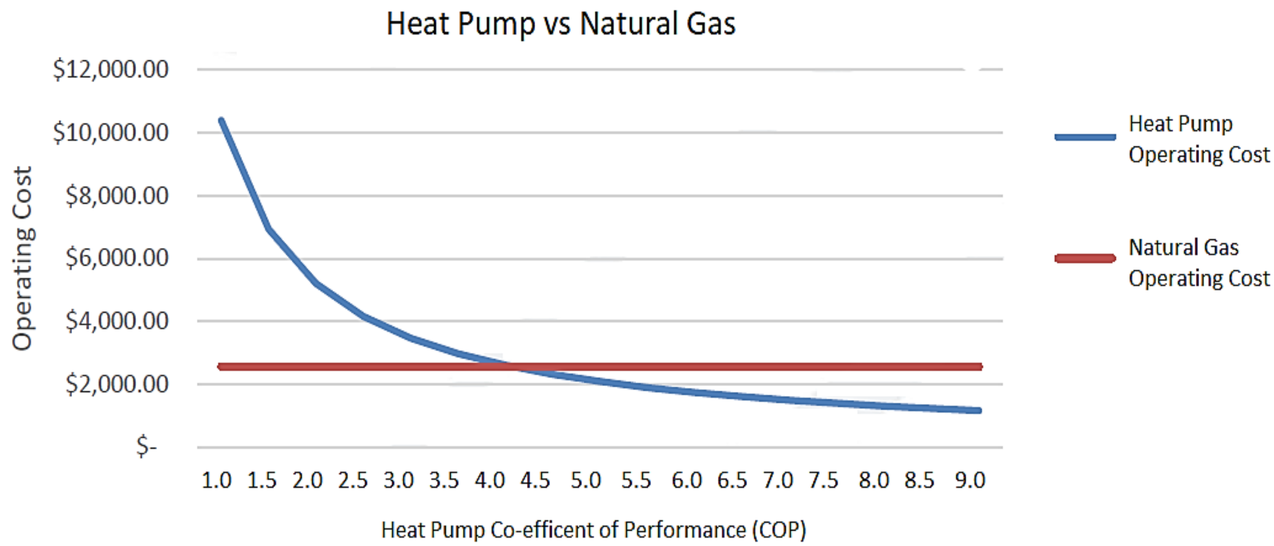
The costs and space information for a typical 250 tonne ground source heat pump, based on the specified assumptions, is summarized in the following table.

Table 10: Example of performance and costs for 250 Ton heat pump system

Metrics for a typical 250-ton Heat Pump	
Heat Pump Capacity (tons)	250
No. Of Boreholes Required	63
Borehole Depth (ft.)	800
Space between boreholes (ft.)	20
Total Land Area (sq. ft.)	40000
Drilling Cost ($/ft.)	$15
Estimated Total Drilling Cost ($)	$750,000
Equipment & Engineering Cost ($/ton)	$7,750
Estimated Total Equipment & Engineering Cost ($)	$1,937,500
Total Project Cost ($)	**$2,687,500**

The operational economics centre on the relatively high cost of electricity when compared to natural gas per unit delivered heat, though given the benefit of the COP, the actual (annual) differences are not great with cooling included. A full life cycle comparison, including the carbon costs, is recommended.

However, improvements to heat pump technology and an increased cost of carbon will make heat pumps a cost-competitive alternative to natural gas equipment. The technology cost curve mapped against technology efficiency is illustrated in the figure below.



Source: Graham Cootes (P.Eng.), HTS Toronto. Email: graham.coote@hts.com

Figure 14: Illustrating benefits for costing of heat pumps as performance (COP) improves

It is expected that the natural gas operating cost will be higher than the cost illustrated above when the carbon charges as part of the federal carbon backstop are taken into consideration.

3.6 Carbon Offset Potential

There is a significant carbon saving in the move away from natural gas. The following figure shows the carbon emissions (gCO_2e) associated with various fuels for equivalent energy output (ekWh). That is, an elimination of about 75% of the carbon footprint based on Ontario's current electricity carbon footprint.

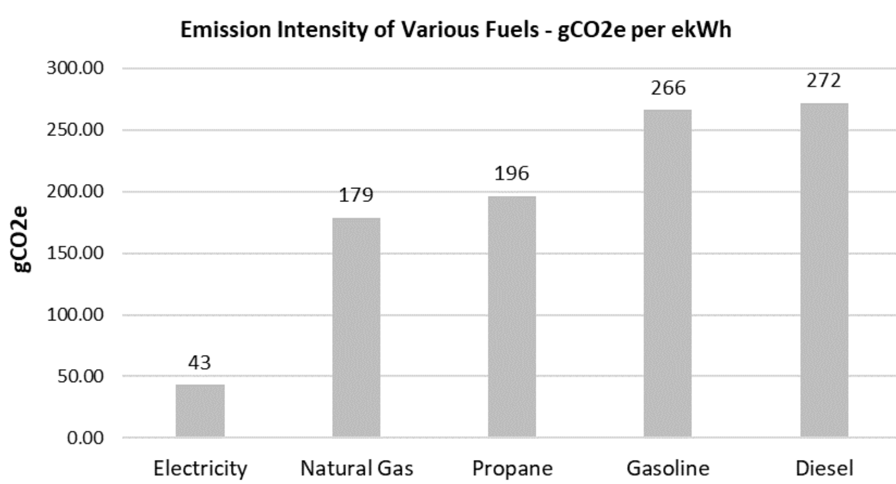


Figure 15: Emissions Intensity of Various Fuels

3.7 Energy Generation Potential

Geo-exchange heat pumps do not generate energy. For the area around Oakville, the ground temperature is constant below 5-6m at about 11-12°C all year. The ground loop will store heat (cooling mode) or release heat (winter mode), while the COP of the heat pump can bring that energy back with an energy cost of only 25% of the heat generated. It is therefore a significant reduction in the overall energy footprint. Combined with enhanced building performance standards geo-exchange and heat pumps will bring about large energy and GHG reductions. An important consideration for the success of these systems is to ensure the energy captured during the summer cooling mode recharges the ground for use during the heating season. If this is not the case, the system will under-perform in the winter and require the back-up heat to come on often. As this is usually an electric coil, this can increase the annual energy costs far above what was estimated.

3.8 Energy Modelling

A geo-exchange system's predictability relies on several factors which include:

- The building energy model: The model must be hourly and reflect the capacity of heat pump energy performance with the ground conditions and building heating loads.
- Building energy balance: To ensure the heat pump balance with ground temperatures can sustain the heating/cooling cycles each year. The summer reject heat is used to recharge the ground for winter heating. This is an important consideration when designing and operating these systems.
- Measurement of the ground's thermal conductivity and presence of groundwater: This requires pre-construction testing. Groundwater movement can remove the stored heat, although the groundwater itself can be an excellent energy source (note that using ground water is not always allowed and must be verified before it is considered).
- Modeling the geo-exchange system itself is complex and depends on detailed ground loop and building load characteristics combined with a good understanding of the technologies and tools by the modelling team. Subject matter experts should be retained for any detailed evaluations and designs.

3.9 Procurement

Heat pumps are very similar to conventional HVAC contracting work and so does not present an issue. Drilling is not a concern, though as mentioned above, there are only a few drillers locally. Installation specialists for the ground loop itself are not that common, although this should not present a problem. It would be prudent to work with a specialist construction firm, given the interrelated nature of the key components and to ensure competent design and commissioning and limit potential issues post-commissioning. It is possible to tender the borehole work separately from the HVAC component. On the design side, it is recommended to ensure the engineering firm has a track record for the evaluation, design, and implementation of a geo-exchange system from the ground to the mechanical room including project management, administration, and commissioning.

3.10 Barriers to Implementation

Staging during construction of the borehole field is a pre-requisite for any retrofit application. If it is a large borehole field, it is possible to have multiple drilling rigs going at one time. The Town needs to be fully aware of upfront development costs because of the borehole testing, design, and modeling requirements. Ground conductivity and thermal performance may become a barrier to the successful application (i.e., moving water will draw heat away). In some cases, the ground could be unsuitable for drilling and removal due to contamination. Electrical capacity within an existing facility needs to be established early in the design. Not all existing terminal equipment (radiators, heating coils) may be suitably sized for a retrofit application and could add costs that render the project impractical.

3.11 Current/ Future Implementation in Municipalities & Equivalent Organizations

There are many different locations – private and public – employing this technology *(source: https://sustainabletechnologies.ca/map-of-geoexchange-systems-in-ontario/)*. As detailed elsewhere in this report, there are already systems under operation within the Town's facilities. Following are some specific additional examples:

- UOIT, Durham: This new campus construction (2005) was based around a low temperature heating loop powered by heat pumps and a large geo-exchange borehole system.
- University of Toronto: The St. George campus is introducing geo-exchange systems into the DES to reduce overall energy costs and GHG footprint. The U of T is planning significant ground source heat pump applications that will deliver into the existing low temperature network. Approximately 600+ boreholes is planned in 3 systems that will offset ~15,000 tonnes CO_2e/yr. by removing the need for gas fired steam.
- Pan Am Games Aquatic Facility, U of T, Scarborough: This large pool complex is operated using a geo-exchange heat pump system. Approximately 150 boreholes with a further 60 boreholes for a new chemistry facility.

3.12 Strategic Direction

Heat pumps will make up a large part of the electrification on the thermal loads for The Town. Ground source systems should be considered when there is sufficient ground to use such as under a new building, under a parking lot or nearby grounds that permit the installation of the borehole field. The supply temperatures from current heat pump technologies are less than conventional heating systems which means retrofitting into an existing building will likely require terminal device conversions, derating and possibly a booster heater. The facility needs to have cooling and heating loads that can be balanced annually to ensure the ground is properly charged. The FCM should prepare a trigger event schedule that uses end of life and HVAC renovations to bring heat pump solutions to the building into consideration. Consider geoexchange solutions for large campus-like opportunities and where thermal off-takers are available, such as around an athletic facility, large community centre, and operations centres. Geoexchange systems should be evaluated using a life cycle cost assessment against a conventional gas fired boiler/chiller system and include the carbon costs, utility escalation, maintenance, and operations.

4 Air Source Heat Pump Systems

4.1 Market Overview

In many respects an air source heat pump (ASHP) system is like a geo-exchange system: use of an electric heat pump to deliver heating and cooling from a source of thermal energy. In the case of an ASHP, the air is the thermal energy source or sink.

- ASHPs are often packaged with a variable refrigerant flow (VRF) energy delivery system as opposed to a traditional water based hydraulic system. This allows them to transfer heat from one area in a building to another.
- They are also available as air-to-water and air to air systems, meaning they can replace boiler/chiller and rooftop air handling or other air delivery systems, without the need for new terminal equipment. Like geoexchange systems, they deliver low temperature heating which must be taken into consideration for retrofit applications.
- ASHPs are also available in air to air, so they can replace rooftop air handling or furnace-type equipment.
- There is no trans-seasonal storage with these systems. The air itself is the source of energy. The refrigerants have a boiling point sufficiently low that they can still operate at below-20°C outside air temperatures with COPs at ~1.5.
- System heating output capacity will change (decrease) with lower outdoor temperatures. This means the system is potentially oversized to meet peak design day design loads, or as with low temperature supply heat pumps discussed above, additional heating may be required to meet those few coldest days. Careful economic analysis and modelling will determine the best combination of peak heating loads.

Source: https://galvezairconditioning.com/cherry-services/heating-services-commercial-install

Figure 16: Typical rooftop-mounted commercial air source heat pumps

- They do require thermal balancing between heating and cooling like a geoexchange system does.
- Effective strategy for retrofit planning
- They require large roof or ground areas for the large-scale equipment. Approximately 20 kW/m^2 area required.

4.2 Application to Building Portfolio/Grid Connectivity

An ASHP retrofit is possible in most buildings, particularly smaller ones currently running on furnace-type or rooftop mechanical equipment where straight swap-outs are possible. The use of the VRF attributes is well suited to buildings that have concurrent cooling and heating loads. For larger buildings, the terminal equipment needs to be able to work with the heat pump's lower temperature characteristics. ASHPs, although much quieter than comparable air conditioning equipment, need to be designed with noise criteria taken into consideration – like a conventional air conditioner – condenser location is an important consideration.

Hot Water Heaters

Air source heat pump hot water heaters are a separate product category and are used solely for generating hot water. They are a relatively new market entrant and work well in places where there is a consistent access to useable waste heat, for example in a mechanical room and where a flue cannot be installed. They are a direct replacement for a conventional gas-fired tank system in the 50-200 US Gal storage capacity range, although costs are much higher as compared to either gas or electricity-powered hot water heaters.

4.3 Application as Retrofit vs. New Construction/Major Renovation

ASHPs are a consideration for all types of construction, new and retrofit. A VRF loop is much smaller than conventional hot water plumbing or ducting making them particularly convenient in renovations where space is a premium. An ASHP requires roof or ground area at the site. For new construction they can be designed into the structure from the schematic design stages. They can also be sized according to higher performance thermal designs and take advantage of the lower temperature supply temperatures for heating. For retrofits they will be replacing existing equipment, typically on the roof. They may not be capable of satisfying the full heating loads efficiently which may require a booster heater for the few hours of design low temperatures each winter.

4.4 Economics

Today, using a heat pump can cost twice as much as traditional packaged rooftop units that consist of direct expansion (DX) cooling and natural gas burners. But heat pump technology is becoming increasingly cost-effective and, according to the National Energy Board, costs could drop 10% to 20% by 2025 to 2030, and 20% to 30% by 2040.

Heating

Depending on outdoor air temperature, a heat pump can achieve COP as high as 3.4 in heating mode, meaning the heat pump can produce 3.4kWh of heating energy for every kWh of electricity consumed. As outdoor air temperature drops below 0°C, the efficiency of heat pumps drops significantly and requires additional support from either an electric heating coil, a natural gas burner or a larger heat pump capacity. For example, at sub-zero temperatures, a 20-ton heat pump may only produce the heating equivalent of a 15-ton heat pump.

Cooling

High efficiency heat pumps or DX units provide substantial energy and utility cost savings compared to traditional standard efficiency DX cooling applications, as demonstrated in the example below. Depending on outdoor air temperature, a heat pump can achieve IEER as high as 18.6 (COP of approximately 5.4), meaning the heat pump can produce 5.4kW of cooling for every kW of energy consumed.

The following table shows the difference in annual operating costs associated with using a 20-ton heat pump instead of an RTU that has 15-ton DX cooling and a natural gas burner, based on current electricity and natural gas utility rates. The case is based on a theoretical 5,000sq. ft. space with one exterior wall in the Greater Toronto Area. The assumed operating schedule is Monday to Friday from 7AM to 5PM.

Table 11: Cost performance example for a 20-ton heat pump. 20 ton is a typical commercial scale.

Technology	Cooling Energy ($)	Heating Energy ($)	Fan Energy ($)	Total Annual Energy Cost ($)
Rooftop Unit + Gas Boiler	$1,014	$1,026	$1,688	$3,728
20-ton heat pump	$460	$4,377	$434	$5,271
Heat Pump Savings	**$554**	**-$3,351**	**$1,254**	**-$1,543**

4.5 Carbon Offset Potential

There is a significant carbon saving in the move away from natural gas. The following figure shows the carbon emissions (gCO2e) associated with various fuels for equivalent energy output (ekWh). That is, an elimination of about 75% of the carbon footprint based on Ontario's current electricity carbon footprint.

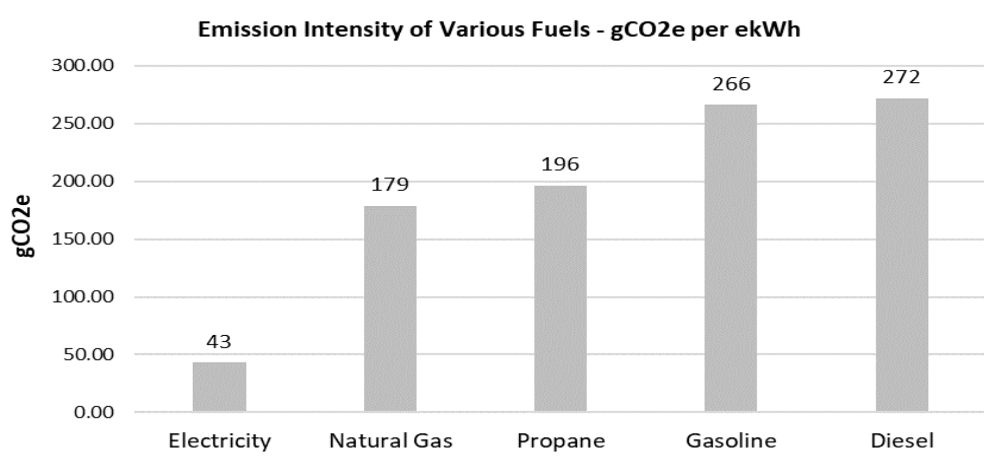


Figure 17: Emissions factors for fuels.

4.6 Energy Generation Potential

As with other heat pumps, this is not a generation system. It can, however, take advantage of waste thermal energy such as in an electrical or mechanical room. These are good candidates to remove thermal energy from a data centre.

4.7 Energy Modelling

Actual energy savings/generation calculations again are contingent on an accurate understanding of the building's energy loads at an hourly level. Manufacturers publish output and efficiency details for a full range or outdoor conditions. Therefore, if heat loads at various outdoor temperatures can be modeled – either by analysing gas bills or via an energy model, performance simulation is straightforward to predict. Either the manufacturer or an experienced design team will be capable of completing the required performance studies.

4.8 Procurement

For new construction, there are several contractors and consultants familiar with VRF-type systems. Manufacturer representatives tend to be closely involved in design work and may offer to do design directly but could make them ineligible for tendering. The procurement policies will need to be evaluated before allowing a vendor to provide both design services and product supply.

4.9 Barriers to Implementation

Replacing boilers/chillers with heat pumps in an existing facility does require careful construction staging during shoulder seasons when both heating and cooling may be required. Renovations may require the treatment of asbestos in ceiling spaces when replacing the plumbing and/or upgrading the ducting. Many existing HVAC systems are designed for peak heating and cooling loads that require large systems and high (heating) low (cooling) supply temperatures. Recall that heating and cooling peaks occur for 2-5% of the season. Sizing a HVAC system for these peaks causes inefficiencies and unnecessary costs. Combing a heat pump system with a side peaking heater/cooler is more efficient, possibly more expensive at first cost but would also operate more efficiently throughout the year. When selecting a consultant, The Town should determine how knowledgeable the firm is with balancing annual and peak loads effectively.

4.10 Current/ Future Implementation in Municipalities & Equivalent Organizations

VRF-driven systems run from ASHPs are now relatively common. As building energy performance improves the use of ASHPs for renovation will be recommended to take advantage of the lower GHG footprint.

- The Dundas West GO station is heated and cooled with ASHPs.
- The University of Toronto Huron Sussex renovation is considering ASHPs for the existing buildings as a part of the drive to lower temperature heating systems.

4.11 Strategic Direction

As with geoexchange heat pumps, air source heat pumps (ASHP) will play a large part in getting away from natural gas heating and achieve the GHG targets over time. ASHPs are an enabling technology in that they can be retrofitted into existing buildings. The Town should prepare a schedule based on replacements (trigger events), end of life or opportunities where the benefits of conversion match with GHG reduction goals.

As mentioned above, The Town should ensure the consultant selection process includes determining their expertise with system design with stipulation that over-sizing to meet the few hours per year when peak capacity is considered and explained in detail (hourly calculations and modeling).

5 Hydrogen & Fuel Cells

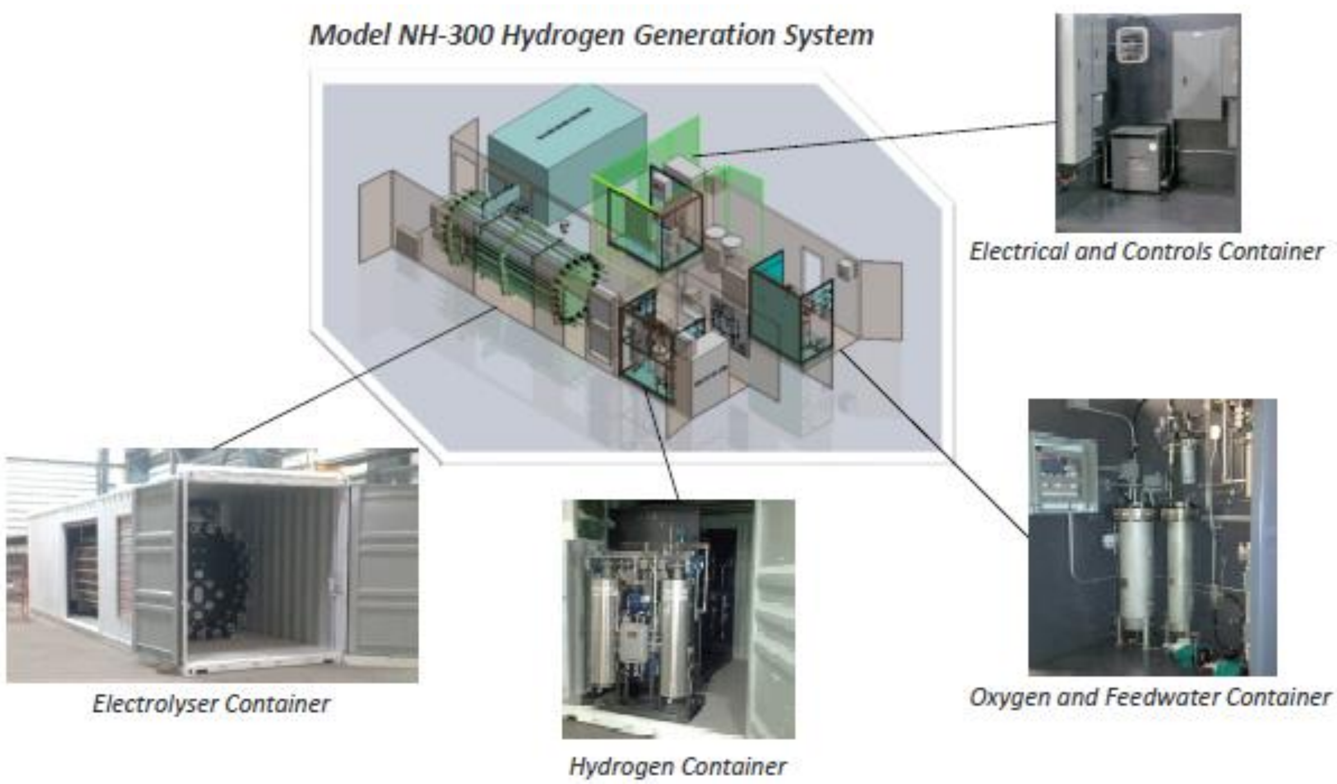
5.1 Market Overview

Hydrogen as a Fuel Source Replacement for Natural Gas

Hydrogen is an energy transmission method – it is not a source of energy but must be created to be used for any loads. Hydrogen is either generated from natural gas using a high temperature steam/methane process (very high carbon footprint), or from the electrolysis of water by means of electricity (low carbon, high-cost energy, though possible with renewable energy). It is an evolving energy resource and capturing attention around the world as a fuel source and a way to displace natural gas for combustion.

Hydrogen Fuel Delivery

While there is a significant amount of hydrogen generated for a range of industrial processes, there is yet no Canadian retail or US delivery mechanism, other than trucked-in as a compressed liquid fuel, or by on-site natural gas conversion at the point of use. For short to medium term considerations, gaseous hydrogen is mixed with natural gas to a maximum of about 15% by volume thereby reducing the carbon content while taking advantage of existing pipeline infrastructure. This is currently being investigated by natural gas distribution companies to lower their GHG levels to meet targets. It may be possible for The Town to purchase hydrogen injected by the utilities and take credit for the reduced carbon, like a renewable electricity contract through the electrical utility.



(Source: Next Hydrogen, 2020)

Figure 18: Sample of system components for a H2 generation plant (~300 m^3/hr).

Electricity/Heat Generation: Stationary Fuel Cells

Fuel cells have been considered, particularly within the transportation sector to offset diesel fuels and the carbon content. Hydrogen is used to generate electricity at the fuel cell with the waste product being water and heat. For stationary applications, this requires an inexpensive source of hydrogen and be competitive with natural gas even taking the carbon content into consideration.

5.2 Application to Building Portfolio/Grid Connectivity

There are currently no commercially available products on the market that could provide heating and electricity generating services at the building scale. Currently and for the foreseeable future, there does not appear to be applications for hydrogen in Oakville in stationary applications. Note that diesel fueled vehicles such as buses and large industrial trucks are currently being converted to operate with hydrogen. The Town is currently investigating the use of electric buses to replace some of their diesel bus fleet.

5.3 Application as Retrofit vs. New Construction/Major Renovation

Currently, hydrogen is being used in short-haul trucking operations. Some municipalities (Japan, California) are piloting hydrogen waste pick-up trucks, again short-haul application. The advantage is that these operations typically have land available to store hydrogen and install filling stations. They also have ready access to renewable energy to make the low carbon hydrogen through electrolysis. Hydrogen is more like diesel in that the tanks can be refilled relatively quickly (versus electric trucks). However, until a cost-effective source of hydrogen becomes available, the potential role for a hydrogen fuel cell-driven project at Oakville would be as a demonstration project, and likely for their waste pick-up fleet

5.4 Economics

The cost per unit of delivered energy is higher than that of electricity and natural gas (2020). This is not expected to approach parity for another 5+ years. The generation and distribution are not currently developed to the point where there is an economic case to be presented for other than on-site use such as for tow-motors. The Town may want to revisit this energy source as hydrogen generation becomes more available for on-site plants and distribution suitable for transportation opportunities within The Town – e.g. garbage trucks, delivery trucks.

As hydrogen is introduced to the natural gas grid, the economics of carbon content will change according to the fraction and carbon rates. These factors will need to be taken into consideration as the information is provided. This will be apparent as the natural gas grid introduces renewable hydrogen energy (RNG) and will impact the emissions factor the Town can use for any natural gas used.

5.5 Carbon Offset Potential

Fuel cells driven by hydrogen sourced from electrolysis, such as renewable energy-based supplies (green hydrogen) and can be a very low to zero carbon fuel. Natural gas-based fuel cells generate significant emissions and not a viable choice (grey hydrogen). Hydrogen will be introduced into the natural gas grid which will reduce the carbon content for conventional heating system use. As mentioned, The Town is considering electric buses versus hydrogen or fuel cell fleet transportation conversions which contributes a large portion of the GHG footprint in The Town.

5.6 Energy Generation Potential

As pointed out, hydrogen is not a source of energy like solar is. A fuel cell can convert between 40% and 60% of the energy in the hydrogen to electricity. In comparison, a typical internal combustion engine is ~30% efficient. The conversion efficiency of renewable electricity as an input fuel for the generation of hydrogen (green hydrogen) to useful output (heat and electricity) is in the region of 30% given the solar panel efficiency is ~17%.

Most of the hydrogen used now for stationary and mobile applications (>95%) is made from natural gas (grey hydrogen). The conversion efficiency of the hydrogen to useful energy must be considered after it is injected into a heating system (natural gas line to boiler) or fuel cell (generates electricity plus some heat). These efficiencies reduce the overall system efficiencies further.

(Source: https://www.fuelcellenergy.com/wp-content/uploads/2017/02/Product-Spec-SureSource-1500.pdf).

5.7 Energy Modelling

Not applicable. Any fuel cell and hydrogen generation system would have output predicted by its manufacturer. Subject matter experts should be retained to assess any hydrogen applications.

5.8 Procurement

The marketplace is currently confined to large scale operations for fleet conversion, some natural gas injection for low carbon fuel supply and some commercial vehicle infrastructure development. Commercial scale systems outside of these applications, though being developed, are not yet suitable for The Town's scale of operation.

The results from municipal pilot projects will be presented and should be followed to make sure The Town is aware of the status of the technology, acceptance, and costs.

5.9 Barriers to Implementation

The main barrier is the lack of available green hydrogen generation and infrastructure for widespread use. As hydrogen is introduced into the gas grid, The Town should be aware of the timing to capture the carbon reduction benefits and emissions factor changes. Technologies that burn hydrogen are being developed with two CHP vendors reviewed (Caterpillar and 2G Energy) that is capable of minimum 25% and potential to go to 100%% hydrogen burn at a scale suitable for municipal facility scales. This restricts competitive pricing though there are other companies developing or releasing hydrogen CHP units at scales suitable for municipal loads These will be similar to conventional gas CHP units and will need specialized operator training for operations and maintenance.

5.10 Current/ Future Implementation in Municipalities & Equivalent Organizations

Other than the use of hydrogen to offset carbon in natural gas distribution, none known of in the building sector yet. There is hydrogen based combined heat and power systems being developed for commercial markets. There are municipalities starting pilot projects for hydrogen powered short haul trucks. A program in north BC is making 65 diesel short haul trucks able to use 40% hydrogen. As hydrogen is introduced into the distribution infrastructure, these will be available for consideration. Any consideration for the use of hydrogen in Oakville should start with short haul trucks such as garbage pick up and as a pilot. A hydrogen generation plant would be required at the main truck operations yard.

5.11 Strategic Direction

Currently, hydrogen delivery and infrastructure are not widespread. The technologies for burning hydrogen as a heating and/or combined heat and power system are being brought to market for commercial applications.

Until there is a more robust distribution system for hydrogen there are no widespread applications that can not be addressed with electrification to achieve GHG goals. Continue to be aware of CHP technologies as they prepare for hydrogen fuel blends. Understand how the carbon reduction of blended fuels will impact the carbon loads and therefore the cost of carbon in conventional heating systems.

Prepare a cost calculation for fuel that includes the defined carbon content for natural gas and the carbon costs that result each year. Carry and monitor these along with the standard utility tracking metrics.

6 Bio-Energy

6.1 Market Overview

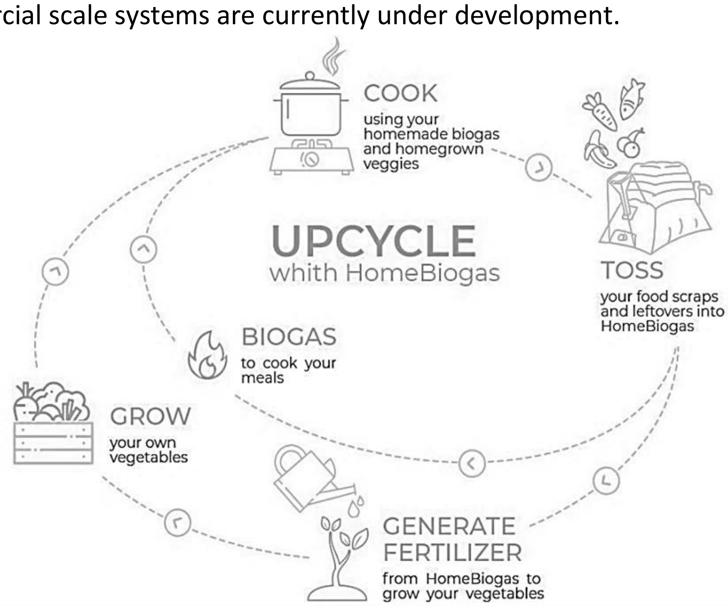
Bio-power can be split into two parts: a point of use heating device or a primary fuel source. These include wood chip/pellet heater/boilers and biogas generation that is burned to generate thermal or electrical energy. Both require large equipment and transportation areas.

Bio-fuels as a Fuel Source

Localised biogas digesters are being used in Ontario, where the gas is generated from organic waste and burned to generate electricity like a natural gas electrical generation system. It can also be captured from a landfill and converted to electricity or produce Renewable Natural Gas (RNG). With appropriate treatment, locally generated methane can be injected into the natural gas grid to offset natural gas consumption. For the end user, this is analogous process to the purchase of wind power for greening electricity consumption. There are companies in Ontario including Bullfrog Power who sell 'renewable natural gas' via this process *(source: https://biothermic.ca)*.

Biofuel can also be naturally produced from the decomposition of organic waste. When organic matter, such as food scraps and animal waste, breaks down in an anaerobic environment (an environment absent of oxygen) it releases a blend of gases, primarily methane and carbon dioxide. Due to the high content of methane in biogas (typically 50-75%), it is flammable and can therefore be captured and used as an energy source

HomeBiogas is an Australian company that has created an efficient and durable biogas generator for domestic cooking and farming that is easy to install and operate. The operation of their biogas system is illustrated in the following figure. Commercial scale systems are currently under development.



Source: https://www.homebiogas.com

Figure 19: example of biogas use cycle

Purchased Bio-fuels for On-site Heating

Figure 20: example of small woodchip/pellet boiler

Wood pellets (a manufactured wood product) or wood chips can be purchased and used as a fuel for stationary boilers, replacing the use of natural gas. The fuel is stored close to the boiler and fed mechanically into the boiler. The boiler itself is similar in footprint and style to a conventional gas boiler, with venting, combustion air and ventilation requirements being comparable. A one-for-one replacement may be possible, with the need for additional space for fuel storage and potentially a pathway for fuel transfer.

Woodchips are significantly cheaper than wood pellets – about 1/3 of the cost, but only at larger scales (>500kW). Either fuel source requires storage and a way to transfer the fuel from storage to the boiler, which is automated. The fuel must be trucked to the storage facility. The larger the storage bin, the less frequently that fuel needs to be delivered.

Ash is generated as a by-product and is a harmless by-product that can either be put in the garbage or used as fertilizer.

6.2 Application to Building Portfolio/Grid Connectivity

These can be considered for buildings at any scale and are possible for a DES design provided appropriate (and reliable for long terms) supply can be found. Adequate fuel space is required as well as the ability to truck the fuel into the storage site regularly all year.

6.3 Application as Retrofit vs. New Construction/Major Renovation

Other than space requirements for the boiler, fuel handling, shipping and fuel storage, there is no reason why either could not be applicable.

6.4 Economics & Carbon Impact

A price of $450-600 per kW capacity installed including fuel storage is typical. This would represent a premium over an equal performance gas boiler. Annual utilization efficiencies are around 85%, similar to non/near-condensing gas boilers. The following figure shows the cost and carbon intensity (gCO2e/ekWh) for various fuels.

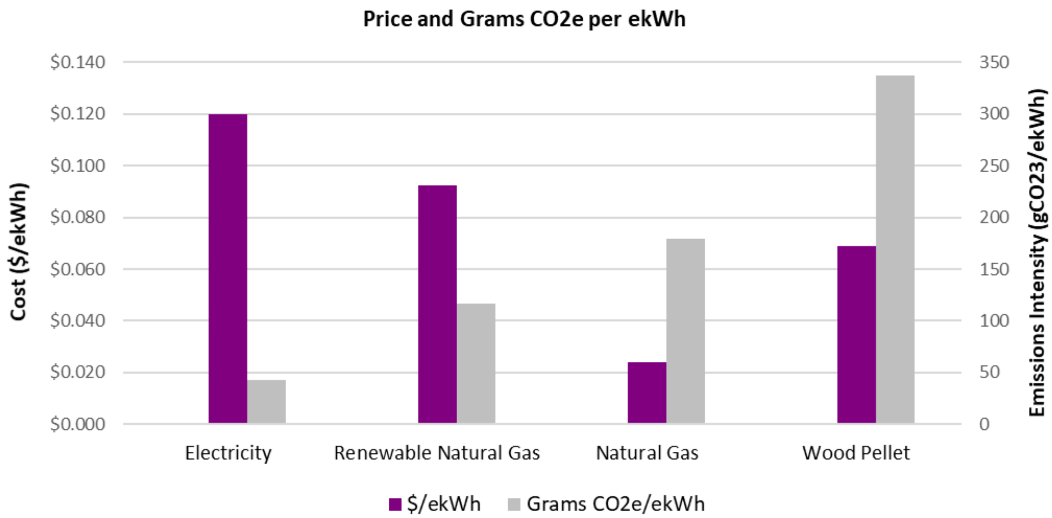


Figure 21: Cost and carbon intensity of various fuels

We can clearly see from the previous chart that bio-fuel extracted from organic and landfill is about 35% less emissions intensive compared to traditional natural gas. However, the cost for RNG is higher compared to traditional natural gas. We also see that the cost of wood pellets is between traditional natural gas and RNG, but it holds the highest emissions intensity among all fuel sources. Hence, landfill gas sequestration or RNG would be a more viable option when considering the emissions impact alone.

6.5 Energy Generation Potential

This is a 1:1 replacement of existing boiler heat. The efficiency of any pellet or woodchip boiler would be comparable to an efficient gas-fired boiler and subject to similar regulation.

6.6 Procurement

There will be a lower number of products available as compared to gas boilers, given the relatively small size of the market in Ontario for commercial applications. The same will be true of installation contractors. There are a limited number of fuel providers and so this needs to be addressed as part of any evaluation. A Feasibility Study is therefore recommended before proceeding with any tender process.

6.7 Barriers to Implementation

One area to be aware of is that sign off from the Ministry of the Environment, Conservation and Parks is required for the installation due to flue gas dispersion. While not expected to be an impediment, this is an additional step over a conventional gas-fired system.

There will be space required to store the fuel. Access to the storage area will be required and for a large plant means large transport trucks arriving regularly. This could face resistance from residents who are along the route to the plant. Storage must be provided to carry through any transportation disruptions due to extreme weather (typically in the winter).

6.8 Current/Future Implementation in Municipalities & Equivalent Organizations

There are a few examples of this application:

- La Cite Verte is a new mixed residential community with a central heating plant comprising 5MW of pellet boilers plus thermal energy storage *(source: http://www.quebecwoodexport.com/images/stories/pdf/ficheEN_cite_verte_WPAC.pdf)*
- The Our Lady of Mercy Catholic School in Bancroft, ON has a wood pellet-driven boiler system.
- The OPG BioEnergy Learning and Research Centre at Confederation College in Thunder Bay, ON is a 275,000sq. ft. educational facility running off 1MW of wood chip boilers.

6.9 Strategic Direction

Due to delivery and storage needs, this is a technology best suited for district energy system applications. Transportation and storage criteria must be included in any feasibility studies and include sufficient fuel to carry through delivery disruptions.

Maintain awareness of the technologies and applications for consideration against other fuel supplies. Consider a more in-depth feasibility study to fully assess the capabilities and application criteria for The Town.

Not perceived as a long-term option or application for large corporate assets. There are technologies that may appeal to some sites for either pilot or awareness projects that can be addressed as they appear.

7 Solar Thermal Hot Water

7.1 Product Background

Solar thermal hot water is the conversion of solar energy directly into heat, usually with a storage to heat the loads. This is a well-established market and technology – easily the most efficient of all pure renewable energy technologies with panel efficiencies of over 80% and sun-to-delivered heat efficiencies close to 60%.

Rooftop or wall-mounted panels collect the sun's energy through a heat transfer fluid – glycol or water – and then transfer it to a storage tank (or is some cases, directly to the loads). Solar thermal hot water acts as a pre-heating system for the hot water loads. It is possible for the system to offset up to 100% of daily hot water needs or provide partial heat to incoming cold water with the existing hot water heating system providing the balance.

Solar Collector & Storage Tank Types

There are two prevailing technologies: flat plate collectors and evacuated tubes. Each have their benefits depending on the load, temperatures, and applications. Both typically use an antifreeze transfer fluid and transfer the heat to a storage tank. Storage tanks can be either conventional pressurised tanks, or non-pressurised systems. The latter are associated with 'drain back' systems, whereby collectors are only filled with heat exchange fluid when solar energy is available, and more typical in residential applications.

(Source: Elgin West Community Centre, Richmond Hill)

Figure 22: Typical, low angle, solar panel array connection

Outdoor Pools

The systems used for outdoor pools are much simpler and cheaper. There is no heat exchanger; pool return water is diverted into a bank of non-glazed collectors – essentially a black rubber matt with hollow tubes – where heat is picked up before the fluid is returned to the hot water heater intakes.

7.2 Market Overview

Solar thermal's popularity is dependent on natural gas prices and government incentive programs. Currently there are few if any supports for solar thermal in Ontario and the long-term low level of natural gas prices has made systems economically difficult to compete though systems are being installed in particular for indoor pools and high make-up water loads (car washes, process loads, recirculation loads).

The industry separates out components and installation services. A vendor will carry a selection of solar components and provide complete turn-key designs and installations. The residential pool heating market has remained robust in response to consumer demands due to its relatively cheap prices.

While many aspects of solar thermal are familiar to any plumber or structural contractor, the nuances of system selection, design and operation tend to lead to problems when installed following conventional mechanical system procurement methods. The consulting industry tends to have limited experience with solar hot water systems which must be evaluated before selecting a firm.

7.3 Application to Building Portfolio/Grid Connectivity

Swimming Pools

Both indoor and outdoor pools offer large and steady loads highly suitable for solar thermal pre-heat systems as well as large roof areas. Care is required in terms of how make up water is piped into the pool to maximise load reductions. Combined with drain water heat recovery and well-functioning de-humidification heat recovery systems can significantly reduce heating loads.

Arenas

An arena running through the summer as well as the winter provides a sufficiently large hot water source when combined with shower usage – Zambonis use in the region of 500-800 litres per flood or the equivalent hot water usage for 5-8 people per day. Many ice melt pits are heated by natural gas systems that can be supplemented or replaced with a solar hot water system. Many rink ice refrigeration plants make use of heat recovery from the compressors to provide hot water and improves the overall ice plant efficiency.

Other Uses

Offices, libraries, and administrative type buildings do not have sufficiently high loads to warrant the use of solar hot water. Senior residences, fire halls and community centres may have laundry and DHW loads that justify a solar hot water system. Careful analysis of the loads through the year is needed to ensure there is sufficient hot water load to justify a solar hot water system.

Installation Criteria

Rooftop constraints for solar thermal are like solar photo-voltaic in terms of the available space. Solar thermal is ideally installed at an angle of approximately 30-45° from the horizontal to maximise annual energy generation, and thus pitched or flat roofs are the best places for installation. While shading is an issue, partial shading of one collector is not as critical as it is for solar PV. The major difference between the two systems is that given the much larger size of solar thermal collectors – typically 4'x8' for flat plate type – that are almost always fixed directly to the roof-structure which tends to increase the cost as compared to a ballasted array. Vacuum tube arrays are lighter and have been installed using a ballasted racking where the loads justify a solar array.

The pipes need to be insulated and protected from the elements and run efficiently to the mechanical room. Most systems use a blend of anti-freeze (food grade polypropylene) for year-round use. Within the mechanical room there needs to be space for storage tanks. Tank sizing is dependent on both the volume and timing of the load: swimming pools are typically installed without storage given the high and continuous loads available, while an office, community centre or arena would require storage.

All roof installed solar will require a structural assessment by a professional engineer to determine that the roof is able to handle the additional dead and live (wind) loads. Wall mounted installations are an option where large areas of space are available and access from a zoom boom/cherry picker is possible. Care needs to be taken regarding shade to the south, given low sun angles during the Fall to Spring.

District Energy

As mentioned in the District Energy section, solar thermal can provide a source of renewable heat into a geo-exchange system. This is a common DES model in Europe and with careful review of the ground's seasonal energy balance between heating and cooling loads should be considered where land is also available.

Metering

It is important to specify thermal metering as a key system component, given heat is the delivered product. This is possible using conventional flow meters and temperature sensors – either through an existing building automation system, or as a stand-alone system.

7.4 Application as Retrofit vs. New Construction/Major Renovation

Solar thermal works well for both new construction and for retrofit. For any major renovation or new construction projects, clearly the greater the roof area available, the better. If the intent is to optimise a buildings' design for solar, then a south-facing pitched roof of 30-45°, facing no more than 45° of due south would be ideal. For a flat roof, ensuring large areas clear of mechanical equipment or shading form penthouses is required along with the structural considerations.

7.5 Economics & Carbon Impact

A small commercial-scale system about 10 collectors (approximately 20kW$_t$-equivalent) and upwards in size would cost in the region of $2,000 to $3,000 per collector including engineering costs. There can be a significant cost difference, depending on the installation methodology and volume of storage required, with flat roofs tending to be the more expensive.

The costs and generation information for a typical 100 kW system holding about 50 collectors, is summarized in the following table. The calculation assumes offsets from a 75% efficient sealed combustion/non-condensing hot water heater or about 13,800 m^3 of natural gas and a cost of $0.24 per m^3 of natural gas.

Table 12: Example of performance and costs for a glazed solar array

Metrics for a typical 10 kW Solar Thermal System	
System Size (kW)	100
Space Required (sq. m)	1,500
System Cost ($)	$150,000
Estimated Annual Generation (ekWh)	110, 000
Annual Cost of Generation ($/ekWh)	$1.36
Maintenance Cost ($)	$30
Natural Gas Savings ($)	$3,312
Annual GHG Offset (tCO2e)	26.08

Given this is a fuel offset technology, the cost and efficiency of the base building hot water heating system needs to be well understood. These range seasonally from a low of about 60% for atmospheric hot water heaters to close to 95% for well-designed condensing hot water heaters. Some pump replacement and piping repair can also be expected. Systems that use an anti-freeze (i.e., polypropylene mixture) will need to be checked each year and refreshed/topped up.

When these systems do not have sufficient hot water loads/storage, the glycol mixture can degrade and require replacement more often (~5-7 years). For an outdoor swimming pool system, the numbers would be much better given the installation and component costs are lower than glazed modules and do not require anti-freeze mixtures.

7.6 Energy Modelling

Commercial grade software can estimate the energy generation to about 95% accuracy. This is similar to the accuracy limits of weather data measurements (ekWh/yr. of insolation) which is limited by satellite readings' accuracy in the absence of local weather station data. Note also that year to year weather variations can result in production swings of about 5-10%. F-Chart, T-Sol are good examples of well proven commercial software. As with PV energy estimating, the output is only as good as the person using the software and needs to have a good understanding of the tool for accurate interpretation. Note that RETScreen is not recommended as a final estimating tool it cannot capture temperature variations properly and does not model the ancillary equipment to the detail needed to make investment grade decisions. It is used for early estimations and comparison of a wide range of technologies.

Solar hot water systems provide energy year-round. They do not supply as much during the winter (vacuum tube are better than flat glazed panels for cold weather use). One performance metric is the annual solar fraction. This represents the amount of solar heat provided divided by the annual hot water demand. I.e., the solar fraction can be as high as 80% during the summertime but will drop to 15% in the winter. The annual fraction will be around 25-30%. A higher solar fraction requires a larger array though over-sizing for the summer is to be avoided. A commercial fraction of around 30% is considered a good metric to design for with a DHW load scenario.

7.7 Procurement

Given there are not as many solar thermal installers to select from, the procurement process should include pre-qualification. It is recommended to retain a specialist firm to generate the design and tender documents, and have a very clear method of choosing between potential design-build solar thermal firms based on previous experience with follow up to past projects as a part of the evaluation. It is recommended the vendor provide training to staff on the operation of the system and how to determine if it is not performing properly.

7.8 Barriers to Implementation

As with PV, the roof structure is the most important criteria. Some roof contractors may not maintain a roof warranty if it has been recently upgraded or replaced. There are not many experienced solar thermal installation companies that can develop large scale system applications. Mechanical permits and final sign off are required and local inspectors may not be familiar with the unique details for a solar hot water system. This lack of understanding can lead to improper plumbing requirements that can significantly impact the performance. It is very important to ensure that maintenance staff are well trained on the system's operation and functionality. Entering a long-term maintenance contract with a reputable company is recommended.

7.9 Current/ Future Implementation in Municipalities & Equivalent Organizations

There are a few examples across the Greater Toronto Area:

- The City of Mississauga has installed solar thermal at its Lions Club of Credit Valley outdoor pool.
- The City of Toronto has many solar thermal systems at many pools, the Toronto Zoo, cooperatives, and a fire hall.
- The central YMCA in Toronto has solar pool heaters on its indoor pool.
- University of Toronto, St. George has a large flat panel and three vacuum tube systems to support the athletic centre and ice rink DHW loads.
- The Town of Richmond Hill has two solar thermal systems serving indoor pools at its community centres.
- The Town of Okotoks has a very well-known geo-solar system whereby solar thermal is used as an additional heat source feeding into a geo-exchange system for a sub-division. In 2015, 100% of the required heating energy came from the sun (source: https://www.dlsc.ca/)

7.10 Strategic Direction

Solar hot water reduces natural gas use directly. When there are annual hot water loads such as in pools, community centres, long term care, athletic centres, and operations facilities, solar hot water systems should be considered to supplement the conventional heating plants. The temperatures delivered are best suited for process laundry, truck/bus washing, and DHW loads. It is also a good match for supporting geoexchange and DES applications.

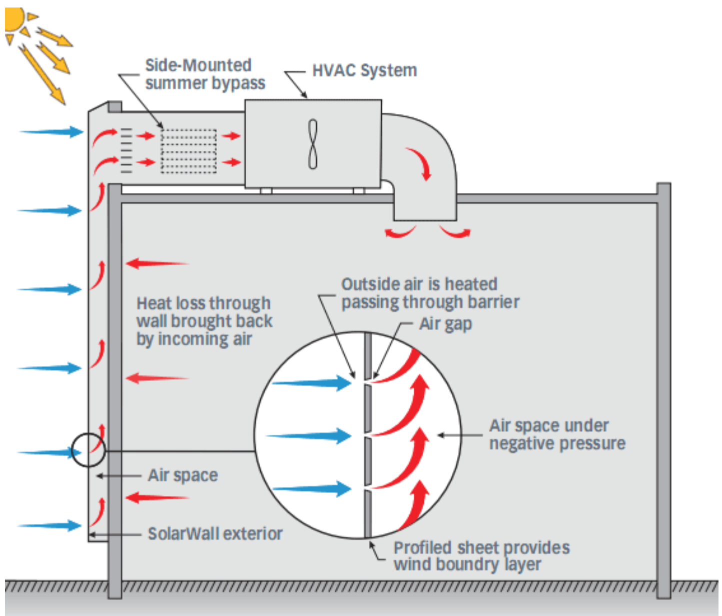
Blackstone recommends encouraging the evaluation of solar hot water applications for any new building or renovation where process hot water is required year-round. The aim is to get a minimum solar fraction of 30% should be targeted. Consider making new buildings with “solar ready” capacity with plumbing (and electrical) chases from the roof to the mechanical rooms.

Solar hot water systems are recommended for on-going consideration.

8 Solar Thermal Air

8.1 Product Background

Solar thermal air heating is often referred to by a trade name – Solarwall – owned by Conserval, a well-known Ontario manufacturer of solar air collectors. These are passive, panelized solar collectors that are connected to the outside air intake of existing air handling or make up air units, usually vertically mounted on a south facing wall.



(Source: Schematic layout – Conserval)

Figure 23: Typical solar air heating arrangement. Note that these pre-heat the air used in ventilation.

The collectors are known as transpired air collectors and are simply a dark coloured (they now offer a wide range of colours), perforated cladding material that is mounted onto an existing façade. Air is drawn through small holes in the cladding via the existing HVAC fan. When the sun shines, the dark metal heats up that air, providing pre-heating to the ventilation air.

This is also available as a roof-mounted product – rows of low-sloped collectors are ballasted and ducted into the air intake.

Control of a bypass damper prevents the system from operating during the summertime. Performance estimations are typically done by Conserval. RETScreen does have solar air heating capability which is sufficient enough for early assessments and to give an indication of the required area to make an impact.

Suitable HVAC Systems

The product is ideally suited for 100% make up air units, as might be found on a maintenance garage, community centres with large air handling units or long-term care facilities. They are connected to the fresh air intake of an air handling unit and offset pre-heating of the air and in some circumstances supplies all required heating.

Seasonal Operations & Orientation

This is a heating season-only product. Theoretically a domestic hot water pre-heat could make use of the warmed air in the summer but is not common practice. As the sun is concentrated to the south much more so than in the summer, it is important that a systems orientation is facing close to due south. The economics favour applications with 7 day/week operations and high fresh air loads. There is little maintenance required for the panels themselves.

Figure 25: Typical wall-mounted installation

Figure 24: Typical roof-mounted installation

8.2 Market Overview

Like solar thermal hot water, the number of installations has been dependent on natural gas prices and government incentive programs. While economics are more favourable for solar air, it tends to be a longer-term investment proposition. Solar air pre-heating is popular in the agriculture sector in Quebec where there are a couple of manufacturers. Ontario is limited to a single supplier (Conserval) who have been active in the market for decades. They support the design services for the consultants selected.

The industry separates out collector product supply and installation services, although suppliers tend to be involved in sizing and design questions. On the installation side there are firms who do work regularly with the product and given it's essentially a cladding layer added to the outside of the building and then connected via ductwork to an existing air system, there is little concern about the ability of an installer to work with the product. As the system is either wall or roof mounted, a structural engineering review is required. The wall mounted system connects to structural components, not just to the existing cladding material.

8.3 Application to Building Portfolio/Grid Connectivity

Locations with 100% Make-Up-Air

The system is suitable to any location where there is a 100% make up air system, particularly those that operate 7 days/week. These work best on a clear south-facing wall. It is possible to install an array on a flat roof area where the air heating loads justify the application. Maintenance garages, such as the Transit Centre, are typically good locations as would be facilities with 100% outside air loads. Lately, consideration is being given for use to upgrade the envelope and increase insulation levels while adding solar heat where loads can be connected.

Metering

This is not typically part of a solar air pre-heat system. However, a flow station and temperature sensors would allow energy calculations to be made and recommended as a commissioning step as a minimum to certify operation and savings potential.

8.4 Application as Retrofit vs. New Construction/Major Renovation

Solar air pre-heat can work in either application. Any project with large outside air loads and looking to get close to net zero should consider solar air, given the ability to offset gas heating of make-up air.

8.5 Economics

The systems' efficiency ranges from approximately 30-65%, depending on the outside temperatures and windspeeds, both of which increase heat loss. Seasonal efficiencies are likely to be closer to 35%. The costs and generation information for a typical 100 kW system holding about 50 collectors, is shown in the table below. The calculation assumes an 80% efficient make up air unit and $0.24/m^3 of natural gas. This equates to about 9,600 m^3 of gas saved per annum. The estimated costing is ~$350/m^2 of installed surface area.

Table 13: Example of solar wall air pre-heat system cost and performance

Metrics for a typical Solar Wall System	
Space Required (sq. ft)	2,500
System Cost ($)	$87,500
Estimated Annual Generation (ekWh)	90, 000
Annual Cost of Generation ($/ekWh)	$0.97
Maintenance Cost ($)	N/A
Natural Gas Savings ($)	$2,304
Annual GHG Offset (tCO_2e)	18.14

Given this is a fuel offset technology, the cost and efficiency of the base building ventilation heating system needs to be assessed. A gas-fired make up air unit is usually around 60-80% efficient depending on the age (lower efficiencies favour the use of solar air systems). As this is a passive system, maintenance costs are zero to low annually. The summer switch-over damper would need to be checked to make sure its functioning and sealing properly.

8.6 Energy Modelling

The only modeling software used is RETScreen. Its accuracy is expected to be 80-90% accurate. The vendor has experience predicting the performance and should be retained for a complete evaluation.

8.7 Procurement

A design phase should involve working closely with a manufacturer to understand sizing and location constraints. A structural engineer will be required to confirm suitability, while the existing make up air unit will also need review to make sure its fan has sufficient pressure to overcome the additional losses through the wall. A competent general contractor should be able to work with this product. However, it may make sense to have an invited bid process with contractor names based on prior product experience or a list sourced from the product supplier.

8.8 Barriers to Implementation

Procurement process needs to be thought through carefully given there are not many suppliers (one in Ontario). As with the other solar arrays, structural capacity needs to be done early to make sure the system can be installed without undue costs. The application is on the exterior of the walls and changes the colour and “look” of the wall. Given the product’s very long-life cycle, this should be a consideration when reviewing project economics.

8.9 Current/ Future Implementation in Municipalities & Equivalent Organizations

There are a few examples of this in the Greater Toronto Area:

- The CANMET building at McMaster University was constructed with a solar air pre-heat system.
- The Peel Regional paramedic service station was also constructed with a solar air pre-heat system.
- Apartment building, south wall, ~25 stories tall – near Parliament and Queen St.

8.10 Strategic Direction

Solar thermal air systems are more often mounted onto vertical walls and where there are outside air heating loads. The opportunities in The Town may be present at existing sports and operations facilities where there are large SE to SW facing walls. As these systems pre-heat air, they are best suited for locations with high winter outside air heating loads. Review sites with outside air heating loads and access to vertical walls with rooftop air distribution systems. An estimated performance can be calculated and reviewed for carbon and natural gas benefits. Solar thermal air systems should be considered where outside air is required and must be pre-heated.

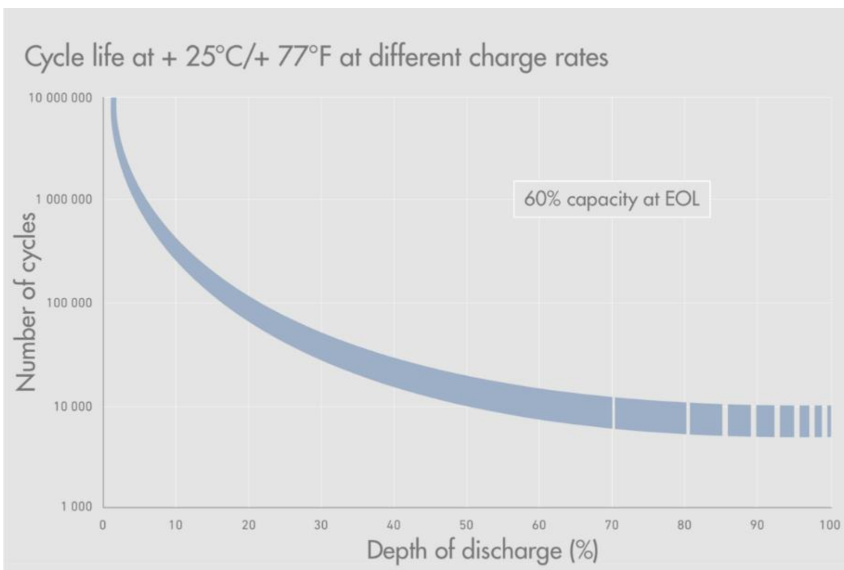
9 Energy Storage

9.1 Product Background

This section will focus on electricity storage using battery technology. While there are a number of competing technologies for the electricity energy storage sector, including aqueous chemical flow batteries and nickel metal hydride or lead acid solid batteries, lithium-ion (Li-ion) batteries have rapidly become the default technology choice.

Li-ion batteries would be connected to the main electrical feed and switchgear coming into a building and so proximity to that location will limit costs. The batteries themselves do require a thermally stable environment, so a ventilated indoor environment is ideal. Fire suppression is also a requirement. There are also containerized systems that can be installed outside with appropriate HVAC. The overall storage capacity – measured in kWh – will decline on a well understood degradation curve over time, based purely on the number of charge and discharge cycles. The following image shows a Li-ion battery with a defined End Of Life when the battery can only store 60% of its original capacity and is reached after 10,000 charge/discharge cycles, or 27 years with a single charge/discharge cycle per year.

Given the massive interest and investment in the battery sector, costs have dropped significantly while energy density (kWh stored per kg of battery) has improved. Batteries are not 100% efficient. That is, energy is lost on both the charge and the discharge cycle, with losses in the 10-15% range. These design factors are well understood and would be taken into consideration.



Cycle life depends on both depth of discharge (DOD) and charging rates. The above results are based on testing at a fixed DOD and varying charging rates. The end of life (EOL) is reached when the remaining capacity is 60% of the initial capacity.

Source – SAFT

Figure 26: Performance example of commercial batteries showing life cycle due to discharge use

kW vs. kWh

A battery stores power (kW_{DC}) and energy (kWh_{DC}) as direct current (DC) compared to the power and energy used from the grid which is alternating current (AC). As with solar photo-voltaic, an inverter is required to convert the DC to alternating current (AC) to enable grid connection and use. The peak kW capacity of the system is defined by the inverter and defines the grid power reduction such as in demand reduction applications. The kWh factor defines how long the system will displace power (and energy).

A large capacity battery can discharge its stored energy (kWh) over a short time-period with a high resulting kW output, or a low kW output over a long period of time. Each has applications depending on the desired benefit.

The first application uses the battery to reduce the kW at certain times during the day and avoid power peaks with savings when demand reduction is rewarded. This typically requires a relationship with the LDC who want certain peaks to be avoided each year. The second application, large kWh storage, offers energy shedding during expensive electrical rate periods, typically late in the afternoons. It also offers a resiliency option to provide energy at a site that can be used as a "safe haven" site during power outages.

9.2 Market Overview

Stationary Batteries

The Li-ion battery market has been led by the growing electric vehicle industry and increasingly in utility grid applications. Stationary batteries typically provide a range of electrical grid support services:

- Short term grid support: voltage and frequency support for when a grid becomes unstable due to variance in supply and demand. This is measured in <15-minute intervals.
- Peaking grid support: batteries store power off peak and reinject that power into the grid for a fixed number of hours to meet peak grid demand – for example on a very hot or cold day. This would be measured in hours – typically less than 6 hours per occasion.
- Uninterrupted power supply (UPS) or back-up generators – batteries provide emergency power supply for short or long periods of time, replacing diesel-fired emergency generators.
- Grid services are independent of the building sector and driven by local utility or grid needs. They are often paid-for services and this is a trend that is expected to increase with the electrification of both transportation and heating. Several systems have been installed in Ontario as part of government-driven procurement processes.

Vehicle-To-Grid Technologies (V2G)

Their batteries store power and can be use by providing power to the EV. However, cars sit idle for most of the day. What if that "idle" power could also be used to help meet peak power loads like a large-scale battery does? An electric vehicle connected to the grid can act as an energy storage system, provided the inverter within the car is capable of two-way power flow. As a result, the same services detailed above can be provided by electric vehicles connected to an EV charging station with appropriate controls and signaling systems in place. This concept is called Vehicle-to-Grid (V2G) and all auto manufacturers are beginning to incorporate the concept into their EV designs.

Blackstone believes strongly in this opportunity and is working with Natural Resources Canada to work on the transaction elements that will be required to turn this concept into a reality. Starting later this year, Blackstone and members of its client base will be hosting "near-commercial", V2G demonstration projects.

This is expected to increase as parking lot EV combined with PV arrays grows and should be a consideration for The Town as they develop communities.

9.3 Application to Building Portfolio / Grid Connectivity

Large Buildings

To take advantage of demand reduction programs, the facility needs to classify as Class A for the Global Adjustment. This would have to be assessed for any large facilities to understand whether a demand reduction (DR) program can be applied. The batteries are charged during the evening and discharged during peak hours typically late in the afternoon. Combining PV and batteries can be combined and used as a DR program. Though as mentioned above, it currently does not make a good business case unless the site is a Class A location. The combination of costs suggests a PV array would be better as a net meter application and reduce the energy. Combining PV and batteries at a "safe haven" centre ensures there is power/energy available when power is shut down.

Time of Use Rates

While in theory a battery could store energy off peak (at night) then discharge into the building during peak rate hours, there is currently no economic case for this in Ontario. The rate structures will increase with time making this an option at some point. A study of what the economics and rate structure is should be completed before this is considered.

Demand Charge Avoidance

Again, there is no economic case for using batteries to limit monthly kW peak charges unless the facility can be classified as Class A for global adjustment.

Back Up Generation

These would work well for any of The Town's buildings. However, given the small quantities of diesel ever consumed there would be no economic case for this. It is also suspected that the overall carbon impact of diesel used within generators is negligible in terms of The Town's carbon footprint. This concept would best be considered for new developments where near to net zero carbon designs are being pursued. This is also a consideration for "safe haven" designs as a resiliency measure, typically in community centres.

9.4 Application as Retrofit vs. New Construction/Major Renovations

Installation in a new building would be straightforward as the electrical rooms can be designed to accommodate. For retrofits, the only requirement would be sufficient space in a ventilated interior location, or space for a ground-mounted container within a reasonable distance to the main electrical room. The battery room usually requires approvals from the Fire Marshall and a fire suppression system installed.

9.5 Economics

An economic case for batteries requires a more detailed evaluation. The application determines the economic performance. If it is to be for demand reduction, the local distribution company may sign an agreement to bring the battery online when there is a grid peak. This only applies for Class A facilities. These can have good returns with paybacks under 5 years in some cases. The LDC will require a connection impact assessment and follow many of the rules for a grid connected renewable system.

9.6 Carbon Offset Potential

Minimal, and large levels only for offsetting emergency diesel generators. If they are used to offset peak hours during the day, they offset the marginal emissions for the grid during those hours which unfortunately is not accounted. Some jurisdictions are using batteries to shift the "grid duck curve" while solar energy systems wind down at the end of the day. These tend to be in areas where the electricity rates are much higher than those in Oakville.

9.7 Energy Generation Potential

No energy is generated – it is stored. They are increasingly combined with solar PV and wind energy systems. The capacity to shift the energy loads during the day is based on the power and stored electricity (kW and kWh). A load shifting system will require high kWh capacity to displace electricity for a long period, i.e., 3 -4 hours. A peak reduction battery will need high kW to offset the power during the expensive peak periods but only for an hour or so.

9.8 Energy modeling

Energy aspects of battery operation are well understood and easily modeled by vendors and a good selection of consultants. The analysis takes into consideration the operation of the batteries – are they for peak reduction and so not called upon very often or for load shedding and shifting the “duck curve” during expensive electricity times. The performance and life of the battery system will depend on the cycles of operation each year.

9.9 Procurement

This is a small but growing market in Ontario. Utilities are driving the market of large-scale systems. However, design-build contractors are available, while the consulting community would not have difficulty in integrating batteries into an electrical design.

9.10 Barriers to Implementation

Significant co-ordination with the utility would be required. Space for the batteries is required and they are heavy. Utilities and their inspectors are gradually getting familiar with the applications. The financing does not favour batteries (or PV combined with batteries) unless the facility is Class A for global adjustment. Rates are not sufficiently high yet to warrant shifting energy loads during peak periods. A net metered PV array would be a better investment for the foreseeable future.

9.11 Current/Future Implementation in Municipalities & Equivalent Organizations

Any project involving a large government or other entity would be driven purely by the grid situation in that specific location. When there is an opportunity to participate in a demand reduction program, batteries can be considered. They are a good choice for resiliency planning at community centres.

9.12 Strategic Direction

Consideration for batteries should first be given a “safe haven” system, for example, in community centres. They can be used there as peak shedding during the year to offset expensive time of day rates where applicable.

Battery technology and the controls for integration into the buildings and grid are improving rapidly. The costs are also dropping making batteries a reasonable energy system to reduce costs during peaks as well as avoid marginal emissions when the grid is carrying gas fired peaker plant power.

Recommendation is to consider battery storage for peak shedding and possible demand reduction schemes in new buildings. Consider for use in buildings with high demand periods and develop a demand reduction plan to capture the grid peak times each year. Consideration for “safe haven” application is recommended.

10 Wind Turbines

10.1 Market Overview

Small Wind

Small wind has been around for many years, both building, ground and tower mounted, mostly for remote sites where the grid is not readily available. Lately there has been an increased use with PV and batteries on parking and street lighting poles which removes the need for electrical grid connections. There are a wide range of suppliers for small turbines. The nature of wind energy and the small profile of these turbines is such that they need high wind speeds to generate consistently.

There are two basic configurations – horizontal and vertical axis turbines. Each have their benefits and considerations when deciding which to use. In both cases the annual wind speed is the determining factor with an average > 5m/sec usually required. The length of the blades is another factor in determining the amount of electricity a wind turbine can generate. Small wind turbines that can power a single home may have an electricity generating capacity of 10 kilowatts (kW). The largest wind turbines in operation have electricity generating capacities of up to 10,000 kW, and larger turbines are in development.

Source: https://www.anthropocenemagazine.org/2017/03/new-model-could-help-make-vertical-wind-turbine-farms-practical/
http://emag.directindustry.com/ai-inspection-routines-siemens-gamesa-fujitsu/

Figure 27: Examples of a large horizontal axis wind turbine (left) and vertical axis turbine (right)

Horizontal-axis turbines have blades like airplane propellers, and they commonly have three blades. The largest horizontal-axis turbines are as tall as 20-story buildings and have blades more than 100 feet long. Taller turbines with longer blades generate more electricity. Nearly all the wind turbines currently in use are horizontal-axis turbines. Horizontal axis turbines prefer steady winds from one direction.

Vertical-axis ("eggbeaters") turbines have blades that are attached to the top and the bottom of a vertical rotor. They can operate in winds that come from a variety of directions relatively easily. Small scale applications are typically less than 10kW. Some versions of the vertical-axis turbine are 100 feet tall and 50 feet wide. Very few vertical-axis wind turbines are in use today because they do not perform as well as horizontal-axis turbines.

Past experiences point out that an existing building rarely has the structural capability to retrofit a roof or structure mounted system. The main issue, other than large loads is vibration which can be transmitted through the building and difficult to remedy. In some designs, the turbines are integrated into the structure as illustrated in the picture below. This requires significant pre-planning and structural design to accommodate. The elevation of the turbines puts them into higher wind regimes.

Figure 28: Example of building integrated wind turbine.

Utility Scale Wind

Large (>150kW) turbines have increased in capacity and performance significantly over the last 10 years with a few large-scale manufacturers installing very large (>2MW) systems around the world in utility scale arrangements. They require a complex connection process to the grid, with significant planning, grid connection and public acceptance concerns.

While The Town's location on the shore of Lake Ontario provides good quality wind resources and likely very good project economics, there are significant public concerns around the use of wind energy in or close to urban settings. Exporting excess power to the grid would provide an opportunity to generate carbon offsets for existing natural gas-associated emissions. Large turbines must connect to the grid directly rather than to a building's electrical system.

Both large and small wind energy systems could be considered for new developments with sufficient setbacks, but this would likely run up against public push-back. At some point virtual power production (VPP) may become possible and The Town could then consider purchasing or partnering in a large-scale wind turbine farm outside of the community.

At this time, the small turbines mentioned above for use on parking and road streetlights (LED) are a good example of wind energy suitable for urban application. It has the benefit of showcasing renewable energy use within the community at a scale that does not cause much concern. They can be installed without connection to the grid saving trench and cabling costs. They are capable of being monitored remotely to track energy generated and avoid down time when repairs are required.

An example of such a system is the Sanya Skypump system. It harnesses the power of the wind and sun to charge EVs. Developed by Urban Green Energy and GE Energy Industrial Solutions, the Skypump utilizes a UGE-4K wind turbine harnesses wind power, while solar panels on the Skypump's roof generate electricity from the sun's rays. The combined energy produced by the wind turbine and solar array is enough to significantly offset the charging station's electricity use. At lower wind speeds, or higher level 2 charging loads, it can be connected to the grid to pull additional energy as required.

(Source: http://www.apsglobalcorporation.com/sanya-skypump.html)
Figure 29: Example of a stand-alone vertical axis wind generation system for a parking light.

10.2 Application to Building Portfolio/Grid Connectivity

Wind energy systems are not recommended for installation onto buildings. The structural and vibration issues cannot be overcome easily or inexpensively. There are systems that can be built into the structure of a new building but not in many sites. There are small systems that power street or parking lights that might be applicable and used typically for awareness of renewable energy for the most part. In some situations where access to grid power is not available and wind powered lighting system can be warranted.

The Town may be able to participate in a virtual power plant venture where they invest in a remote wind farm to partner in a long-term power purchase agreement to offset their conventional grid purchases and collect the carbon credits. Though The Town sits on the shore of Lake Ontario, installing turbines in the Lake or close to urban centres would be unlikely.

10.3 Application as Retrofit vs. New Construction/Major Renovation

As mentioned above, attaching a small wind energy system to an existing building is not recommended. In new construction they can be incorporated into the structure but again, concern for vibration will make the costs for the system high and not easily justified.

Wind turbines work efficiently in winds that are free from disturbances from urban structures. Retrofitting a wind turbine amongst buildings will not operate efficiently.

10.4 Economics

The economics for large scale wind turbine applications are favourable over long term agreements or power purchase agreements (PPAs). Large wind farms are required to take advantage of scale and the amount of generation needed to make the low cost of electricity possible. Small systems will not be favourable when compared to small photovoltaics for loads such as remote lighting.

10.5 Carbon Offset Potential

Wind energy systems displace electricity and so reduce the carbon according to the current emissions factors for the grid. Large scale farms generate the levels of electricity to cause significant carbon emissions reductions.

10.6 Energy Generation Potential

The average winds in Oakville, close to the Lake are about 15-18 km/hr (4-6 m/s) between October and April. These averages will be found above 30 m and where there are few buildings. Wind turbines require average speeds above >6 m/s typically before they can start to generate power at a reasonable level. The higher the turbine hub is above the ground, the more power available in the winds and less turbulence from the urban buildings. The power produced is related to the third power of the wind speed – for a doubling of the wind there is an eight-fold increase in the power. For example, a 600kW wind turbine (45m diameter at 50m hub height) starts to produce power at 5m/s but only 45kW. It only reaches the nameplate power when the wind is at 14 m/s (about 55-60 km/hr). The wind turbine near the CNE in Toronto is ~600 kW and produces about 1,200,000 kWh/yr.

10.7 Energy Modelling

Wind energy modelling should be completed by an experienced engineer conversant with wind system performance. There are many variables that an experienced modeler needs to understand before an accurate estimate of performance can be completed.

10.8 Procurement

There are several wind energy system providers for a large range of generation capacities. A specialist should be retained to estimate the performance, propose a system type, prepare the specifications, and oversee the request for proposals as well as to review the responses when selecting a vendor/installer. When selecting a consultant for the structural design, a team familiar with wind energy systems should be hired.

If a wind system is being considered, begin connection impact and environmental studies early and retain experts in these fields.

10.9 Barriers to Implementation

Public pushback has been strong against wind turbines in most jurisdictions. Other than a virtual power plant arrangement a wind turbine close to The Town is not likely to be received well by the public. As with any other renewable energy system, the generated power would be injected into the grid or building as net metered energy and require the same connection impact studies. An environmental impact study would also be required. The turbines will need specialized staff to operate and maintain them.

10.10 Current/ Future Implementation in Municipalities & Equivalent Organizations

The opportunity for The Town is to partner with a virtual power plant operation where a power purchase agreement is in place, typically for 20+ years.

10.11 Strategic Direction

Wind energy can be either active or passive. Active wind energy capture using a turbine is not applicable within The Town but may be possible through a virtual power plant and PPA. Small turbines such as used for remote lighting standards are possible though likely not as efficient as a small PV system.

Passive use of wind through design is recommended to assist with ventilation and directing to prevent uncomfortable wind tunnels and snow build up. We recommend a wind study be completed for new buildings to ensure passive wind energy is being used to benefit energy and comfort.

Wind energy is not recommended for urban applications other than small scale, stand-alone systems. Consideration for a partnership in a VPP should be investigated.

Net Metering and Virtual Power Plants

Rooftop and on-site ground mount PV (such as car port systems) will typically be connected to the local grid through a "net meter". This means the power generated is used within the facility only. The recommendation for a PV fraction (as shown in the table above) would be net metered. This connection format is standard with the local utility. A recommendation for future electricity generating applications, at the urban scale level, is to be net metered. A follow up consideration that may become possible for the Corporation are "virtual power plants" (VPP). These are RE systems that are not on or not close to The Town with the output allowed to offset the energy delivered to The Town from the grid. For example, The Town could participate in a large PV or wind facility many kilometers away. A VPP would generate the electricity and inject the power into the transmission or distribution grid and be considered as an energy used within The Town. This concept has been considered for a few years in many jurisdictions though usually not possible due to the architecture of the grids – the power cannot be shipped from where the generation sites are to the region it is needed. That and a robust accounting process has yet to be developed. It is recommended The Town maintain awareness of this concept through discussions with the local distribution company and their peers in other jurisdictions and relevant associations.

Suggested Policy Considerations:

1. Develop net metering ready standards for new construction and large renovations, i.e., room for electrical equipment, sub-meters, junction boxes, etc.
2. Participate with industry and municipal associations for VPP updates and lobbying

Appendix A: RE Technology Rubric

In this section, we have consolidated the technologies reviewed in the study and have formulated a rubric to showcase the implementation potential relative to Oakville's corporate portfolio. The rubric contains two matrices – the Technology Assessment Matrix and the Applicability Matrix.

The Technology Assessment Matrix evaluates and ranks the RE options based on the following metrics:

- ✓ Market performance
- ✓ Applicability for Oakville
- ✓ Ease of procurement
- ✓ Carbon offset potential
- ✓ Energy generation Potential
- ✓ Ease of modelling & engineering
- ✓ Implementation barriers

The Applicability Matrix evaluates and ranks the RE options based on their relevance and feasibility to The Town's corporate building archetypes and to the larger Oakville community:

- ✓ Non-building application
- ✓ Administration and Office buildings
- ✓ Community Centres
- ✓ Indoor Arenas
- ✓ Transit Facilities
- ✓ Fire Halls
- ✓ Other Buildings

Table Methodology

Scale

0 – 3: be aware of this negative impact
4 – 6: worthy of consideration if other factors are more positive
7 – 10: should be a significant driver for reviewing potential for use

Economics Methodology

<= 5 is more expensive than the base case
>=5 is cheaper than the base case

Energy Generation Methodology

- No mark given for technologies not generating additional energy e.g. biofuel
- For direct energy generation projects e.g. solar, ranked based on useful energy generation potential and energy efficiency. 10 >= 100% energy conversion.

Carbon Offset Methodology

- For substitution technologies, score based on % reduction per technology
- For energy generation e.g. solar, score based on cost per tonne generated per $ invested over life cycle ($50 per tonne base case = 10)

Technology Assessment Matrix

	Market	Portfolio Application	Economics	Carbon Offset%	Energy Generation&	Modelling	Procurement	Implementation Barriers+	TOTAL	RANK
Solar Photovoltaic	9	9	10	6	7	9	8	8	8	1
Solar Thermal Water	8	7	6	7	8	8	8	8	8	2
Air Source Heat Pumps	7	8	5	7	2	7	7	8	6	3
Solar Thermal Air	7	6	5	4	5	8	8	5	6	4
District Energy Systems*	7	3	5	8	2	7	8	5	6	5
District Energy Heat Pump Based System@	7	3	5	8	2	5	7	4	5	6
Geo-Exchange Heat Pump Systems	5	7	2	6	2	8	6	4	5	7
Wind Energy	5	3	5	4	4	6	6	6	5	8
Bio-Energy	6	6	5	4	0	6	5	5	5	9
Energy Storage	4	2	1	1	0	5	5	4	3	10
Hydrogen & Fuel Cells	1	0	0	0	0	2	1	0	1	11

* Assumes conventional gas boiler/electric chiller system

@ Assumes electrically driven heat pumps connected to a geo-exchange borehole system

+ A high mark means low barriers to implementation

& Note that heat pumps require significant energy input but convert that to heat with efficiencies >200%

% Solar Photovoltaic can offset peak electricity emissions which have a much higher carbon intensity as compared to the average. Solar thermal assumes base fuel case of natural gas, else same applies.

Applicability Matrix

	Non-Building Application	Administration/ Office	Community Centres	Indoor Arenas	Transit Facilities	Fire Halls	Other Buildings	TOTAL	RANK
Solar Photovoltaic	7	8	9	9	9	8	6	8	1
District Energy Systems*	0	7	9	9	7	7	7	7	3
District Energy Heat Pump Based System	0	7	9	9	7	7	7	7	3
Air Source Heat Pumps	0	8	8	8	6	8	8	7	3
Solar Thermal Water	4	3	8	7	7	8	8	6	5
Geo-Exchange Heat Pump Systems	0	5	8	8	8	4	3	5	6
Solar Thermal Air	0	3	4	6	9	6	2	4	7
Energy Storage	0	4	6	5	5	1	2	3	8
Wind Energy	3	3	3	3	4	3	2	3	9
Bio-Energy	5	2	3	0	0	0	3	2	10
Hydrogen & Fuel Cells	0	0	0	0	2	0	0	0	11
Total									

* Assumes conventional gas boiler/electric chiller system

@ Assumes electrically driven heat pumps connected to a geo-exchange borehole system

APPENDIX E

Phase C: Strategic Visioning Workshop – March 2021

Renewable Energy Generation Strategy – Corporate

The Town of Oakville
September 2021

blackstone
energy services

Contents

Introduction

The Town of Oakville ("The Town") engaged Blackstone Energy Services ("Blackstone") to develop their Renewable Energy (RE) Generation Strategy for their corporate portfolio of buildings in the Fall of 2020. As part of this process, Blackstone held the Strategic Visioning Workshop ("Workshop") as a step toward realizing that strategy. This report serves as a summary for the events of the day.

The Workshop was held via Microsoft Teams Video Conference on Monday March 1, 2021 from 2:00 PM to 5:00 PM. The Workshop involved attendees from various departments from The Town as well as representatives from Blackstone.

The Workshop focused on informing The Town's stakeholders of the various Renewable Energy (RE) technologies studied and evaluated as part of the RE generation strategy, and the role RE technologies could play in realizing Oakville's vision to become "the most livable Town in Canada".

The Town of Oakville announced a climate emergency in June 2019. The Town also set short- and long-term goals to reduce corporate greenhouse gas (GHG) emissions by 30% from 2014[1] levels by 2030, and by 80% from 2014 levels by 2050. The Town has finalized various community-wide plans to foster climate action with corporate and community points of view. This Strategic Visioning Workshop ("Workshop") is a step toward realizing The Town's GHG reduction goals.

The Workshop aimed at shaping the future of RE generation at The Town. The engagement from key staff and stakeholders from The Town has ensured that Blackstone creates an RE generation strategy that supports the goal of making Oakville "the most livable Town in Canada".

The purpose of the Workshop was to inform The Town's Stakeholders of the findings and facts to support the development of The Town's RE Strategy and prioritize them based on collaborative discussions. This would help The Town address their "climate emergency" commitment and help to guide a plan and agenda for climate action.

The objectives for the Workshop were:

- To increase awareness & confidence in Renewable Energy (RE) Technologies
- To assess internal vision & direction for RE at The Town of Oakville
- To understand stakeholder views & priorities for RE projects
- To evaluate strengths, weaknesses, opportunities & threats (SWOT) for RE technologies
- To identify barriers for success
- To gain consensus to guide final strategy report

[1] A recommendation to change the baseline year to 2015 has been proposed to remove the impact of the Ontario grid turning off coal fired generation in 2014.

Workshop Attendees

The Town of Oakville

Table 1: Attendees from The Town

Dave Cano	Energy Solutions Manager (Facilities & Construction Management)
Nancy Sully	Commissioner, Corporate Services and Treasurer
Nick Valerio	Manager – Capital Projects (Facilities and Construction Management)
Rob Cameron	Manager – Facilities Operations (Facilities and Construction Management)
Julie Mitchell	Director – Recreation and Culture (Recreation and Culture)
Brent Copeland	Action Senior Manager Operations (Recreation and Culture)
Donna Hales	Manager – Climate Action (Climate Action)
Janis Olbina	Manager – Parks Planning and Development (Parks and Open Space)
Tom Mulvale	Acting Manager – Parks Operations (Parks and Open Space)
Joanne Phoenix	Manager – Fleet & Accessible Services (Oakville Transit)
GianCarlo Mirolla	Supervisor – Maintenance (Oakville Transit)
Alex Stinson	Project Leader – Mechanical (Facilities and Construction Management)
Gary Robinson	Project Leader – Electrical (Facilities and Construction Management)
Deniz Ergun	Research Policy Analyst (Climate Action)
Suma Abid	Environmental Energy Analyst (Facilities and Construction Management)
Kelly Livingstone	Planner (Planning Services)
Tricia Collingwood	Senior Planner – Current Planning – East District (Planning Services)
Amanda St. John	Sr. Economic Development Officer (Economic Development & Corporate Strategy)

Blackstone Energy Services

Table 2: Attendees from Blackstone

Tim Schneider	Vice President, Energy Solutions
Darlene Remlinger	Vice President, Communications
Paul Leitch	Director, Environmental Sustainability
Shashi Kiran Ravikumar	Energy & Sustainability Analyst
Sophia Hortsing-Perna	Project Management Coordinator

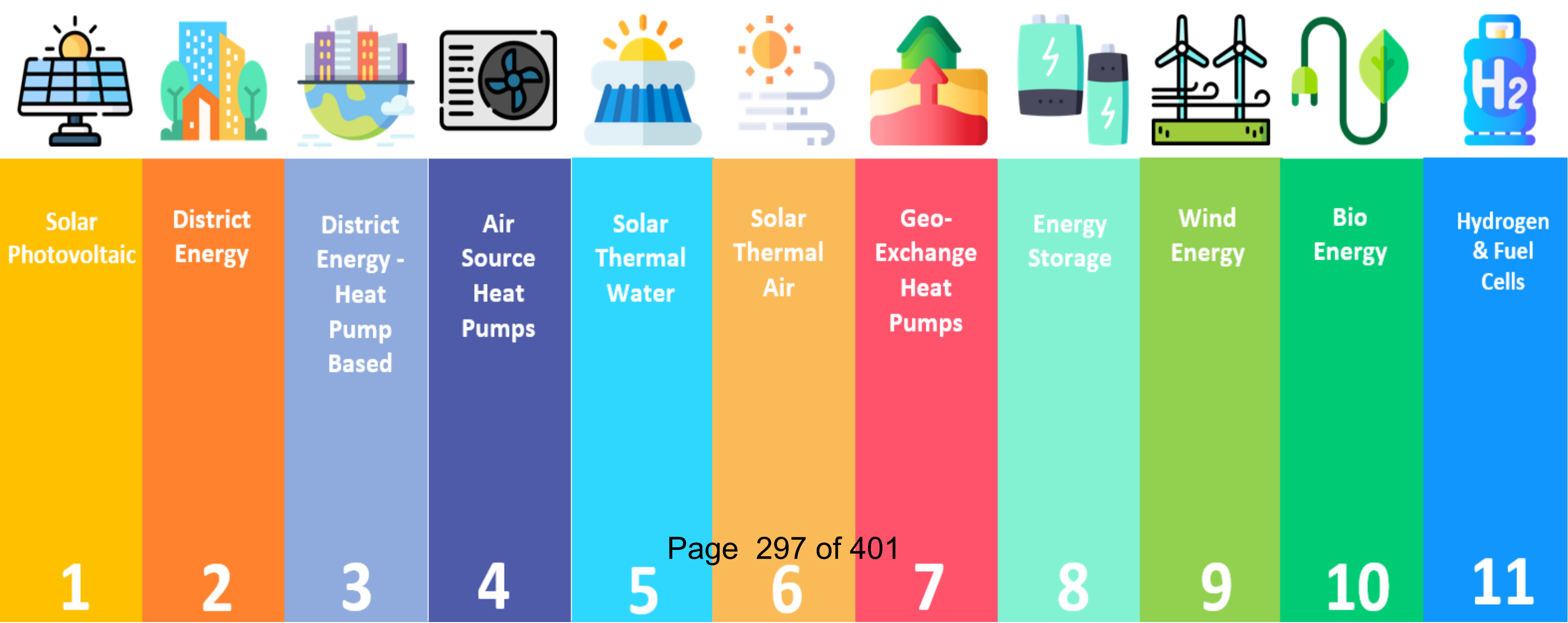
Workshop Synopsis

During the process of developing the RE Strategy and the Workshop, the Blackstone Team completed a detailed analysis of renewable energy technologies suitable for The Town, reviewed The Town's existing renewable energy systems installations, reviewed renewable energy technology applications in neighboring municipalities, analyzed the functionality and the specifications that result in successful implementations, developed project cost estimates and co-benefits of RE technologies, and identified barriers or risks for implementation.

A Pre-Workshop Package was sent to all attendees in advance of the Workshop. This package served as a reference that outlined details of the eleven (11) technologies being presented. For each technology Blackstone provided an applicability matrix ranking, background information, a strengths/weaknesses/opportunities/threats (SWOT) analysis, and a star ranking. Blackstone also analyzed the co-benefits of individual technologies and their role in strengthening The Town's four pillars of sustainability – economic sustainability, environmental sustainability, social sustainability, and cultural sustainability.

The following sections describe the various themes, technologies, and activities that were discussed and executed in the workshop.

Figure 1: RE Technologies Analyzed



Co-benefits of RE Generation

Human activity drives climate change via increased GHG emissions that cannot be absorbed by natural systems. Renewable energy generation can help limit the GHG emissions released into the atmosphere. RE deployment and GHG reduction will generate co-benefits that go beyond controlling climate change, such as:

- Improving The Town's urban environment
- Improving public health outcomes
- Reducing municipal operating & capital costs
- Supporting innovation
- Increased awareness

RE generation would also create co-benefits that can help strengthen The Town's four pillars of sustainability. This is illustrated in the figure below.

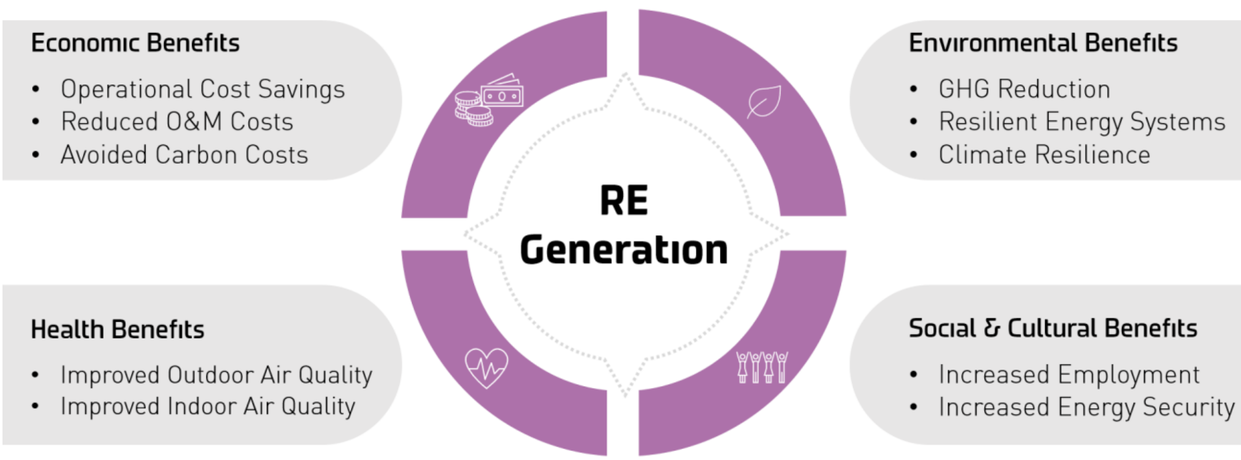


Figure 2: 4 Pillars of Sustainability

Social Cost of Carbon

Climate change can indirectly cost businesses, families, governments, and taxpayers millions of dollars each year through rising health care costs, increased food prices and increased insurance premiums. A metric used to quantify these costs, resulting from the harsh impacts of climate change is the Social Cost of Carbon (SCC). The SCC is the measure of economic harm resulting from climate change. It expressed as the dollar value of the total damages from emitting one ton of carbon dioxide into the atmosphere per year.

Environment and Climate Change Canada (ECCC) estimates the current SCC at $190/tCO2, expressed in 2012 dollars. This cost does not include the damages caused by extreme weather events and natural disasters induced by climate change. This is reflected in the carbon tax legislation, C12, where the cost of carbon is increased each year from 2021, resulting in $170/tonne in 2030.

The Town's Targets & Efforts to Date

The Town's targets were outlined to ensure that everyone as on the same page as what this strategy was working towards. The targets were pulled from The Town's 2019 Energy Conservation and Demand Management (ECDM) Plan, which include short and long term goals to reduce corporate greenhouse gas (GHG) emissions by 30% from 2014[1] levels by 2030, and by 80% from 2014[1] levels by 2050.

The Town has multiple energy conservation and RE efforts to date, including Solar PV and Ground Source Heat Pumps (GSHP) at multiple locations. The Town has made great strides in RE Technology and has many accomplishments to be proud of. It is great to see The Town on this journey and attempting to incorporate RE wherever possible. This workshop gave a deeper understanding of how the staff recognize and rank RE solutions based on current knowledge.

Renewables Energy in Municipalities

Blackstone analyzed the climate action plans from three surrounding Municipalities including Guelph, Milton, and the Region of Peel (Brampton, Mississauga, Caledon). It was found that establishing a municipal climate action plan involved setting strategy for Climate Change Adaptation and Climate Change Mitigation. Some strategies involved a combination of both (see figure below).

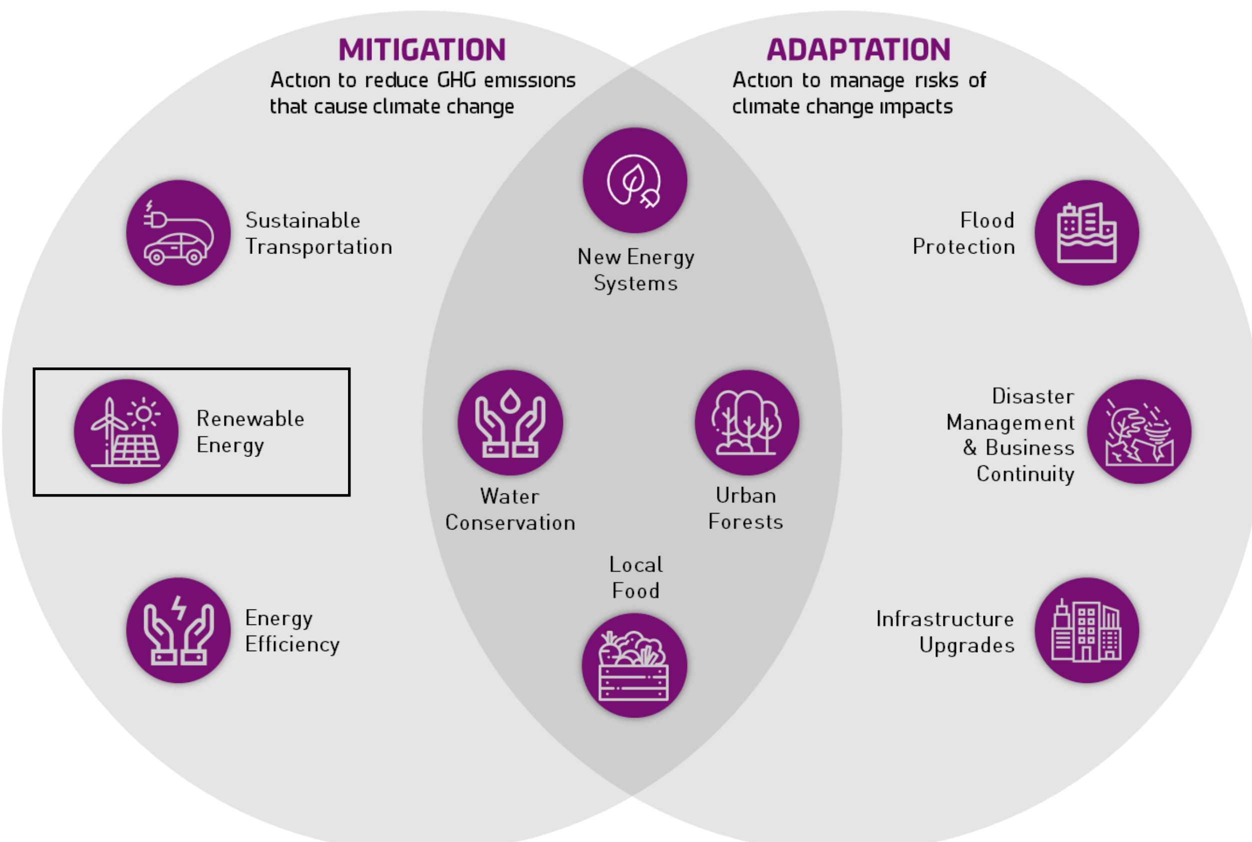


Figure 3:Municipal Climate Action Plan Strategies

Climate change adaptation is referred to the climate action taken to manage the risks of harsh climate change impacts. While climate change mitigation involves in climate action that aimed at reducing GHG emissions that caused climate change. The Workshop focused mainly on climate change mitigations as RE generation plays a crucial role in municipal GHG mitigation efforts and in GHG reduction.

It was found that The Town is in good company and is not alone is its journey through RE generation and to GHG mitigation. Two of the Cities (Brampton and Mississauga) have similar targets to The Town and all the municipalities are analyzing similar RE technologies and policies on their journey to reduce GHG emissions.

Renewable Energy Technologies Discussion

During this section of the Workshop, Blackstone invited the attendees to offer their comments and ask questions to foster a collaborative discussion surrounding all the RE technologies.

Each technology was assessed on its co-benefits and its potential to strengthen the four pillars of sustainability, as identified by The Town: economic, environmental, health, and social & cultural. A star rating was provided by Blackstone under various sub-categories, grouped under the four pillars (see image below). These ratings were then tallied to create an overall star ranking.

Figure 4: 4 Pillars categories

The RE technologies were also ranked according to a point-based evaluation, where the overall star rating for each technology was converted and scored out of a maximum of 55 points. This is illustrated in the image below.

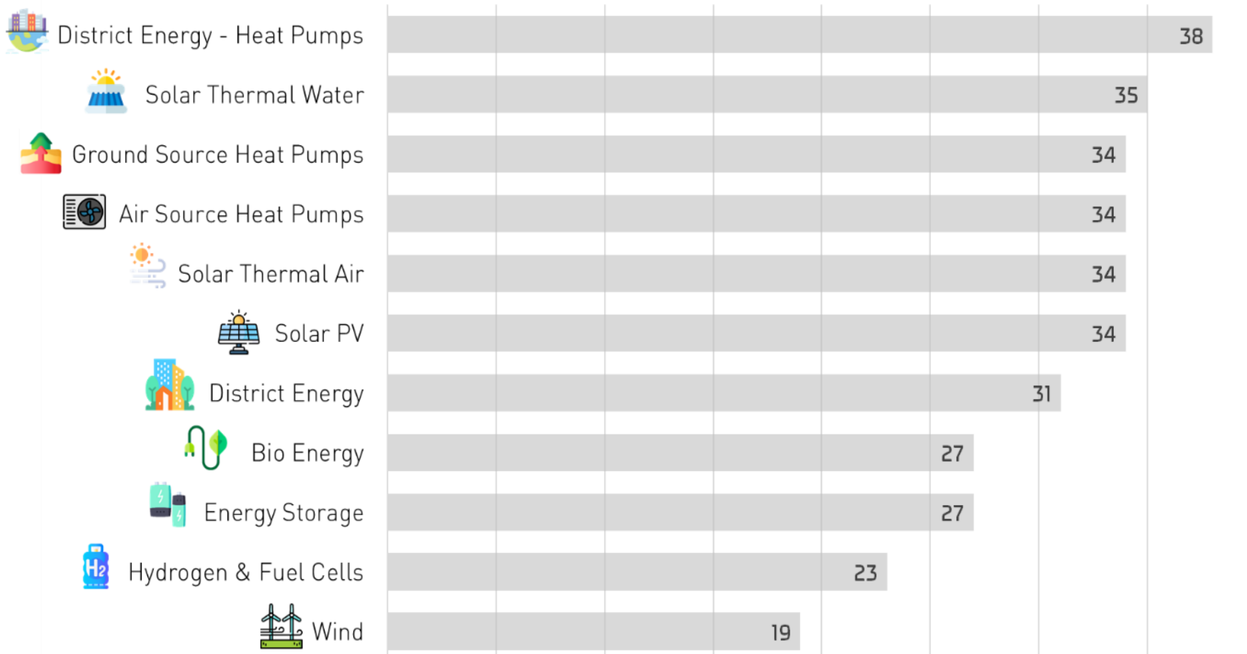


Figure 5: RE Technologies Ranking

This information was used as a guide to start the discussion and to get feedback from the stakeholders attending the Workshop. A “Questions and Answers” section outlining the items discussed is provided in Appendix 1.

Mural Voting Activity & Discussion

As part of the Workshop Blackstone conducted a voting activity using the collaborative "Mural" platform. This process took about 30 minutes and gave all attendees an opportunity to ask any additional questions, view the star ratings, and the SWOTs for each technology.

The goal of this activity was for the attendees to take the information presented to them, and rank the eleven technologies based on their understanding of the sustainability of RE for the overall strategy moving forward, and how these will fit in with The Town becoming the most livable Town in Canada.

Each attendee was given eleven votes, however, multiple votes were allowed per technology, so that if for example, Solar PV, was a priority for them they could place multiple votes for it. This voting activity gave Blackstone insights into how different members of The Town viewed the various RE Technologies and allowed them to be ranked in order of their preference.

These results prompted additional discussion around why certain technologies ended up at the top or bottom of the ranking and was an excellent source of feedback for Blackstone. The result of the voting session is illustrated in the image below.

37 Votes	Solar PV
25 Votes	District Energy Systems - Heat Pump
25 Votes	Solar Thermal Water
18 Votes	Air Source Heat Pump
15 Votes	District Energy Systems
11 Votes	Geo-exchange Heat Pump / Energy Storage
8 Votes	Solar Thermal Air
5 Vote	Hydrogen & Fuel Cells
3 Votes	Bio Energy / Wind Energy

Figure 6: RE Technologies Voting Results

Closing Comments

The Town is engaged with the Community and Corporation when it comes to dealing with the climate emergency. The Workshop event today was attended to by staff from a range of departments as well as those involved with the community which shows a commitment to being a part of the solution. The information gathered from the people involved and on-going discussions will help The Town develop a RE Strategy. The following summarizes the main points brought up during the session:

- As shown in the ranking and heard during the discussions, solar (electrical and thermal) is a leading technology for renewable energy contribution. This is to be expected, solar is high profile, growing around the world, getting less expensive, quiet, and is well known.
- To achieve significant PV contribution The Town will need to watch for and consider virtual PPA opportunities. As these evolve, The Town can plan to implement PV on the rooftops and take advantage of net metering.
- Solar heat also ranked high as it is also recognized, understood, and has a track record. Due to the low cost of natural gas they will have long paybacks (>20 years) until the cost of carbon is included which reduces the payback to <18 years by 2025.
- It is interesting that solar air did not rank higher. This is likely because it is not as recognized though a well proven solution. Using solar energy for electricity and thermal loads is recommended.
- Heat pumps in general and district energy systems were ranked high. Heat pump technologies are very good for electrification plans. DES is being reviewed for the Town for growth centres and it makes sense to consider heat pumps. The Corporation can maintain contact and ensure any new developments include high performance standards that permit low temperature, DES heating temperatures.
- The remaining technologies (wind, biomass, hydrogen) did not register highly. In the case of wind, there are no applications other than small models for roadside lighting. Biomass, though a possible energy source, is not well known in an urban situation. Hydrogen will become more distributed and could be a transition fuel for short-haul trucks in Town.

The responses to the technologies were informed, helpful, and indicates a corporate awareness of the options. Because solar ranks high and hydrogen ranks low does not mean hydrogen should be neglected. We feel that the rankings illustrate the sense of availability to deal with attaining GHG reduction goals within a reasonable time frame. Technologies such as batteries and hydrogen are relatively new, expensive and do not have the same visual impact as solar does. They are becoming mainstream and should be monitored for opportunities to integrate into the GHG reduction strategies.

Getting to a robust RE Strategy implementation stage will require more discussions with FCM staff to ensure good opportunities and ideas are not missed. The work completed for the reports did not allow for detailed evaluation of opportunities other than high level – i.e., we could not be sure if roofs were strong enough or if the connection capacity is there for solar. Installing heat pumps requires more investigation of the HVAC equipment and how the thermal energy is delivered before educated suggestions can be made.

The net step will be to agree to how and where to install RE systems. In the Phase D report, suggested plans for PV installation at Community Centres that proposes a roll out for that archetype and could be used as a template for future PV planning. We look forward to working with the Corporation in assisting with the development of a strong RE Strategic Plan.

Appendix 1: Questions & Answers

Renewable Energy in Municipalities

Question 1

Comment from TOO Stakeholder
The Town of Oakville has a community energy strategy that has set goals outside of the Corporation and includes recommendations around RE use. Corporate emissions make up ~2% of GHG emissions. The Town's leadership for a sustainable energy future complements the community directions..

Renewable Energy Technologies Discussion

Question 1 – RE: Solar PV

Question from TOO Stakeholder
Would we be considering large scale off-site solar installations or on-site rooftop type projects? Or both?

Answer from Blackstone
Consideration for maximizing solar generation in existing facilities is a primary recommendation for adopting RE. Steps to take into account are available rooftop space connection capacity for net-metering, and existing roof structure.

Ground mount systems are large scale solar farms. These are typically megawatt scale, compared to the kilowatt scales on rooftops. We have laid out some of the policy and physical considerations in the Pre-Workshop package, and in our Study, about large ground mount and rooftop solar systems.

Incorporating large offsite PV, or renewables in general, virtual power plants will be possible. Brownfields and lands that aren't that useable for other functions, will become eligible for a virtual plant. These large RE sites generate electricity that goes into the grid and credited towards the Town's electricity use.

Comment from TOO Stakeholder
We want to fully understand the context in which we are providing feedback. Considerations between ground mount, offsite, EV, etc. installations would be very different than onsite. I'll keep that in my head as we move forward in the conversation.

Comment from TOO Stakeholder
The concept of virtual net metering or virtual power plants is going to be crucial to whether or not we embark or not in an offsite PV farm. The answer to the question depends, we need to look at each situation and see if it makes sense, and if the building is structurally sound to be able to sustain a rooftop installation. In the future if there is access to a virtual power plant we don't need to have a facility close by getting that electricity when instead its getting fed into the grid and we are benefitting as if we had our facilities right next to the farm.

Question 2 – RE: Solar Thermal Water

Question from TOO Stakeholder
For Solar Thermal Water, can you speak to why the operational cost savings is at 2 and not higher?

Answer from Blackstone
Solar hot water is a supplement to your main heating load. So, you supplement the main boiler plant and that's where the savings are. Solar hot water systems (and solar air) are not complicated to operate. Operationally you get a lot of energy for a little bit of electricity to run the small pump or fan. From an operational perspective, there is not much to do with them so that why we took it as a low operation cost for the energy collected.

Question from TOO Stakeholder
Wouldn't that mean that operational cost savings would need to be higher for solar thermal water? (i.e, a 4 instead of a 2, because they are not expensive to operate).

Answer from Blackstone
The price of gas is low right making it difficult for solar hot water to compete on a cost basis alone, but it is a high GHG emissions source. Those are the kind of criteria when we chose the ranking. They are inexpensive to operate but there is not much savings in terms of dollars and tend to have long paybacks.

Question from TOO Stakeholder
To add to that discussion [solar hot water], I was curious about if there is any consideration of re-evaluation based on the carbon tax that's coming in the next 5/10/15 years. Is there a threshold where the operational savings might start to be much more impactful?

Answer from Blackstone
It's a relatively new line item in the financial analysis (Bill C12 passed this past Spring). We do take that into consideration, but it's not set in stone yet, so we were hedging a bit. The cost of carbon would make solar thermal, air and hot water far more appealing going forward and tend to reduce the paybacks.

Question 3 – RE: Solar Thermal Air

Question from TOO Stakeholder
Wondering why air vs. water is 1-star higher for operational savings (assuming your offsetting a gas system). Just curious – thinking indoor and outdoor pool application (not just DHW).

Answer from Blackstone
Solar air systems operationally bring benefits because of the insulation when using a "solar wall"(which is the technology considered for the measures).

Question 4 – RE: District Energy Systems

Question from TOO Stakeholder
Not all the folks on the call here from the Town might be familiar with the work we are doing with district energy and pre-feasibility. I wanted to be really clear that it is looking at a community scope, that may or may not include Corporately owned buildings. That is something that we must go through and see if they are any sites that could be included at this very early stage of looking at district energy. As a community there is a strong push towards district energy as a supply and distribution solution to lower GHG and emissions impacts and receive all the other benefits throughout our community, whether Corporately owned buildings, residential communities, and in our business and commercial districts as well. Has there been any thought about our Corporate facilities generating supply from some of the waste energy from some of our sites? Looking at it through this lens of evaluation, either part of the supply or acting as a district energy node in and of itself?

Answer from Blackstone
District energy systems can take various sources of energy into the loop. We understand from The Town's plan that you're looking at 5 or 6 different development centres, where a DES might apply if Corporate buildings are included I would think about connecting them. In terms of taking any other waste streams, absolutely, we would consider that and mention it in our final report. A good example is wastewater streams, which are good sources in large communities.

Mural Voting Activity & Discussion

Question 1 – RE: Voting Activity

Question from TOO Stakeholder
When we are casting our votes, are we casting them in the frame of the Corporation of Oakville or more of a community wide project?

Answer from Blackstone
This study is for the Corporation, and the strategy going forward for the Corporation portfolio.

Question 2 – RE: Results

Question from TOO Stakeholder
I just wanted to say I am not surprised at all that Solar PV is at the top of that list. But one of the things I would like to see being considered as part of that is how we can bridge the gap between having solar PV and people in the community spaces knowing that there is PV somewhere on the building or offsite, and being able to see or learn about what those stations are doing.

Answer from Blackstone
As a Town you have a lot of success stories and broadcasting those successes is an important part of renewable energy strategies. Adding signage noting what is happening, and point people to the successes. From a community perspective you want people to know what you're doing and that you are part of the climate mitigation solution.

Question 3 – RE: Results

Question from TOO Stakeholder

Was surprised to see how low Hydrogen and Fuel cells rank. After attending the Smart Energy Kingston Conference if it is new technology is it just a matter of time or is it just too expensive?

Answer from Blackstone

It has been very visible and audible in the Federal strategy to net-zero about the investment in hydrogen, in particular in Alberta which has a high GHG grid. Hydrogen technically is not a renewable energy; it is a vehicle for carrying energy and how you make the hydrogen is really important. Right now, the infrastructure isn't in place From a Canadian perspective it makes a lot of sense as we are big, we've got pipelines, and we've got applications where you can mix it in with natural gas and offset carbon. It is definitely on our radar to watch, and as I follow up we [Blackstone] will send out to the group our "Year in Energy" report, and we have a section on hydrogen where it talks about green hydrogen, blue hydrogen, and provide a little but more information.

Email Feedback Received

Email 1

Question from TOO Stakeholder

Are we talking about existing projects completed? New projects? Which town facilities would be possible candidates for which type of RE projects? Examples:

a) We have PV at many town facilities. Do we have capacity for more?
b) District Energy program: I understood there is a concurrent feasibility study on this, however I think it would have been helpful to understand if we were looking at possibly partnering with local developers in this type or project or just using Town buildings? Not sure if we would ever corporately have the density to support these types of projects (though a hybrid would seem most logical).
c) Air / ground source heat pumps: this is closest to my role at the town, so I have a strong understanding of which facilities could benefit from this. In terms of the visioning workshop, I think it would have been helpful to tie specific examples to specific facilities.

Answer from Blackstone

a) We are proposing you consider PV wherever you can and will be recommending policies to reflect that. We can only do an estimated area review for more PV without being sure of the roof structure. Same for the connections – we cannot be sure there is capacity but can let you know what the potential might be (i.e., a lot more roof at 16 Mile – is there connection capacity?).
b) There may not be a large DES opportunity for the existing Corporation sites as DES favours the supply to multiple buildings. However, if a large development goes up beside 16 Mile, a large GSHP/solar system could make up a small DES for that area. Any large developments being planned should consider DES and then if the corporation has any properties inside that area, make sure they design to accommodate energy from a DES. We would suggest a more detailed ownership model evaluation be undertaken in that regard.
c) We were thinking a little more generally for the workshop but would like to talk to you and follow up for more ideas of where these technologies would work.

Question from TOO Stakeholder
We have partnered with our local utility Oakville Hydro for many Town RE projects. There are pros and cons to this model. Has this worked for us in the past? Would we possibly look at running these projects entirely through the town?

Answer from Blackstone
We should follow up with you about how the projects were coordinated and understand your take on that. Oakville Hydro will always need to be involved – from pre-CIA through to the final ESA and commission reporting. The level of project management by the Town can be determined depending on the scope.

Question from TOO Stakeholder
Building on a couple previous points, what kind of partnerships exist for different types of RE projects? I think the feasibility piece could have been more specific to our context. It felt like asking our input without being able to fully understand what that looks like. Example: PV was the highest focus strategy in our poll, however do we have many more sites to accomplish this?

Answer from Blackstone
Your note about Town specific is noted. While keeping it fairly generic, we will show some “for example” to give you a feel for the application. We didn’t want to get too tied up in details for applications at this time but would like to hear your (and the Town’s) ideas.

Comments from TOO Stakeholder
Great questions around this project and our own experience and ability to implement RE. I think it’s important to provide some background on this project: when we started this conversation, I did have the same idea of having feasibility studies on specific locations and specific technology. However, at the time, we felt like we didn’t know enough about renewable energy technologies to make these cases. We took a step back and decided to go for a study that helped us identify what technologies are out there, what are their benefits and disadvantages, associated costs, and benefits. With this information, we could then start thinking about implementation of specific technologies throughout town facilities.

DES: The Town wouldn’t own the system, but we would be users and perhaps suppliers of waste energy to these systems. The idea would be to have one (or more) DES systems that serve entire neighborhoods, and our buildings would be just one of those customers. Not something we would do alone, but something that the community is looking at more seriously lately. Regarding the model with OEC, to be honest, I do not think it’s the best approach but something that will likely be a part of the strategy on how to implement RE projects at the town.

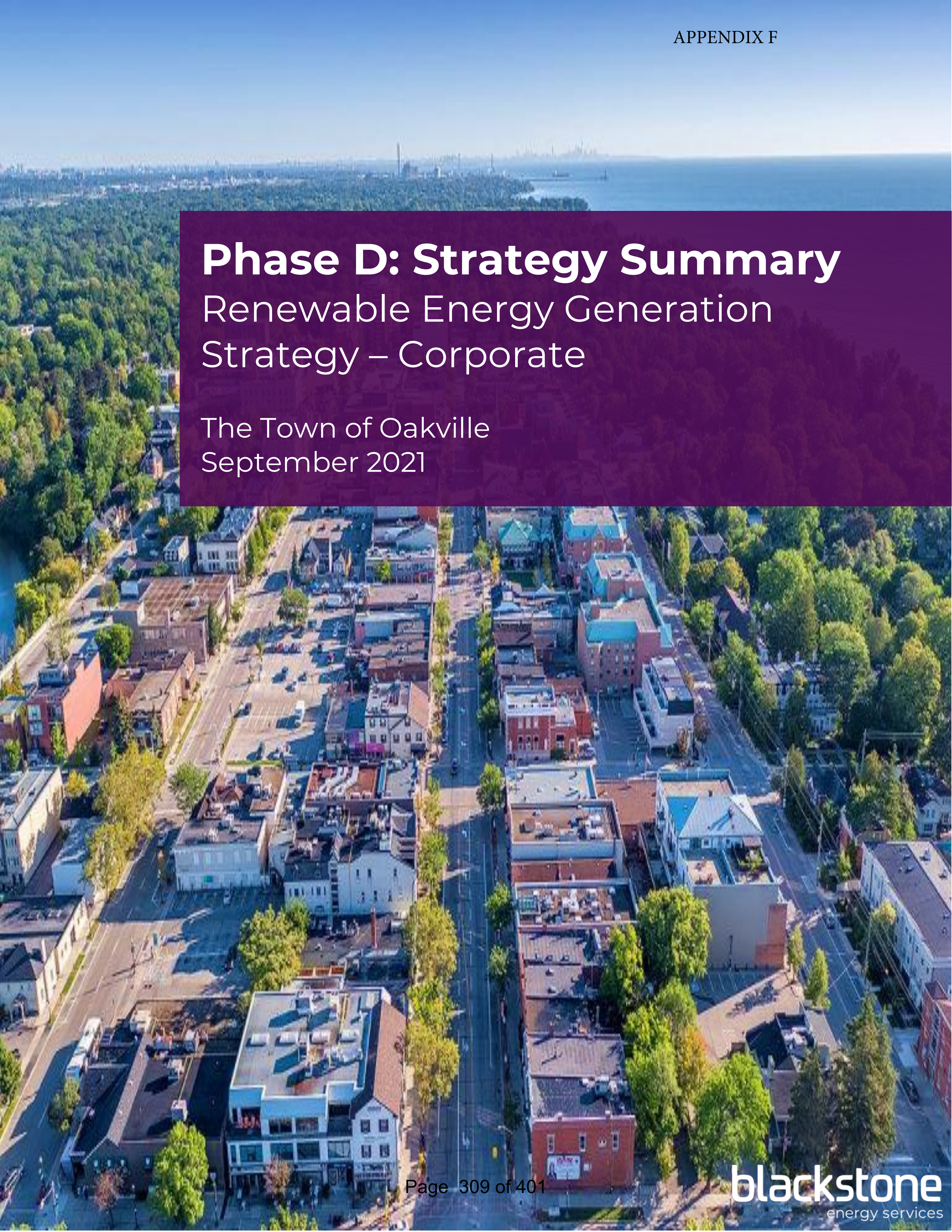
Finally, I think we are at a point where we wouldn’t want to say no to a technology because right at this moment, we don’t have the space or ability to implement. I was interested more in learning what people’s take on RE was and if there was a strong feeling (for or against) a particular technology, so we wouldn’t even bother considering it. From yesterday’s workshop, I can see that wind and bioenergy are not something we would look into, and I agree with those statements. If we consider the other technologies, there are quite a few options in terms of development/installation/operation that can be integrated into a building with a large rooftop, or as part of the wall, or on the ground (as an example). We’d need to understand what risks and benefits are associated with the technology, to see if it makes sense for us to entertain a project of this sort. But we need to integrate this kind of thinking into the strategy, to make sure we are considering all aspects.

APPENDIX F

Phase D: Strategy Summary

Renewable Energy Generation Strategy – Corporate

The Town of Oakville
September 2021



blackstone
energy services

Contents

Introduction

The intention of this report is to describe low carbon technology strategies and how they can be applied in the Town of Oakville ("The Town" refers to corporate facilities for this report) to reduce carbon emissions to 80% below 2014 levels by 2050. Renewable energy (RE) systems are well recognized and fall into the broader application "low carbon" solutions. Going forward, we recommend The Town use the more generic and broader description "low carbon" to be sure all technologies that can assist in meeting the net-zero goals are considered – not just ones deemed "renewable" that are currently used. Blackstone analyzed ten (10) technologies as part of the "Renewable Energy Strategy":

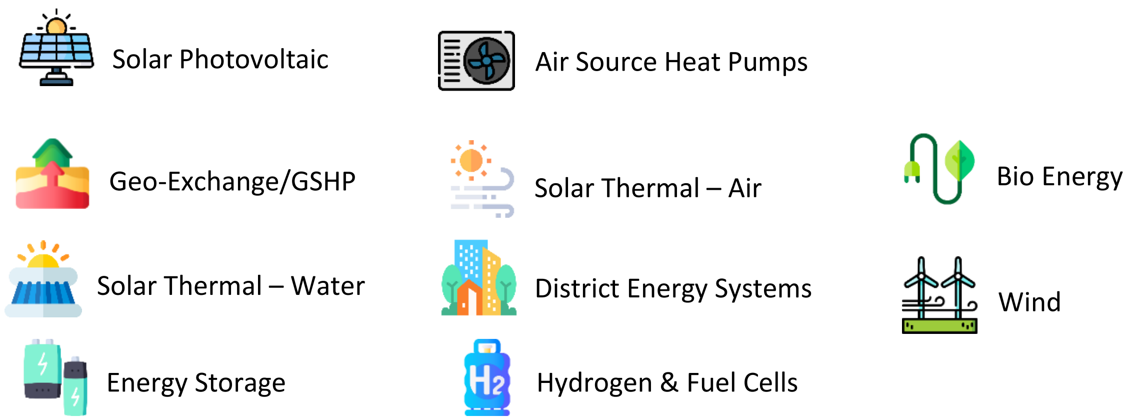


Figure 1: RE Technologies Analyzed

The following strategic discussions present solution reviews around conventional renewable energy systems (solar electric, solar thermal, wind) as well as low carbon technologies (district energy, hydrogen, heat pumps, biomass, batteries). These technologies are at a range of maturities (from young; hydrogen, to established; solar) and are candidates in most facilities though not all with comparable eligibilities. Though there may be a good wind regime for a facility near the lake, the public push-back would likely be significant and make it impractical. Social, environmental, and economic attributes must be taken into consideration, individually and as an integrated whole, for all energy related discussions.

Many low carbon solutions have both active and passive benefits. Wind may not be a good candidate with a turbine but is a low carbon energy source through "passive ventilation". Capturing rejected heat for use by heat pumps will improve the performance of a heat pump system. We recommend that all solutions consider passive and active elements of low carbon applications.

The final strategic plan is to prioritize the reduction of energy loads through conservation and low energy system designs first. Following that, low carbon technologies be evaluated in all energy-based decisions with a focus on how the solution will maximize the reduction of GHGs over the long term. All new and large renovations will be designed, through standards, to high performance, low source heat, designs. Rather than basing decisions on the first cost, a LCA approach should be used that includes the cost of carbon in all decisions. Solar PV can be quickly implemented on most facilities and will offset the increased use of electricity as natural gas is reduced heading toward a net zero future. Solar applications should be investigated as soon as possible.

Strategic Plan for Low Carbon Future

The Town has shown consistent attention to the environment over the years. They accepted the fact that human induced greenhouse gases are causing significant climate degradation and passed a climate emergency statement in 2018. The Town has prepared several energy and carbon reduction measures through conservation and demand management plans since 2005 with the most recent one published with a plan for 2020 to 2025.

The Town has targeted a 20% reduction of corporate energy and GHG levels by 2030 and 80% by 2050 compared to 2014. At that level The Town could reach a net-zero carbon footprint by 2050 if they tackle their GHG footprint consistently over the next 30 years. Achieving this target, as daunting as it may seem, is possible with a coordinated effort between the corporation and community. Even with the level of action and measures taken over the years, a coordinated and collaborative approach is the best way to tackle big climate issues.

The strategies presented in this report address the need for a coordinated plan with shared and shareable results. The benefits of a strategy and collaboration across The Town will be reliable and sustainable energy and GHG reductions that are realistic, timely, cost effective, long lasting and something The Town can be proud of.

Primary Strategy Points

1. Develop and target high performance energy/GHG standards and measures in all facilities
2. Plan to electrify HVAC systems through targeted replacement and for all new facilities
3. Prepare buildings for thermal autonomy/resiliency with high performance envelopes
4. Plan to offset increased electrical loads with RES (i.e., PV, bi-directional EV stations)
5. Educate the communities about the plans, efforts, and successes

The Why, What, How & When of a RE Strategy

- The Town has embarked on a path to achieve or be close to carbon neutrality by 2050
- A Climate Emergency was approved by Council in 2019
- A strategy will gather and present reasonable standards, policies, measures, and timelines that can be applied across the Corporate portfolio and be coordinated within the Community
- Define technologies that can be integrated into the Corporate framework and how to take advantage of the strengths realizing that they will evolve
- Prepare business case foundations for the solutions that will show the benefits and costs for low carbon solutions
- Where applicable, the strategy will suggest “trigger” events that enable low carbon solutions, such as roof renovations, major HVAC replacements, incentive funding

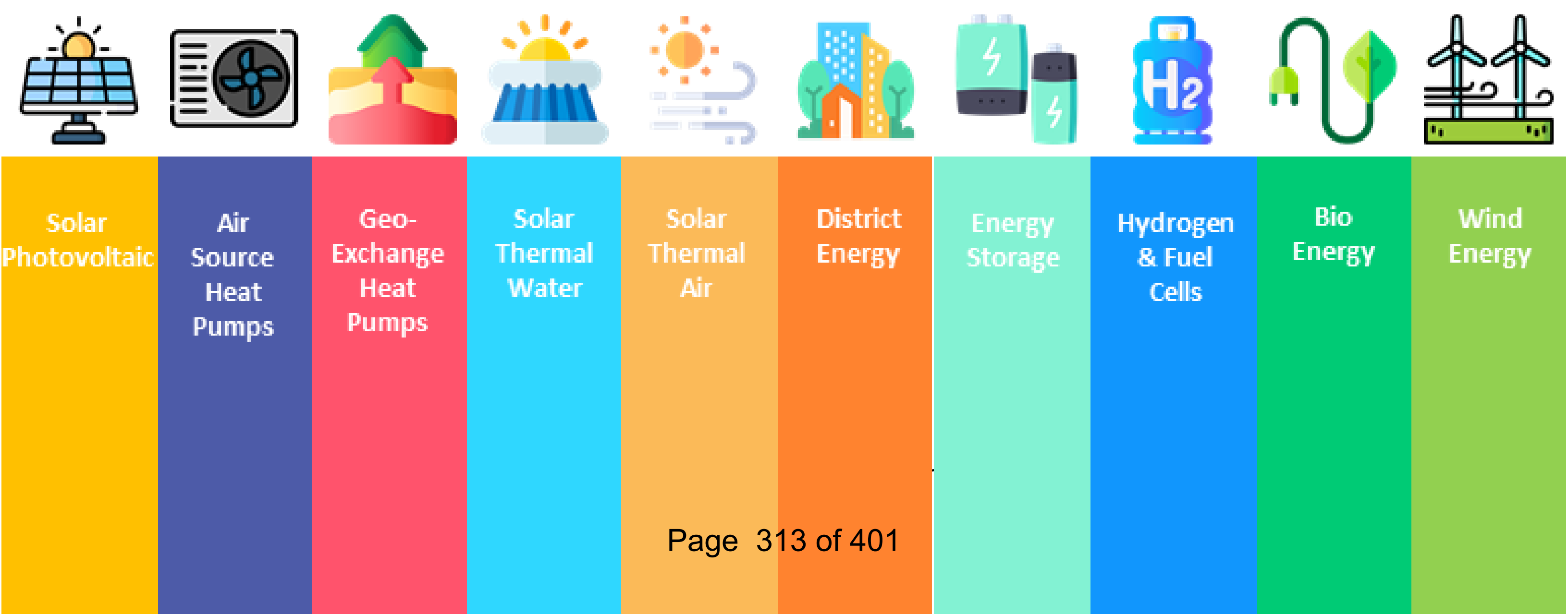
Renewable Energy Technologies Considered

Blackstone evaluated ten (10) renewable energy (RE) technologies options during this study. These represent the currently available and most common technologies in use at a municipal scale and will likely be applicable at some scale within The Town for the next 10 to 30 years. New technologies will evolve from these systems typically with higher efficiencies for the same footprint, lower capital costs, lower operating and maintenance costs, longer life cycles, end-of-life recycling, and integration possibilities. Detailed information on each technology can be found in the Phase B report of the full project.

- Solar energy including photovoltaics (electricity) and thermal energy (heated air and water)
- Heat pumps including ground source (geo-exchange), air source and waste energy
- Decentralized and district energy systems (energy nodes)
- Bio energy (wood pellets)
- Hydrogen (stationary boilers and transportation)
- Wind energy (urban scale and large of-site)
- Batteries (resiliency and demand shedding)

Though the focus is on the active technologies listed above, passive systems such as daylighting, induced ventilation, landscaping, site planning are necessary components for successful long-term energy planning and best addressed in building and community design standards. These are discussed in the policy section of the Phase A report of the full project.

Figure 2: RE Technologies Analyzed

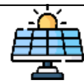


Strategic Directions

The following sections describe each of the low carbon technologies reviewed. The descriptions are to showcase the application at a high level for strategic direction.

The intention of these next sections (3.1 to 3.10 inclusive) is to provide a short strategic description for preliminary discussion. Full details on each technology can be found in the Phase B report of the whole project.

1. Solar – Photovoltaic



Photovoltaic energy (PV) is an accepted, well understood, long lasting technology that will be an important system to meet The Town's goals and showcases the use of renewable energy very well. PV technologies currently include mono/polycrystalline and thin film modules and can be applied on roofs, ground, as awnings, carports and more recently as building integrated systems. The direction is to install PV systems wherever feasible and aim for a minimum contribution to the corporate electrical loads from solar power by 2030 and beyond.

PV system applications should be pursued at all new construction and major renovations when roofs are being upgraded. Net metered systems are recommended. The Town should ensure minimum energy performance standards are used for all new and renovation projects to ensure high performance energy loads result for optimum PV generation impact.

Be prepared to enter virtual power plant agreements as they emerge. This concept, described in this report, would access large scale PV generation, and reduce the increased electricity loads due to proposed fuel switching (electrification).

As an example, the following table illustrates a PV plan for the existing Culture & Recreation facilities based on estimated array sizes. These areas are put into context by comparing them with the array size at the Glen Abbey facility (1,800 m^2 for 226 kW_{DC} for approx. 8 sq.m./kW).

The Culture & Recreation Facilities and Operations/Administration buildings offer the most opportunity for GHG reductions due to electrification. The "Other" row includes streetlights, parking, splash pads, etc., with no to very low natural gas use and why the GHG reduction is negative. (i.e., some added GHG due to purchased electricity for the loads).

Culture and Recreation Centre Opportunity
The following table illustrates estimated cost performance for the Culture & Recreation sites which tend to have roof areas suitable for PV. Estimated costs (2020), using an electrical escalation of 2%, a PV panel degradation of 0.55%/yr. and actual GHG costs/tonne to 2030, again at the range of PV system contributions.

Table 1: *Estimated PV array performance to 2030 – Culture & Recreation Centres*

Culture & Recreation	PV system size kWdc	Est Cost	Est Energy Generated kWh/yr.	Est Value $ 2021	Elect CUSUM $ value 10 yrs.	Tonnes/ yr.	GHG CUSUM value 10 yrs.	Total value $ 10 yrs.
10% from PV	1,483	$2,817,700	1,683,205	$252,481	$2,752,896	72	$72,258	$2,825,154
20% from PV	2,965	$5,633,500	3,365,275	$504,791	$5,336,060	145	$144,467	$5,480,527
50% from PV	7,413	$14,084,700	8,413,755	$1,262,063	$12,107,596	362	$361,192	$12,468,788
80% from PV	11,860	$22,534,000	13,461,100	$2,019,165	$21,344,239	579	$577,868	$21,922,107

For reference, a 1,483 kW_{DC} system would require a total of ~12,000 m^2 or the equivalent of almost seven (7) Glen Abbey size arrays on roofs.

PV Installation Strategy

The following table proposes a PV installation strategy and the results between 2025 and 2050 at the Corporate facilities. The percent (%) values represent estimated contributions of the PV array for the year of installation. The annual corporate electricity for each milestone assumes a 2.5% electrical load increase for each building type section. For example, a total of 1,696 kW installed in Culture & Recreation would supply ~18% of the electricity load for that building group in 2025; about 32% in 2030 after a 2.5% growth rate per year for electricity from 2025 to 2030.

Table 2:*Proposed PV Installation Schedule to address GHG contributions and electricity growth*

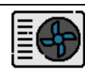
Building Types	2025 kW installed	%	2030 kW installed	%	2040 kW installed	%	2050 kW installed	%
Culture & Recreation	1,696	18%	3,393	32%	8,482	64%	13,572	82%
Operations/Administrative	1,396	16%	2,792	29%	6,980	58%	11,168	74%
Arenas	916	14%	1,833	25%	4,582	49%	7,331	63%
Other	472	10%	945	17%	2,362	34%	3,780	44%
Total	**4,481**	**15%**	**8,963**	**27%**	**22,406**	**54%**	**35,851**	**69%**

Note that the proposed PV strategy does not imply the GHG targets will be met – only the level of offset electricity generated against that used within the corporate buildings. Growth in electricity will increase when natural gas HVAC systems are replaced with electrical systems, e.g., heat pumps. Consideration for the added electrical loads due to fuel switching should be taken into consideration where fuel switching is completed. See the Phase B report of the full project for a discussion on the impact of fuel switching on GHG levels.

Recommended Strategic Direction

1. Prioritize PV applications – roof, carport, ground, façade. Culture and recreation facilities offer the best opportunities. Recommended as early plan selection (~1,700 kW or 14,000 $m^2$of array area at community centres before 2025, increase across portfolio to ~4,400 kW by ~2025).
2. Target 15% corporate electricity contribution through PV by 2030 (~ 4,400kW), increasing to ~55% by 2040 (~22,400 kW) and 70% by 2050 (~36,000 kW).
3. Anticipate and estimate electrification of natural gas heating of The Town's corporate energy loads with PV as an electricity offset measure. See more detailed information in the Phase B report – Solar Photovoltaic section.
4. Trigger PV opportunity applications when roof upgrades are being planned.
5. Encourage Town policy to require high performance designs to meet high performance energy indices; include PV into revised building performance standards; building applied and integrated.
6. Investigate opportunities to participate in virtual power plant projects and power purchase agreements as they become available.

2. Air Source Heat Pumps



As with geo-exchange heat pumps, air source heat pumps (ASHP) will play a large part in reducing natural gas heating and achieve the GHG targets. ASHPs are an enabling technology in that they can be retrofitted into existing buildings. The Town should prepare a schedule based on HVAC replacements due to major repairs or end of life (i.e., trigger events) and prepare sizing models that reflect actual thermal performance after potential conservation measures.

Recommended Strategic Direction

1. Give priority to the selection of heat pump technologies for all HVAC designs.
2. Ensure all new building designs and major renovations (e.g., when HVAC systems are being replaced) are based on high performance standards allowing low temperature heating sources.
3. Compare all heat pump systems to conventional natural gas fired systems using a life cycle cost analysis over a ~20-year cycle, including the cost of carbon.
4. FCM to initiate an on-going heat pump system monitoring and verification protocol with existing heat pumps to gain insights around optimum performance criteria and share with HVAC design teams.

3. Geo-Exchange Heat Pump Systems

Heat pumps will make up a large part of the electrification on the thermal loads for The Town. Ground source systems should be considered when there is sufficient ground such as under a new building, under a parking lot or nearby grounds for the borehole fields. The supply temperatures from current heat pump technologies are less than conventional heating systems which means retrofitting into an existing building will likely require terminal device conversions, derating and possibly a booster heater. The facility needs to have cooling and heating loads that can be balanced annually to ensure the ground is properly charged.

FCM should prepare a trigger event schedule that uses end of life and HVAC renovations to bring heat pump solutions to the building into consideration. Consider geo-exchange solutions for large campus-like opportunities and where thermal off-takers are available, such as around an athletic facility, large community centre, and operations centres. Geo-exchange systems should be evaluated using a life cycle cost assessment against a conventional gas fired boiler/chiller system and include the impacts of carbon costs, utility escalation, maintenance, and operations.

Recommended Strategic Direction

1. Give priority to the selection of heat pump technologies for all HVAC designs.
2. Give priority to ground source geo-exchange systems where land or ground volume is available (e.g., parking lots, land close to sites, under buildings in some cases).
3. Ensure all new building designs and major renovations (e.g., when HVAC systems are being replaced) are based on high performance standards allowing low temperature heating sources.
4. Compare all heat pump systems to conventional natural gas fired systems using a life cycle cost analysis over a ~20-year cycle, including the cost of carbon.
5. FCM to initiate an on-going heat pump system monitoring and verification protocol with existing heat pumps to gain insights around optimum performance criteria and share with HVAC design teams.

4. Solar Thermal – Water

Solar hot water reduces natural gas use directly. When there are annual hot water loads such as in pools, community centres, long term care, athletic centres, and operations facilities, solar hot water systems should be considered to supplement the conventional heating plants. The temperatures delivered are best suited for process laundry, truck/bus washing, and DHW loads. It is also a good match for supporting geo-exchange and DES applications. Solar hot water is a recommended technology for consideration and use.

Blackstone recommends encouraging the evaluation of solar hot water applications for any new building or renovation where process hot water is required year-round. The aim is to get a minimum annual solar fraction of 30% (solar supplies 30% of annual hot water needs). Consider making new buildings "solar ready" with plumbing (and electrical) chases from the roof to the mechanical rooms. Roof structures will be a major decision factor as will solar access.

The cost of natural gas will increase due to the impact of carbon rates, possibly being on the same order of magnitude as the commodity itself by 2030. It would be prudent to consider solar hot water now and capture the savings potential of these carbon fees over the next nine (9) years which will help reduce the simple payback.

Recommended Strategic Direction

1. Always consider pre-heating water with solar in applications where year-round hot water is required. Good sites to consider for solar hot water, e.g., pools, community centres, laundry facilities, fleet washing, domestic hot water.
2. Ensure all new building designs and major renovations (e.g., when DHW systems are being replaced) are based on high performance standards allowing solar heating sources to contribute to annual loads.
3. Consider the costs of carbon when assessing the life cycle costs of a solar hot water system as it will reduce the DHW/hot water heating plant size and take advantage of the increasing costs of natural gas.
4. Due to increasing costs of natural gas due to carbon costs and variable commodity costs, consider renovating large DHW load applications with solar hot water.

5. Solar Thermal – Air

Solar thermal air systems are more often mounted onto vertical walls and where there are outside air heating loads. The opportunities in The Town may be present at existing sports and operations facilities where there are large South-East to South-West facing walls. As these systems pre-heat air, they are best suited for locations with high winter outside air heating loads.

The Town should review sites with outside air heating loads and access to vertical walls with rooftop air distribution systems. An estimated performance can be calculated and reviewed for carbon and natural gas benefits. Solar thermal air systems should be considered where outside air is required and must be pre-heated.

The cost of natural gas will increase due to the impact of carbon rates, possibly being on the same order of magnitude as the commodity itself by 2030. It would be prudent to consider solar air now and capture the savings potential of these carbon fees over the next nine (9) years which will help reduce the simple payback.

Recommended Strategic Direction

1. Always consider pre-heating air with solar in applications where large volumes of outside air are required between September and June each year. Good sites to consider for solar air are those with central distribution air systems from rooftop air handlers, e.g., pools, community centres, offices, fleet garages.
2. Ensure all new building designs and major renovations are based on high performance standards allowing solar heating sources to contribute to annual loads.
3. Consider the costs of carbon when assessing the life cycle costs of a solar hot water system as it will reduce the DHW/hot water heating plant size and take advantage of the increasing costs of natural gas.
4. Due to increasing costs of natural gas due to carbon costs and variable commodity costs, consider supplementing large DHW loads with solar hot water.
5. Due to increasing costs of natural gas due to carbon costs and variable commodity costs, consider adding solar heated air to pre-heat loads.

6. District Energy Systems

The Town is planning to develop intensification neighbourhoods which could be candidates for a DES model. FCM group at The Town should maintain contact with this effort and coordinate opportunities to design new buildings or renovations that can connect to a community DES. The community uses many corporate facilities now so it is very likely there will be a need for buildings within the developments that will come into the FCM portfolio. Other DES opportunities within the FCM should be pursued when available, such as for large athletic facilities with multiple thermal off takers nearby (i.e., expansion of sports complex to include expansion with pools). In all cases, renewable energy systems should be considered in the DES designs.

Recommended Strategic Direction

1. Connect with and formalize a relationship for participation in community level DES developments to include Corporate facilities
2. Ensure building performance standards (new and renovation) anticipate DES design requirements that can use low temperature heating water.
3. Encourage a life cycle cost analysis, including the cost of carbon, for evaluating a DES connection or campus of multiple Corporate buildings, compared to conventional natural gas heating.
4. Ensure RE such as PV and solar thermal energy is considered during DES evaluation and design and target a RE contribution fraction to offset GHG from the DES.

7. Energy Storage

Consideration for batteries should first be applied in a “safe haven” site, for example, in community centres. They can be used there as peak shedding during the year to offset expensive time of day rates where applicable. In the current Ontario grid architecture, the benefits of batteries can be realized for buildings certified as Class A for global adjustment. Battery technology and the controls for integration into the buildings and grid are improving rapidly. The costs are also dropping making batteries a reasonable energy system to reduce costs during peaks as well as avoid marginal emissions when the grid is carrying gas fired peaker plant power. Technologies for combining PV and batteries are available. This combination is of interest for EV charging/discharging applications where parked cars are used for a small portion of the time during the day to offset grid power. This V2G concept is discussed more later.

The recommendation is to consider battery storage for peak shedding and possible demand reduction schemes in buildings that are Class A. Consider for use in buildings with high demand periods and develop a demand reduction plan to capture the grid peak times each year. Consideration for “safe haven” application is recommended.

Recommended Strategic Direction

1. The priority for battery storage systems should be into facilities that could become "safe haven" energy hubs such as community centres and long-term care facilities.
2. These should initially be designed to support emergency level equipment to extend the resiliency of the site to provide comfort under extreme weather conditions, lighting, some refrigeration, heating system fans, pumps, some service plug loads for charging phones, computers, radio/television, for 4 to 6 hours.
3. Extend the consideration to peak power shaving and shifting applications in sites where shaving and shedding is possible (Class A), such as operations centres, administration, sports complexes.
4. Ensure all new buildings are designed with high efficiency electrical load end devices.
5. Ensure all buildings are designed for high efficiency electrical loads to extend the electrical autonomy and provide safe-haven potential.
6. Follow technologies and case studies with V2G applications.

8. Hydrogen & Fuel Cells

Currently, hydrogen delivery and infrastructure are not widespread in or around Oakville. Hydrogen produced by steam reformation of methane is called "grey hydrogen" and not a good low carbon source. Hydrogen is clean when it is made using renewable energy and called "green hydrogen", which is preferred. Hydrogen made from reformation and the carbon is captured is called "blue hydrogen" and more common than green hydrogen. The technologies for hydrogen as a heating and/or combined heat and power system are being brought to market for commercial applications. Until there is a more robust distribution system for hydrogen electrification will be the more appropriate strategy to reduce GHG emissions in buildings and fleets. Hydrogen is being used for short-haul trucking and last mile deliveries in some pilots now. The hydrogen is generated at the trucking operations centre. Hydrolysis is an expensive technology still though with increased deployment should become more cost effective within 5-10 years. The Town should continue to be aware of CHP technologies as they prepare for hydrogen fuel blends and understand how the carbon reduction of blended fuels will impact the carbon loads and therefore the cost of carbon in conventional heating systems.

The Town should prepare a cost calculation for fuel that includes the defined carbon content for natural gas and the carbon costs that result each year and carry and monitor these along with the standard utility tracking metrics.

Recommended Strategic Direction

1. Hydrogen is not yet ready for wide-spread use without more distribution infrastructure.
2. If hydrogen is to be used, short-haul and last mile trucking is likely the early adoption scenario.
3. FCM maintains an awareness of the state of hydrogen generation, applications (i.e., fleet operations in particular, CHP in general) and distribution.
4. FCM maintains an awareness of the status and cost impacts of hydrogen content in natural gas to ensure correct emissions factors are being used when calculating GHG loads from existing natural gas heating.
5. Follow the natural gas supply mix information as hydrogen is introduced as this will reduce the GHG emissions factor.

9. Bio-Energy

Due to delivery and storage needs, this is a technology best suited for district energy system applications. Transportation and storage criteria must be included in any feasibility studies and include sufficient fuel to carry through delivery disruptions. The Town should maintain awareness of the technologies and applications for consideration against other fuel supplies. Consider a more in-depth feasibility study to fully assess the capabilities and application criteria for The Town. This technology is not perceived as a long-term option or application for large corporate assets. There are technologies that may appeal to some sites for either pilot or awareness projects that can be addressed as they appear.

Recommended Strategic Direction

1. Not a good option for corporate portfolio.
2. FCM maintains an awareness of the technologies in the context of an urban application.
3. Ensure all new building designs and major renovations (e.g., when HVAC systems are being replaced) are based on high performance standards allowing low temperature heating sources.
4. The Town may select biomass as a fuel source for a DES that would be outside of the FCM responsibilities and should be aware of this decision as it may impact operations staff.

10. Wind

Wind energy can be either active or passive. Active wind energy capture using a turbine is not applicable within The Town but may be possible through a virtual power plant (VPP) and PPA. Passive use of wind through design is recommended to assist with ventilation and directing to prevent uncomfortable wind tunnels and snow build up. We recommend a wind study be completed for new buildings to ensure passive wind energy is being used to benefit energy and comfort. Wind energy is not recommended for urban applications other than small scale, stand-alone systems. Consideration for a partnership in a VPP should be investigated.

Recommended Strategic Direction

1. Active wind technologies are not likely to be eligible within the boundaries of Oakville.
2. There are some small-scale wind systems available for streetlights, off-grid parks, trails, that may be appropriate – they are a highly visible form of renewable energy that might appeal to the community.
3. Consider passive use of wind energy through free ventilation, wind breaks, venturi prevention planting, channeling.
4. Stay aware of the potential to join a virtual power plant opportunity when this energy supply method becomes available.

Summary of Strategic Direction for RE

Renewable Energy/Low Carbon Direction

The stages of the development of a renewable energy strategic direction include discussions of the technologies, sites, policies, standards, costs/benefits, and stakeholder considerations. Renewable energy systems are an increasingly recognized and accepted means to generate low carbon energy for community and corporate use (in the interest of expanding the discussion around renewables, we feel it is more appropriate to call "renewable energy" "low carbon" solutions). Though not described as such throughout these reports, it is a phrase that should be used more often as it encompasses more current technologies, as well as evolving ones, that will reduce the carbon presence of The Town. An example of a low carbon solution but not a fully recognized renewable energy source, is the use of air to water heat pumps.

The low carbon technologies reviewed are currently available and marketable with a range of applications within The Town. Some are not as marketable as others (e.g., PV versus hydrogen), but all are increasing their presence, cost effectiveness, understanding, and acceptance. Many can be integrated, so a holistic solution assessment needs to be used going forward – e.g., PV plus batteries, or solar hot water and heat pumps.

The following is a summary of the direction the Town can consider in their ongoing path toward an 80% reduction of GHG's by 2050.

Strategic Direction

1. Continue to reduce the energy loads through concerted energy conservation programs and high-performance low carbon building design standards.
2. Give priority to the electrification of HVAC loads.
3. Target increasing levels of PV contribution to the corporate electrical loads – e.g., 15% at 2030; 55% at 2040 and 70% at 2050.
4. Require appropriate renewable and low carbon energy system designs and assessment be included during site planning.
5. FCM to prepare GHG targets and milestones for submission to The Town Plan and encourage the commitment to achieve them as a part of The Plan.
6. Formalize renewable energy contribution targets as percent of total Town energy corporately to be achieved by 2030+.
7. Adopt and enforce a life cycle cost analysis that includes the cost of carbon.

Recommended Policy Initiatives

Using the policies, guidelines and standards reviewed in the Phase A report of the full project, and with insights from the Corporation, the following policies should be considered to encourage renewable and low carbon solutions. Many of the technologies we see today will improve in terms of efficiency, range of operating conditions, cost, and applications. The best policy scenario is one that allows future technologies to be considered and adopted as they evolve. For this reason, policies, guidelines, and standards will tend to be somewhat vague as they try to cover all scenarios.

Strategic Direction

1. Promote plans to electrify the HVAC systems for the corporate facilities.
2. Promote PV installation to offset corporate electricity loads and offset increased electricity use due to electrification.
3. Allow for flexible technology improvements, policies, standards, and guidelines, i.e., specify “best in class” or “high performance alternates”.
4. Standards should be reviewed and adapted on a regular cycle – e.g., 3-5 years maximum or at the update schedule for the OBC, whichever is sooner.
5. Formalize Corporate Energy Team collaboration with Council reviews of low carbon development strategies, planning and standards – e.g., formal RE Strategy Committee that includes Energy Engineering department staff to report to Council annually.
6. Consider setting the baseline year for energy benchmarking to 2015 to remove the impact of changing the grid emissions carbon content due to the closing of the coal fired electricity generation plants in 2014. Comparison before and after are appropriate but will skew the savings making future comparisons difficult.
7. Establish a minimum renewable energy fraction of the Corporate facilities energy profile along with a timeline for implementation, e.g., 15% at 2030; 55% at 2040; 70% at 2050.
8. Develop absolute energy and GHG performance indices applied to relevant Corporation building archetypes and stepped to increasingly higher absolute performance indices on a defined cycle. Propose standards that are higher performance than the current OBC plus SB10.
9. Include comprehensive commissioning procedures for all new buildings and large renovations that include thermal and air sealing tests – e.g., infrared imagery and blower door tests.
10. Require a RE Strategy/low carbon solution whenever a building permit is required for Corporate facilities.
11. Include renewable energy/low carbon design criteria into corporate Building Design Standards to meet minimum new and renovation performance indices.
12. Develop and promote a life cycle cost analysis, including the costs of carbon for low carbon system evaluation. Require a LCA report comparing RE Strategy and low carbon solutions with conventional technologies in all proposals/tenders over the life of the technology.
13. Strengthen the words “should” and “encourage” in all policies to actions words, e.g., “shall”, “adopt”, where renewable and low carbon energy systems are presented.

REPORT

Council

Meeting Date: April 25, 2022

FROM:	Planning Services Department Finance Department
DATE:	April 19, 2022
SUBJECT:	**The More Homes for Everyone Act, 2022 and Implications for Oakville – April 25, 2022**
LOCATION:	Town-wide
WARD:	Town-wide

RECOMMENDATION:

1. That the report titled "The *More Homes for Everyone Act,* 2022 and Implications for Oakville – April 25, 2022" be endorsed and submitted to the Province, along with the Council resolution, as the Town of Oakville's comments on the *More Homes for Everyone Act,* 2022, and related proposals under the Province's *More Homes for Everyone Plan*.

2. That the comments within this report related to the *More Homes for Everyone Act,* 2022 changes to the *Planning Act* be endorsed as the Town of Oakville's response to ERO No. 019-5284 and Proposal No. 22-MMAH006, and submitted to the Ministry of Municipal Affairs and Housing (MMAH) prior to the April 29, 2022 commenting deadline.

3. That the comments within this report related to the *More Homes for Everyone Act,* 2022 and changes to the *Development Charges Act, 1997* be endorsed as the Town of Oakville's response to Proposal No. 22-MMAH007 and submitted to the MMAH's Municipal Finance Policy Branch prior to the April 29, 2022 commenting deadline.

4. That the comments within this report related to the Province's Community Infrastructure and Housing Accelerator guidelines be endorsed as the Town of Oakville's response to ERO No. 019-5285, and submitted to the MMAH prior to the April 29, 2022 commenting deadline.

5. That the comments within this report on how to diversify housing choices within existing neighbourhoods be endorsed as the Town of Oakville's

response to ERO No. 019-5286 and submitted to the MMAH by the April 29, 2022 commenting deadline.

6. That a link to this staff report, along with Council's resolution and comments, be provided for information to Halton's Members of Provincial Parliament, Halton Region, the City of Burlington, the Town of Halton Hills, the Town of Milton, Conservation Halton, Credit Valley Conservation, the Grand River Conservation Authority and the Association of Municipalities of Ontario.

KEY FACTS:

The following are key points for consideration with respect to this report:

- On March 30, 2022 the Province tabled Bill 109 - the *More Homes for Everyone Act,* 2022 that proposed changes to various provincial statutes including the *Planning Act* and the *Development Charges Act.*
- The proposed changes were posted on the Environmental Registry of Ontario (ERO) and Ontario's Regulatory Registry (ORR) with a public commenting period of 30 days or less. This report was originally prepared so that the town could provide formal comments to the Province, through a Council resolution, for the postings with a commenting deadline of April 29, 2022.
- On April 14, 2022, while the commenting period for these proposals was still open, Bill 109 – *More Homes for Everyone Act*, 2022 received Royal Assent and is now law.
- This report describes the changes to the *Planning Act* and the *Development Charges Act* and other statutes and provides comments from town staff on these changes.
- In the case of minor changes to municipal administrative processes, town staff offers support, although the Province has not provided sufficient detail.
- Town staff also supports changes to legislation that improve transparency and accountability in the housing sector.
- Town staff does not support changes that re-inforce ministerial over-reach, increase delays, increase costs from litigation and reduce local municipal planning and decision making authority.
- Town staff does not support changes in the legislation that apply a punitive approach to refunding planning application fees. This could result in a shortfall of planning revenues which would need to be funded by the town's tax levy.
- The Province's punitive approach will act as a deterrent to the cooperative planning process being fostered in Oakville and instead will result in more litigation, costs and delays. This will not improve planning decision timelines and certainly will not improve housing affordability.

- The lack of detail in Bill 109 - *More Homes for Everyone Act*, 2022 and time for review has undermined the ability of town staff to conduct a comprehensive analysis and to understand impacts to the town's processes and operations.
- Overall, it is challenging for the Town of Oakville to support legislative changes that the Province has pushed through without appropriate and meaningful consultation.

BACKGROUND:

The Province has declared a housing crisis based on the lack of housing options that meet the needs and budgets of most Ontarians. Further to its *More Homes, More Choice: Ontario's Housing Supply Action Plan* (2019), the Province continues to seek ways to increase the supply of market rate rental and ownership housing as quickly as possible. These efforts to address market housing affordability are largely separate from provincial supports for affordable housing for the most vulnerable Ontarians.

On December 6, 2021, the Province appointed a nine-member Housing Affordability Task Force (HATF) to recommend measures to address market housing supply and affordability.

On February 8, 2022, the Province released the *Report of the Ontario Housing Affordability Task Force* with the intent of generating feedback from municipalities and the public. The HATF Report includes recommendations that touch all aspects of market housing, from supply, to the development approvals system, to financial matters, to setting a goal of adding 1.5 million homes over the next 10 years.

The recommendations focus on changes to planning policies and zoning, approval and appeals processes, and government supports. An appendix to the HATF report included additional recommendations specific to affordable housing. Legislation to implement at least some of the HATF recommendations was expected to be forthcoming.

On March 30, 2022, under the banner of the *More Homes for Everyone Plan* (ERO No. 019-5283), the Province issued a number of proposals aimed at addressing the housing supply crisis, including:

- Bill 109 – *More Homes for Everyone Act*, 2022, proposed extensive changes to the *Planning Act* and *Development Changes Act, 1997,* among other things; and,
- Proposed guidelines in the *More Homes for Everyone Act,* 2022 support the use of the new Community Infrastructure and Housing Accelerator tool.

At the same time, the Province is seeking input on how to diversify housing choices in existing neighbourhoods. That consultation is focused on finding ways to support gentle density and increase "missing middle" housing, including the encouragement of multigenerational housing solutions.

The full slate of provincial public consultations related to housing, along with commenting deadlines, is as follows:

Environmental Registry of Ontario Postings

- ERO No. 019-5283: Consultations on the More Homes for Everyone Plan [1]
- ERO No. 019-5284: Proposed *Planning Act* Changes – The Proposed *More Homes for Everyone Act, 2022*; comments due April 29, 2022* [2]
- ERO No. 019-5285: Community Infrastructure and Housing Accelerator – Proposed Guideline; comments due April 29, 2022
- ERO No. 019-5286: Opportunities to increase the missing middle housing and gentle density, including supports or multigenerational housing; comments due April 29, 2022
- ERO No. 019-5287: Housing Needs in Rural and Northern Municipalities; comments due April 29, 2022 [3]

Ontario's Regulatory Registry Postings

- Proposal No. 22-MMAH006: Proposed *Planning Act* Changes; comments due April 29, 2022*
- Proposal No. 22-MMAH007: Proposed *Development Charges Act* Changes; comments due April 29, 2022*
- Proposal No. 22-MMAH008: Proposed Regulatory Changes – O. Reg. 82/98 of the *Development Charges Act, 1997*; closed April 6, 2022 [4]

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[1] This March 30, 2022 posting was provided for information purposes. It includes links to all of the postings listed in this report.
[2] A proposal identified with an asterisk (*) was for changes included in the *More Homes for Everyone Act, 2022*, which received Royal Assent on April 14, 2022.
[3] This report does not address this proposal, as it is not relevant to Oakville.
[4] This report does not address proposals that were administrative in nature or already closed (e.g., ORR Proposal Nos. 22-MMAH008, 22-MMAH009 and 22-MGCS003).

- Proposal No. 22-MMAH009: Proposed Regulatory Changes – O. Reg. 509/20 Community Benefits Charges and Parkland; closed April 6, 2022
- Proposal No. 22-MMAH010: Access to Provincial Financing for Not-for-Profit Housing Providers; comments due April 29, 2022
- Proposal No. 22-MGCS003: Proposed Regulatory Changes – Condominium Cancellations; closed April 22, 2022
- Proposal No. 22-MGCS010: Proposed Changes to the *New Home Construction Licensing Act, 2017*; comments due April 29, 2022*
- Proposal No. 22-MGCS011: Proposed *Ontario New home Warranties Plan Act* changes; comments due April 29, 2022*

Certain proposals that are administrative in nature and at the time of writing this report were closed to comment, are not addressed by this report (i.e. ORR Proposal Nos. 22-MMAH008, 22-MMAH009 and 22-MGCS003).

Also not covered in this report since they do not apply to the Town of Oakville are changes to the *City of Toronto Act, 2006* and "Housing Needs in Rural and Northern Municipalities".

In a March 31, 2022 memorandum, the Deputy Minister of Municipal Affairs and Housing stated that the provincial government is committed to prioritizing the implementation of all of the HATF's recommendations over the next four years. There will be a housing supply action plan every year starting in 2022/2023.

A provincial Housing Supply Working Group will be established to monitor progress on the municipal implementation of provincial initiatives. The working group will engage with municipalities, the federal government, various provincial ministries, industry partners and associations to assess progress and determine improvements to annual housing supply action plans.

On April 4, 2022, Oakville Council received a report titled "Report of the Ontario Housing Affordability Task Force and Implications for Oakville", which was prepared prior to the release of Bill 109 and associated proposals.

On April 14, 2022, Bill 109, the *More Homes for Everyone Act*, 2022 received Royal Assent and came into law.

COMMENTS:

The purpose of this report is to provide Council with preliminary analysis and commentary from town staff on the *More Homes for Everyone Act,* 2022 and related provincial proposals. This commentary, along with any additional comments provided by Council, is intended to form the Town of Oakville's submission to the Ministry of Municipal Affairs and Housing.

As noted, the *More Homes for Everyone Act,* 2022 received Royal Assent on April 14, 2022. The Province enacted this legislation while the comment period was still open and despite claims to be seeking input and feedback on the various proposals. It is unclear how the Province intends to incorporate any municipal feedback now that the legislation has already been passed prior to any meaningful public consultation. It also appears that the *More Homes for Everyone Act,* 2022 received Royal Assent without amendment to the original Bill.

Now that the *More Homes for Everyone Act,* 2022 has passed, a number of changes are made to the *Planning Act*, the *City of Toronto Act, 2006,* the *Development Charges Act, 1997,* the *New Home Construction Licensing Act, 2017* and the *Ontario New Home Warranties Plan Act*.

These changes are intended to address the housing crisis by making changes to the planning process, addressing real estate speculation and protecting homebuyers.

Changes to the *Planning Act*

This section responds to changes to the *Planning Act* from the *More Homes for Everyone Act,* 2022, as proposed through ERO No. 019-5284 and Proposal No. 22-MMAH006.

Official Plan Amendments and Approvals

The *More Homes for Everyone Act,* 2022 amends the *Planning Act* to provide the Minister of Municipal Affairs and Housing with discretionary decision making authority to ironically suspend the 120-day time period for filing a non-decision appeal of an official plan or official plan amendment (OPA) where the Minister is the approval authority. The Minister of Municipal Affairs and Housing is typically the approval authority in the case of an upper- or single-tier Municipal Comprehensive Review (Growth Plan conformity exercise).

This suspension may provide the Minister additional time to consult with a municipality to clarify or resolve matters. It may also result in delayed timing for a decision on a Municipal Comprehensive Review (MCR).

Changes to the *Planning Act* will also enable the Minister of Municipal Affairs and Housing to refer part, or all of an MCR, Official Plan Amendment or Official Plan to the Ontario Land Tribunal (OLT) for advice on approving or modifying the planning instrument prior to a final decision.

The OLT may hold a hearing and if so, notice is given to the municipality, but it is unclear what role the municipality will play at the hearing. Here again is a situation creating more delay and increased costs from uncertainty and litigation.

While the operational details of these provisions have not been provided, there is a concern amongst municipalities and as evidenced in the submission from the Association of Municipalities of Ontario to the Province that this will cause significant delays and increased costs for municipal staff and consultants in litigation at the OLT.

For Oakville, delays in the approval of Halton's MCR will result in delays in the continued support and implementation of the town's urban structure and subsequent approval of the local OPAs, plans of subdivision and zoning by-law amendments.

It is difficult to understand how increased litigation and delayed approvals will improve affordability, timeliness of land use decisions and increase the supply of housing in the Province. Town staff does not support this change in the legislation.

Refunding Planning Application Fees

Additional changes to the *Planning Act* will apply punitive consequences in the form of gradual planning application fee refunds. The implementation of these measures is anticipated to have major financial impacts to the town.

These refunds will be from municipalities to applicants for site plan, zoning by-law and official plan amendment fees if a decision is not made within the legislated timelines (Figure 1).

For The Town of Oakville, the 2022 activity rate forecast is for $2.9 million in planning application fees revenue. Assuming a similar activity rate forecast for 2023, when the new regulations for fee refunds take effect January 1, 2023, at least $2.9 million could be at risk.

Any shortfall caused by the Province's proposed fee refund changes would need to be covered by Oakville's tax levy, where current tax payers, including residents and businesses, would be responsible for covering the difference.

Figure 1: Punitive schedule for planning application fee refunds

	No Refund	50% Refund	75% refund	100% Refund
Zoning By-law Application	Decision made within 90 days	Decision made within 91 and 149 days	Decision made within 150 and 209 days	Decision made 210 days or later
Combined Official Plan Amendment and Zoning By-law Application	Decision made within 120 days	Decision made within 121 and 179 days	Decision made within 180 and 239 days	Decision made 240 days or later
Site Plan Application	Decision made within 60 days	Decision made within 61 and 89 days	Decision made within 90 and 119 days	Decision made 120 days or later

It is important to note that utilizing the town's tax levy to cover shortfalls in planning revenues will also increase the cost of property ownership for existing property owners. These impacts may affect housing affordability and impose barriers to accessing home ownership across the Province.

Regarding the development application process, this always involves review and collaboration between the municipality, agencies and the applicant, as well as engagement with the community and Council.

The timing and duration of this process is often beyond the control of the municipality, as in the case of delayed responses and incomplete submissions from applicants. Another source of delay in the process comes from time spent waiting for comments from public agencies, including provincial agencies.

As a result of these changes to the *Planning Act,* the Town of Oakville will need to review its planning application processes to accommodate the new timelines. In the face of external delays in a planning process and to avoid financial consequences to existing taxpayers from refunding fees, the town will need to explore all options including understanding the implications of refusing planning applications. This type of action will result in further delays and litigation costs at the OLT.

Another consideration for external delays is whether an applicant would deliberately delay their response for revisions or requests for information in a planning process. This type of delay, which is beyond the control of the municipality, could extend the timing of the planning process beyond the "no penalty" period of the legislated timeframe. Clearly this is an unintended consequence of the punitive schedule for planning applications fee refunds imposed by the legislation.

The Province has indicated that the OLT is presently backlogged. It is difficult to see how increased litigation and delays in the OLT and the provincial court system will improve affordability and increase the supply of housing in the Province. Town staff does not support this change in the legislation.

Use of Surety Bonds

Another change as a result of the *More Homes for Everyone Act*, 2022 is the use of surety bonds instead of cash or letters of credit as securities, which are currently required by most municipalities. Staff support surety bonds; however, do not support the ability of the owners of land and applicants to stipulate the type of surety bonds and other prescribed instruments used. The municipality should have the authority to specify the type and structure of the surety bond. Surety bonds can be set up in a way that both provides the intended benefits to the developer while also limiting risk and administrative burden for the municipality.

Changes to the Site Plan Application Process

Changes to the *Planning Act* now require municipalities to delegate site plan approval from municipal Councils to staff, extend site plan review timelines from 30-60 days, and apply complete application rules to site plans.

As Council is aware, the site plan application process is technical in nature as it implements the land use policies and zoning regulations that are already in effect. The review of development at the site plan stage is specific to following the town's design standards and requirements. The Town of Oakville has a positive experience expediting site plan approvals in a streamlined process. Town staff supports extended plan review timelines since this will help the collaborative review process with applicants. Formally applying a complete application process to site plan applications, which the town does already, is also supported since it will help to clarify expectations and improve transparency.

Changes to the Plan of Subdivision Process

The legislation now allows the Minister of Municipal Affairs and Housing to prescribe certain matters as conditions of subdivision approval that were not previously permitted to be imposed. It is not clear what these potential new matters may be. It is also not clear what the intent is behind this amendment or the need for provincial intervention into local municipal affairs for subdivision approvals.

Town staff does not support this new legislation since it erodes the town's authority over the orderly disposition of land, resources, facilities and services with a view to securing the physical, economic and social efficiency, health and well-being of the community.

An additional administrative change has occurred to allow lapsed plans of subdivisions to be reinstated, one time only, where there are purchase and sale agreements, and the application lapsed within the last the past five years. Town staff supports this change.

Changes to Growth-Related Funding Tools

The *More Homes for Everyone Act,* 2022 makes changes to growth-related funding charges including Parkland Dedication and Community Benefits Charge (CBC) with the goal of creating more transparency and certainty relating to fees or levies charged by municipalities to developers.

Regarding the CBC, municipalities with a community benefits charge by-law will be required to undertake and complete a review, including consulting publicly, on their by-law at least once every five years.

Town staff estimates that these changes will cause minimal increases in administration since the CBC review can be done in conjunction with the Development Charges (DC) study as part of its regular review cycle. Town staff supports increases in transparency, public engagement and public reporting.

Other changes from the *More Homes for Everyone Act,* 2022, include implementing a tiered alternative parkland dedication rate that would only apply to land designated as a Transit-Oriented Community (TOC) under the *Transit-Oriented Communities Act,* 2020:

- Smaller sites that are five hectares or less would be assigned parkland dedication up to 10% of the land or its value.
- Larger sites greater than five hectares would be assigned parkland dedication up to 15% of the land or its value.

These TOC projects are defined and relate to projects in the City of Toronto, York Region, or any other provincial transit project prescribed by regulation. As such, it does not currently apply to Oakville.

However, the town is currently in the midst of finalizing its Parks and Open Space Strategy with the intent of presenting it to Council in the near future. Town staff may be supportive of some cap on parkland dedication set by the municipality in areas that could be identified as a TOC in the future, for example Midtown Oakville.

Town staff would not be supportive of a cap imposed by the Province without local municipal input and which prevents the Town from establishing adequate ratios of parkland to housing in the town's urban areas.

Changes to the *Development Charges Act*

This section responds to changes to the *Development Charges Act*, 1997, from the *More Homes for Everyone Act,* 2022, as proposed through Proposal No. 22-MMAH007.

The changes to the legislation are intended to enhance transparency around DCs by enhancing existing reporting requirements for municipalities that levy DCs.

Currently, municipalities are required to prepare a DC background study, in which they provide projected expenditures on DC - eligible capital. This background study is used to inform the DC bylaw and the charges levied on development.

Forecasting capital projects as input to the DC study is typically based on longer term master planning and detailed analyses undertaken at a point in time. The Town of Oakville engages in such practices and it is standard to update these forecasts on a five-year basis.

The new provincial regulations will require additional detailed annual reporting from the Town. It is not clear from the Province if these new requirements will be focused on service areas, or on individual capital projects within service areas.

In either case, due to the lack of detail provided by the Province at this stage, town staff are uncertain as to the implications of these changes and how they may result in an increased and unplanned administrative burden on the town.

Community Infrastructure and Housing Accelerator

The Province has introduced the Community Infrastructure and Housing Accelerator (CIHA) tool as provided in ERO No. 019-5285.

This new CIHA tool would allow municipalities to submit a request to the Minister of Municipal Affairs and Housing to expedite approvals for local priorities such as market-rate housing, non-profit housing, buildings that facilitate economic development, mixed-use developments, and community infrastructure such as long-term care facilities.

Local councils would be required to pass a council motion, and to host a public meeting to discuss the use of a CIHA for each project. Finally, a municipality would submit a request to the Minister of Municipal Affairs who could impose conditions on the CIHA.

The new CIHA tool largely resembles municipally-requested Minister's Zoning Orders (MZOs), but with added public consultation requirements to ensure that residents have an opportunity to provide feedback on such requests.

Town staff has concerns regarding potential misuse of this tool to for example facilitate ad hoc employment conversions, the provision of servicing outside urban boundaries, and development in areas that may conflict with comprehensive growth management processes that have identified where and how growth should occur in municipalities.

Town staff is of the opinion that this tool should only apply to lands designated for urban uses as identified in official plans, should be aligned with the provision and timing of municipal infrastructure, and should have regard for provincial policies and plans.

Changes to Protect Ontario Homebuyers and Renters

The *More Homes for Everyone Act,* 2022 makes changes to the *New Home Construction Licensing Act*, 2017 (ORR 22-MGCS010), and *the Ontario New Home Warranties Plan Act* (ORR 22-MGCS011).

These changes are intended to protect residents who buy, own and rent homes in Ontario. This will be achieved by increasing fines and administrative penalties for builders and vendors of new homes that contravene the provisions of the Act which includes failing to meet the standards of competence and conduct, failing to support and promote a fair market place and failing to comply with the code of ethics. Changes are also made regarding extended warranty periods and setting conditions for such an extension so that missing or unfinished work may be completed.

Town staff does not have concerns with new legislation that supports consumer protection in the homebuilding industry.

Diversifying Housing Choices in Existing Neighbourhoods

The Province is seeking input through ERO No. 019-5286 on how to diversify housing choices in existing neighbourhoods. That consultation is focused on finding ways to support gentle density and increase "missing middle" housing, including encouraging multigenerational housing solutions.

Delivering housing supply is something that can only be addressed through the willing participation of all levels of government and the housing industry working towards shared, reasonable goals.

There are also important municipal considerations that must be factored in to the delivery of diverse housing choices in existing neighbourhoods, including:

- Regional / local urban structure
- Water and wastewater services
- Stormwater management and tree canopy coverage
- Cultural heritage conservation
- Local zoning and urban design
- Building standards and fire safety
- Transit service

At it's meeting of April 4, 2022, Oakville Council received the "Report of the Ontario Housing Affordability Task Force and Implications for Oakville" which provided commentary on the Task Force Final Report Recommendations.

That report expressed support for measures to deliver housing supply that included:

- Permitting secondary suites as-of-right which has broad-based municipal support.
- Permitting multi-tenant housing as-of-right but subject to appropriate by-law and licensing frameworks for safety and maintenance.
- Permitting as-of-right zoning of six to 11 storeys (with no minimum parking requirements) on streets served by higher order public transit. In Oakville, the town-wide urban structure identifies opportunities along Dundas Street and Trafalgar Road north of Midtown Oakville.

Oakville's Next Steps

The delivery of housing is subject to forces often beyond a municipality's control; and not necessarily singularly focussed on the amount of supply. Housing affordability can be affected by many factors including federal immigration policy, financial factors (e.g. labour, supply chain challenges, interest rates), and geographic location.

The Town of Oakville will continue to examine housing matters locally and in conjunction with agency partners, the development industry and the community.

There will be a housing information report containing a preliminary policy analysis tabled for Council discussion at the May 16, 2022 Planning and Development Council meeting. The purpose of that report is to provide:

- An overview of housing-related legislation, plans and policies at the federal, provincial, regional, and town levels;
- Commentary on various emerging housing matters, trends and themes; and,
- A preliminary assessment of the town's housing policies in the Livable Oakville Plan and the North Oakville East Secondary Plan, identifying issues and matters to be addressed.

As part of the town's ongoing Official Plan Review, staff will be advancing the Residential Areas Policy Review focused on the Residential Areas of the town's Urban Structure. That review will examine the land use designations and policies within the Residential Areas, and propose updates to address growth, change and housing options in the context of the framework for growth established by Council through the Urban Structure.

In terms of concerns that remain outstanding, town staff offer the following:

- The absence of regulatory and operational details to support the function of the legislation has created uncertainty around the Province's amendments.
- With this uncertainty, it is difficult to understand the complete range of implications for municipalities and how to respond appropriately and efficiently.
- As a result of some of the Province's amendments, increased and unplanned administrative burdens for municipalities are anticipated.
- Some of the new legislation is predicted to cause significant delays and increased costs for municipal staff and consultants in litigation at the OLT.
- The punitive approach to refunding planning application fees creating revenue shortfalls that need to be funded by the town's tax levy is problematic.

In the face of uncertainty, increasing administrative burdens and costs from litigation, erosion of local municipal planning and decision making authority and timing delays in the planning process, it is not clear how the Provincial measures will increase housing supply and improve housing affordability.

Town staff are of the opinion that the opposite will occur and that some aspects of the new Provincial legislation will have unintended consequences to increase time and costs in the housing sector. In other words, housing supply and affordability will be negatively affected.

CONSIDERATIONS:

(A) PUBLIC
Members of the public may provide comments on the *More Homes for Everyone Act,* 2022, and related proposals through the postings on the Environmental Registry of Ontario (https://ero.ontario.ca/) as well as Ontario's Regulatory Registry (https://www.ontariocanada.com/registry/).

(B) FINANCIAL
There are no financial considerations arising from this report. However, the *More Homes for Everyone Act,* 2022 changes in respect of refunding planning application fees and increased litigation and appeals of matters to the Ontario Land Tribunal will have substantial financial impacts for the town.

(C) IMPACT ON OTHER DEPARTMENTS & USERS
This report was prepared by the Planning Services department in consultation with the Legal, Finance, Building Services and Oakville Fire departments.

(D) CORPORATE STRATEGIC GOALS
This report addresses the corporate strategic goal(s) to be the most livable town in Canada.

(E) CLIMATE CHANGE/ACTION
The *More Homes for Everyone Act, 2022,* is intended to facilitate the construction of more housing across the Province. Council may mitigate the impact of new housing on our changing climate by directing intensification to existing urban areas in accordance with Oakville's town-wide urban structure.

CONCLUSION:

Staff is recommending that this report be endorsed and submitted to the Province, along with the Council resolution, as the Town of Oakville's comments on the *More Homes for Everyone Act,* 2022 and the related proposals.

In the case of minor changes to the legislation from the *More Homes for Everyone Act,* 2022 to address municipal administrative process town staff offers support. Town staff also supports changes to legislation that improve transparency and accountability in the housing sector.

Town staff do not support changes that re-inforce ministerial over-reach, increase delays, increase costs from litigation and reduce local municipal planning and decision making authority.

Town staff also does not support changes in the legislation that apply a punitive approach to refunding planning application fees. This will result in a shortfall impact to the town's tax levy where current tax payers would be responsible for covering the difference.

The lack of time for review has undermined the ability of town staff to conduct a comprehensive analysis. An evaluation of these legislative changes and their impacts to the town's ability to plan its future in a manner that retains livability and financial sustainability has been difficult to undertake.

Overall, it is challenging for the Town of Oakville to support legislative changes that the province has pushed through without appropriate and meaningful consultation.

Further information and analysis on housing and related matters will be brought forward for Council consideration as timing permits and as appropriate.

Prepared by:

Lesley E. Gill Woods, MCIP, RPP
Senior Planner, Policy Planning and Heritage

Kirk Biggar, MCIP, RPP
Acting Manager, Policy Planning and Heritage

Matt Day, CPA, CGA
Manager - Development Financing & Investments

Recommended by:

Gabe Charles, MCIP, RPP
Director, Planning Services

Jonathan van der Heiden, CPA, CA
Deputy Treasurer and Director of Finance

Submitted by:

Nancy Sully, CPA, CMA
Commissioner, Corporate Services Commission & Treasurer

Neil Garbe, RPP, PLE
Commissioner, Community Development Commission

REPORT

Council

Meeting Date: April 25, 2022

FROM: Finance Department

DATE: April 19, 2022

SUBJECT: **2021 Financial Results and Surplus Disposition**

LOCATION:
WARD: Town-wide

RECOMMENDATION:

1. That the staff report dated April 19, 2022, entitled *2021 Financial Results and Surplus Disposition* from the Finance department, be received.

2. That the transfers to and from the Reserves and Reserve Funds and transactions contained in the report dated April 19, 2022 from the Finance department be approved.

3. That the $11.15 million surplus be transferred to the General Capital Reserve.

KEY FACTS:

The following are key points for consideration with respect to this report:

- The Financial Results report presents the town's financial activities from January 1, 2021 to December 31, 2021.
- The total town variance after reserve transfers is $11.15 million favourable or 5.2% of the tax levy. Safe Restart Agreement funding from the province along with town mitigation efforts due to reduced programming and services resulted in cost savings, primarily in personnel services and benefits, which offset the impact from the COVID-19 pandemic.
- Total capital expenditures of $59.6 million have been incurred in this period.
- A total of 70 capital projects have been identified for closure this period resulting in $3.92 million being returned to reserves and reserve funds.
- A total of 22 tendered contracts and 2 single source awards in excess of $100,000 were awarded during this period.
- Inflation accelerated in the second half of 2021 and beginning of 2022 due to widespread supply chain issues stemming from the pandemic. This elevated inflationary environment is expected to continue, as the geopolitical conflict in eastern Europe has created additional uncertainty, pushing up prices for

energy and commodities, and introducing new constraints on supply chains. It is expected that this will result in financial pressure for the town's operating and capital budgets in 2022.

BACKGROUND:

This report provides an update regarding the town's financial activities from January 1, 2021 to December 31, 2021 and covers all financial matters including: operating budget, capital budget, reserve and reserve fund balances, investment and trust funds, and purchasing activities. Based on the unaudited financial results, the majority of town programs have a favourable variance. This is primarily due to savings in personnel costs, though savings have been recognized in a number of other areas as well; together, these offset revenue losses due to the COVID-19 pandemic.

COMMENT/OPTIONS:

OPERATING BUDGET

Based on the December 31st results, the total town variance, after policy related and recommended reserve transfers, is $11.15 million favourable or 5.2% of the tax levy.

($ Millions)	2021 Annual Budget	2021 Year-end Actuals	2021 Variance to Budget ($)
Emergency Services	40.45	41.56	(1.11)
Road Network	25.83	23.78	2.05
Oakville Transit	28.17	21.88	6.29
Recreation and Culture	21.98	19.90	2.08
Parks and Open Spaces (incl. Cemetery and Harbours)	19.30	18.37	0.93
Oakville Public Library	10.21	9.87	0.35
Community Development	3.01	(0.44)	3.45
Political Governance	3.79	3.59	0.20
Municipal Enforcement (incl. Parking)	2.81	3.11	(0.30)
Corporate Support Services	32.94	30.46	2.48
Total Program Variance	**$ 188.49**	**$ 172.08**	**$ 16.42**
Corporate Hearings & Litigation	0.50	1.63	(1.13)
Corporate Revenue & Expenses	(188.99)	(190.45)	1.46
Town Variance before transfers	**$ -**	**$ (16.75)**	**$ 16.75**
Policy Related and Recommended Transfers for Programs:			
Transfer (to)/from Storm Event Reserve			(0.66)
Transfer Oakville Public Library surplus (to)/from Tax Stabilization Reserve			(0.35)
Transfer (to)/from Building Enterprise Reserve			(4.07)
Transfer (to)/from Cemetery Reserve			(0.03)
Transfer (to)/from Harbours Reserve fund			(0.47)
Transfer (to)/from Parking Reserve fund			not recommended
Transfer (to)/from Election Reserve			(0.02)
Total Town Variance after transfers			**$ 11.15**

As shown above, the total Program variance is $16.42 million favourable and more information on these program variances can be found below. Corporate Hearings and Litigation has an unfavourable variance of $1.13 million due to costs for the Glen Abbey hearing. Corporate Revenue and Expenses has a favourable variance of $1.46 million. This is primarily due to higher revenue from supplementary taxes and payments–in-lieu of taxes ($3.40 million) as well as the General Safe Restart Agreement (SRA) funding from the province with $1.89 million received for Phase 2 and $2.85 million received for Phase 3. The funding from the province has reduced the need for the town to utilize the $4.54 million in budgeted Tax Stabilization funding. The total Program variance combined with Corporate Hearings & Litigations and Corporate Revenues & Expenses shows a total town variance before transfers of $16.75 million favourable.

Reserve transfers

Legislation requires any surplus/shortfall generated from building permit revenues to be transferred to/from the Building Enterprise Reserve resulting in a transfer to the reserve of $4.07 million. Town policy is to balance any surplus/deficit for Cemeteries, Harbours, Parking, and Election to their own program specific reserves. Town staff are recommending that surpluses in Cemeteries, Harbours and Election be transferred to their respective reserves and reserve funds as normal at year-end. Parking was impacted by the COVID-19 pandemic and experienced a deficit of $0.11 million. Town staff are recommending that the transfer from the Parking reserve fund to cover the shortfall not occur in 2021 given the impact of the pandemic and the town's overall surplus which is similar to the approach taken with the Parking deficit in 2020. Town staff are also recommending that the savings in winter control be transferred to the Storm Event reserve and the surplus for the Oakville Public Library be transferred to the Tax Stabilization reserve. After all policy related and recommended transfers, the total town variance after transfers is $11.15 million favourable.

Usual practice would be to recommend that the surplus be transferred to the Tax Stabilization Reserve; however, the balance in this reserve is very healthy ($64.8 million) and above the GFOA recommended levels. Therefore, town staff are recommending that the surplus be transferred to the General Capital Reserve given the size of the capital program and inflation risk. The 2022 capital program of $276.3 million and ten year capital forecast of $1.6 billion are substantial. Furthermore, inflation accelerated in the second half of 2021 and beginning of 2022 due to widespread supply chain issues stemming from the pandemic. This elevated inflationary environment is expected to continue as the geopolitical conflict in eastern Europe has created additional uncertainty and introduced new constraints on supply chains resulting in financial pressure for the town in 2022. The recommendation to transfer the surplus to the General Capital Reserve will ensure that our capital program remains strong.

COVID-19 Impact

The impact of the pandemic on the town's operations and the response undertaken by the town has impacted the programs in different ways. The total estimated COVID-19 impact is $9.53 million with $7.17 million due to revenue loss and $2.36 million due to additional costs. The $0.70 million variance for Transit is for transit fares only, not including Transit SRA funding, based on a 2021 external revenues budget of $4.47 million which was reduced substantially from a 2020 budget of $9.29 million. The additional costs include personnel services for officers to assist with COVID-19 enforcement in the community, redeployment of Recreation staff to assist with Parks maintenance due to a significant increase in visitors to parks, overtime in Emergency Services as well as materials, supplies and purchased services to address COVID-19 related concerns.

COVID-19 Impact ($ Millions)	2021 Variance to Budget
Revenue Loss	
Recreation and Culture	(5.82)
Transit	(0.70)
Parking	(0.56)
Other Programs	(0.09)
Total Revenue Loss	**$ (7.17)**
Additional Costs	
Personnel Services and Benefits	(1.59)
Materials and Supplies	(0.11)
Purchased Services	(0.66)
Total Additional Costs	**$ (2.36)**
Total estimated COVID-19 Impact at year-end	**$ (9.53)**

Program Variance

Mitigation efforts continued throughout the year and savings in expenditures were realized to offset the impact from the pandemic. Despite the total estimated COVID-19 impact, the total Program variance is $16.42 million favourable. The most significant variances to budget by expense and revenue type are discussed below.

($ Millions)	2021 Annual Budget	2021 Year-end Actuals	2021 Variance to Budget ($)
EXPENSES			
PERSONNEL SERVICES & BENEFITS	166.22	155.27	10.94
MATERIALS & SUPPLIES	22.73	21.35	1.38
CAPITAL OUT OF OPERATIONS	0.30	0.35	(0.05)
PURCHASED SERVICES	35.32	33.09	2.23
PAYMENTS & GRANTS	5.52	4.48	1.03
INTERNAL EXPENSES & TRANSFERS	36.56	37.13	(0.57)
Total EXPENSES	**266.65**	**251.68**	**$ 14.97**
REVENUES			
EXTERNAL REVENUES	(54.68)	(57.67)	2.99
INTERNAL RECOVERY & FUND TRSFS	(23.47)	(21.93)	(1.55)
Total REVENUES	**(78.16)**	**(79.60)**	**$ 1.44**
Total Programs	**188.49**	**172.08**	**$ 16.42**

Personnel Services & Benefits - $10.94 million favourable. These savings are higher than normal, mainly in Recreation & Culture and Transit, due to reduced programming and services during the year as well as in Infrastructure Maintenance for the traffic crossing guards program. Also, the town continued to mitigate the COVID-19 impact of revenue loss and additional costs by keeping positions vacant and only filling critical positions.

Materials & Supplies - $1.38 million favourable. These savings are primarily attributed to utilities mainly in Recreation and Culture due to the closure of various facilities and reduced programming as well as savings on fuel and vehicle parts in Transit due to reduced services.

Purchased Services - $2.23 million favourable. These savings are primarily attributed to instructor and performer fees and programming costs in Recreation and Culture due to reduced programming throughout the year. Also, demand for specialized Transit service was lower than normal resulting in savings on taxis.

Payments & Grants - $1.03 million favourable. These savings are due to reduced Presto fees and bank service fees given the reduced number of payment transactions. Also, reduced programming in Recreation and Culture has resulted in favourable variances in the fee assistance program as well as the reciprocal agreement with the school boards.

External Revenue - $2.99 million favourable. Although revenue loss due to COVID-19 is estimated to be $7.17 million as discussed in the previous section, some programs experienced higher revenues primarily due to permit revenues in Building Services, Safe Restart Agreement funding in Transit, additional recoveries for work completed for Halton Region, unbudgeted grants in Municipal Enforcement, and higher sports field rental revenues as well as unbudgeted grants in Parks.

Internal Recovery & Fund Transfers - $1.55 million unfavourable. This is primarily due to transfers from the Tax Stabilization reserve which were not required given the overall surplus. Also contributing to the variance are lower recoveries for equipment usage which are offset by lower internal charges as well as lower recoveries of staff time from capital projects given efforts to keep positions vacant as well as fewer capital projects this year.

The most significant variances to budget by program area are discussed below. Appendix A provides more detail of the variance by program area.

Recreation and Culture - $2.08 million favourable
The variance is primarily due to $4.65 million in personnel savings given reduced programming and keeping positions vacant in order to mitigate the impact of the pandemic. Savings in materials and supplies ($1.38 million) and purchased services ($0.91 million) are due to savings on utilities as well as instructor and

performer fees and other costs given the closure of facilities and reduced programming during the year which also resulted in revenue loss of $5.62 million.

($ Millions)	2021 Annual Budget	2021 Year-end Actuals	2021 Variance to Budget ($)
EXPENSES			
PERSONNEL SERVICES & BENEFITS	21.21	16.56	4.65
MATERIALS & SUPPLIES	5.04	3.67	1.38
CAPITAL OUT OF OPERATIONS	0.07	0.05	0.01
PURCHASED SERVICES	3.95	3.04	0.91
PAYMENTS & GRANTS	1.35	0.64	0.70
INTERNAL EXPENSES & TRANSFERS	4.49	4.14	0.35
Total EXPENSES	**$ 36.10**	**$ 28.11**	**$ 8.00**
REVENUES			
EXTERNAL REVENUES	(13.63)	(8.01)	(5.62)
INTERNAL RECOVERY & FUND TRSFS	(0.50)	(0.20)	(0.30)
Total REVENUES	**$ (14.13)**	**$ (8.20)**	**$ (5.92)**
Total Recreation and Culture	**$ 21.98**	**$ 19.90**	**$ 2.08**

Oakville Transit - $6.29 million favourable

The variance is primarily as a result of Safe Restart Agreement (SRA) funding to offset COVID impacts and cost saving measures designed to offset the reduction in ridership and associated loss of revenue from fares. While the 2021 budget accounted for anticipated COVID impacts, the ongoing pandemic and extended provincial lockdown resulted in a further transit revenue shortfall of $0.70 million beyond these planned reductions. Transit staff implemented additional service level changes that effectively mitigated this shortfall. These savings were realized in personnel services, Presto fare settlement fees, motor vehicle parts, tires, lubricants and fuel as well as savings from taxi usage for specialized transit trips. Ridership continued to be impacted by the pandemic and was below target. However, recent weekly reports display a slow but steady upward trend.

The town recognized a total of $3.98 million in SRA funding ($0.65 million for Phase 2, $2.38 million for Phase 3 and a $0.95 million top-up payment) from the Provincial government in 2021 to support with COVID-19 municipal transit pressures which is captured under external revenues in the table below.

($ Millions)	2021 Annual Budget	2021 Year-end Actuals	2021 Variance to Budget ($)
EXPENSES			
PERSONNEL SERVICES & BENEFITS	21.00	19.39	1.61
MATERIALS & SUPPLIES	4.56	3.84	0.72
CAPITAL OUT OF OPERATIONS	0.01	0.01	(0.00)
PURCHASED SERVICES	3.61	2.96	0.65
PAYMENTS & GRANTS	0.91	0.76	0.15
INTERNAL EXPENSES & TRANSFERS	4.66	4.65	0.01
Total EXPENSES	**$ 34.73**	**$ 31.60**	**$ 3.13**
REVENUES			
EXTERNAL REVENUES	(4.47)	(7.72)	3.25
INTERNAL RECOVERY & FUND TRSFS	(2.10)	(2.00)	(0.10)
Total REVENUES	**$ (6.57)**	**$ (9.72)**	**$ 3.15**
Total Oakville Transit	**$ 28.17**	**$ 21.88**	**$ 6.29**

Road Network - $2.05 million favourable

The variance is primarily due to personnel savings for various vacancies and the traffic crossing guards program. This is partially offset by lower recoveries for equipment usage as well as lower recoveries of staff time from capital projects given efforts to keep positions vacant as well as fewer capital projects this year. The unfavourable variance in materials and supplies is related to work being done for the Region which is fully recoverable and reflected in external revenues.

($ Millions)	2021 Annual Budget	2021 Year-end Actuals	2021 Variance to Budget ($)
EXPENSES			
PERSONNEL SERVICES & BENEFITS	15.98	14.04	1.94
MATERIALS & SUPPLIES	6.51	7.31	(0.80)
CAPITAL OUT OF OPERATIONS	0.09	0.09	0.00
PURCHASED SERVICES	9.63	9.10	0.53
PAYMENTS & GRANTS	1.35	1.38	(0.03)
INTERNAL EXPENSES & TRANSFERS	7.22	7.13	0.09
Total EXPENSES	**$ 40.79**	**$ 39.07**	**$ 1.73**
REVENUES			
EXTERNAL REVENUES	(5.12)	(6.39)	1.27
INTERNAL RECOVERY & FUND TRSFS	(9.84)	(8.90)	(0.94)
Total REVENUES	**$ (14.96)**	**$ (15.29)**	**$ 0.33**
Total Road Network	**$ 25.83**	**$ 23.78**	**$ 2.05**

Community Development - $3.45 million favourable

The variance is primarily due to higher permit revenues in Building Services and personnel savings for various vacancies. Legislation requires any surplus/shortfall generated from building permit revenues to be transferred to/from the Building Enterprise Reserve resulting in a transfer to the reserve of $4.07 million.

($ Millions)	2021 Annual Budget	2021 Year-end Actuals	2021 Variance to Budget ($)
EXPENSES			
PERSONNEL SERVICES & BENEFITS	14.41	13.32	1.08
MATERIALS & SUPPLIES	0.08	0.06	0.02
CAPITAL OUT OF OPERATIONS	0.01	0.00	0.01
PURCHASED SERVICES	0.51	0.39	0.12
PAYMENTS & GRANTS	0.11	0.10	0.01
INTERNAL EXPENSES & TRANSFERS	8.07	8.06	0.00
Total EXPENSES	**$ 23.18**	**$ 21.93**	**$ 1.25**
REVENUES			
EXTERNAL REVENUES	(17.16)	(19.82)	2.67
INTERNAL RECOVERY & FUND TRSFS	(3.01)	(2.55)	(0.46)
Total REVENUES	**$ (20.17)**	**$ (22.37)**	**$ 2.21**
Total Community Development	**$ 3.01**	**$ (0.44)**	**$ 3.45**

Corporate Support Services - $2.48 million favourable

The variance is primarily due to $2.71 million in personnel savings for various vacancies as positions have been left vacant to mitigate the impact of the pandemic. This is partially offset by Internal Recovery and Fund Transfers due to Tax Stabilization funding which was not required in 2021 given the overall surplus and lower recoveries of staff time from capital projects given efforts to keep various positions vacant and fewer capital projects this year.

($ Millions)	2021 Annual Budget	2021 Year-end Actuals	2021 Variance to Budget ($)
EXPENSES			
PERSONNEL SERVICES & BENEFITS	27.93	25.22	2.71
MATERIALS & SUPPLIES	1.09	1.01	0.08
CAPITAL OUT OF OPERATIONS	0.03	0.03	0.00
PURCHASED SERVICES	8.31	7.98	0.33
PAYMENTS & GRANTS	0.42	0.43	(0.01)
INTERNAL EXPENSES & TRANSFERS	0.34	0.41	(0.07)
Total EXPENSES	**$ 38.11**	**$ 35.07**	**$ 3.04**
REVENUES			
EXTERNAL REVENUES	(1.86)	(2.32)	0.46
INTERNAL RECOVERY & FUND TRSFS	(3.31)	(2.28)	(1.02)
Total REVENUES	**$ (5.17)**	**$ (4.61)**	**$ (0.56)**
Total Corporate Support Services	**$ 32.94**	**$ 30.46**	**$ 2.48**

Emergency Services - $1.11 million unfavourable

The variance is primarily due to $0.91 million in additional overtime incurred, primarily in November and December, due to the COVID-19 pandemic.

($ Millions)	2021 Annual Budget	2021 Year-end Actuals	2021 Variance to Budget ($)
EXPENSES			
PERSONNEL SERVICES & BENEFITS	36.30	37.16	(0.87)
MATERIALS & SUPPLIES	0.74	0.85	(0.11)
CAPITAL OUT OF OPERATIONS	0.01	0.02	(0.01)
PURCHASED SERVICES	1.83	1.86	(0.03)
PAYMENTS & GRANTS	0.05	0.04	0.01
INTERNAL EXPENSES & TRANSFERS	2.07	2.11	(0.04)
Total EXPENSES	**$ 40.99**	**$ 42.04**	**$ (1.05)**
REVENUES			
EXTERNAL REVENUES	(0.51)	(0.44)	(0.07)
INTERNAL RECOVERY & FUND TRSFS	(0.03)	(0.04)	0.01
Total REVENUES	**$ (0.54)**	**$ (0.48)**	**$ (0.06)**
Total Emergency Services	**$ 40.45**	**$ 41.56**	**$ (1.11)**

2022 Update on Minimum Wage

It should also be noted that on November 2, 2021, the Provincial Government announced that minimum wage would increase from $14.25 to $15.00 per hour effective January 1, 2022. In order to maintain the integrity of our part-time wage grid, mitigate compression and ensure that we remain competitive in attracting candidates, a 3.8% adjustment (or $375,400 total cost) was applied to the part-time wage grid for 2022. The lowest rate on the part-time wage grid is $15.27 per hour. Given the timing of the province’s announcement and town’s budget process, the total cost was not reflected in the 2022 budget resulting in an impact of $265,600 which staff will monitor alongside mitigation efforts due to the COVID-19 pandemic. The 2023 budget will be adjusted to reflect this impact.

CAPITAL BUDGET

For active projects in this period, the total cumulative approved capital budget is $457.5 million with total expenditures of $59.6 million bringing the total life-to-date or cumulative spending to $344.5 million. Appendix B shows more information on total approved budget and expenditures by program.

Some of the major projects underway with 2021 spending are shown below.

Capital Project	LTD Approved Budget	2021 Expenditures and Commitments	Total LTD Expenditures (incl. Prior Years)
53311410 Speers Rd - GO Station W of 3rd Line to 4th Line	30,744,000	4,353,328	27,266,316
54412007 Replacement Buses	4,170,000	4,142,838	4,164,838
53332101 Road Resurfacing and Preservation Program	5,050,000	3,292,302	3,570,973
54411903 Major Vehicle Refurbishment	5,188,000	2,587,183	4,999,153
53311006 Sixth Line Urbanization and Widening w/AT - North Park to William Halton Parkway	12,847,200	2,531,124	5,210,295
52272101 EAB Management Program	2,374,500	1,992,836	1,992,836
53371505 Vista Promenade - Shoreline Protection	2,761,000	1,926,760	2,304,829
47801901 Museum - Coach House Renovation	2,750,000	1,697,757	1,997,034
53381703 Maplehurst Storm Sewer - South of Bridge Road to Shaw Street - Construction	5,128,000	1,638,847	4,623,387
Total	**$ 71,012,700**	**$ 24,162,974**	**$ 56,129,661**

Capital Budget Transfers and Closures

In accordance with the Financial Control Policy, Commissioners are authorized to approve the transfer of funds between projects for any project where the costs exceed budget by the lessor of 10% or $200,000. There were no transfers between projects approved by Commissioners during this period.

In addition, the CAO has authority to authorize funds from reserves, reserve funds or other appropriate sources up to $350,000 provided the expenditures are within the original scope of the project. The following required funding was approved by the CAO in this period.

Project No.	Project Title	Total Approved	Reserve, Reserve Fund or Other Financing Source	Note
42102123	Fixture Conversions and HVAC Upgrades	$ 25,000	Building Maintenance RF	Additional funds to cover internal labour costs for the delivery of this project which are not covered by the ICIP grant.
52902102	Busby Park Launch Ramp/Seawall	$ 75,000	Capital Reserve	Additional funds are required to complete the replacement of the launch ramp.
43302103	Fire Master Plan	$ 28,200	Fire DCs	Additional funds are required to meet enhanced scope requirement due to legislative changes and addition of Centre for Public Safety Excellence accreditation.
36102120	Trafalgar Rd Widening Fibre Work	$ 58,000	Halton Region	Additional funds to complete mitigation work to route fibre on alternate paths. The additional funding will be fully recovered from the Region.
53412103	ICIP Pedestrian Crossover	$ 20,000	Roads DCs	Additional funds to cover the internal labour costs on the pedestrian and trail crossing improvement project which are not covered by the ICIP grant.

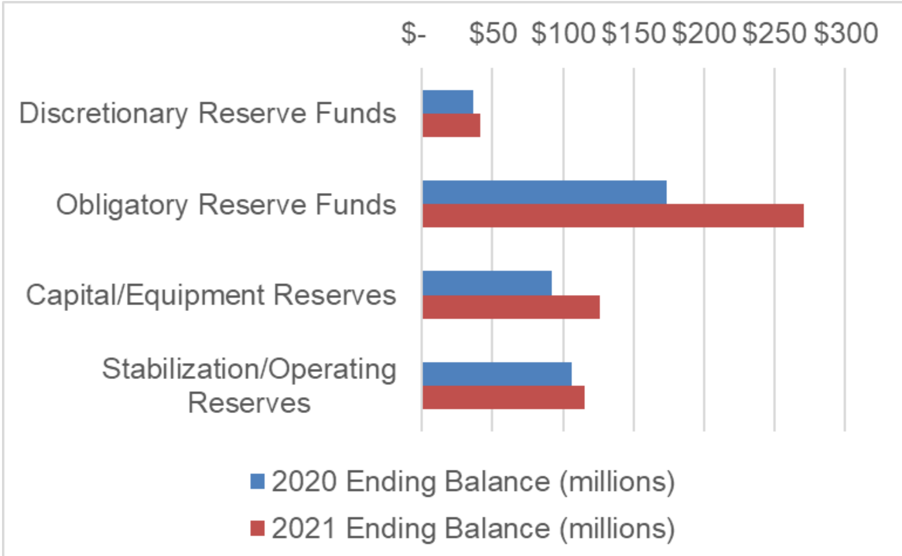
As part of ongoing capital project management, staff review the status of all active projects each quarter to ensure that as projects are completed and an asset goes into service, projects are closed. During the review this period, a total of 70 projects will be closed. These closures represent a net surplus of $3.92 million that will be returned to reserves and reserve funds. This includes $1.72 million to be returned to town capital and equipment reserves and $2.20 million to be returned to development charge and program specific reserve funds. There were higher than budgeted external recoveries primarily due to the LED Streetlight conversion project which resulted in the need to issue less debt ($1.15 million) for this project. Appendix C provides more details of the project closures by program.

Authority	Project Budget vs Actual			Impact on Reserves (in $1,000s) (Positive = surplus, negative = add'l funds required/received)			External Revenues	Debt Issuance
	TOTAL APPROVED BUDGET	TOTAL ACTUAL EXPENSES	PROJECT LIFE VARIANCE	Town Capital & Equipment Reserves	Dev. Charge & Prog. Specific Reserve Funds	Total to/(from) Reserves		
Commissioner	76,165.6	71,638.0	4,527.6	1,808.4	2,199.2	4,007.6	630.0	(1,150.0)
CAO	255.1	346.4	(91.3)	(91.3)	-	(91.3)	-	-
Net Impact	$ 76,420.7	$ 71,984.4	$ 4,436.3	$ 1,717.1	$ 2,199.2	$ 3,916.2	$ 630.0	$ (1,150.0)

RESERVES, RESERVE FUNDS AND TRUST FUNDS

Reserve and reserve funds are an integral part of the municipal budget planning process and long term financing plan that contributes to the municipality's sound financial position. Reserve Funds are established by Council for a specific purpose and include funds that have been set aside in accordance with legislative requirements or at the discretion of Council. As such, the town has both obligatory reserve funds and discretionary reserve funds. Capital and Equipment reserves form an important component of the town's long-term capital financing plan and are used to finance maintenance and replacement of existing infrastructure to maintain assets in a state of good repair, provide for community enhancements as well as fund the town's share of new infrastructure to service the growing community. Stabilization and Operating reserves are used to offset extraordinary and unforeseen expenditure requirements, one-time expenditures, cyclical expenses, revenue shortfalls and help to minimize fluctuations in the tax levy. Trust funds are held by the town for the benefit of other agencies or entities in accordance with specific statutes or trust indenture.

The 2020 and 2021 ending balances are shown below with further details of individual reserve and reserve funds in Appendix D.



*Note: Obligatory reserve balances do not include approved funding for capital projects not transferred yet as funds can only be transferred to projects as spending occurs.

Reserves

Stabilization and Operating reserves are healthy and remained stable over the course of the year. As previously discussed, as a result of higher building permit revenues, an additional transfer of $4.07 million to the Building Enterprise Reserve is recommended in accordance with legislation. Capital reserves increased significantly in 2021, from $71 million to $104 million, primarily due to the sale of Brantwood school and savings on capital project closures.

Reserve Funds

Obligatory reserve funds, which include Development Charges, cash in lieu of Parkland, provincial Gas Tax and the federal Canada Community-Building Fund (“CCBF”, formerly federal gas tax), increased from $174 million to $270 million as expected revenue exceeded current year capital needs. DC and cash-in-lieu of parkland revenue exceeded budget as a result of higher than anticipated development activity. Furthermore, the Town received $6 million in top-up funds from CCBF, which is in addition to the scheduled payment.

Legislation for these reserve funds requires that funding only be transferred to capital projects once spending has been incurred; therefore, it is important to note that the fully committed balance when considering all approved funding is $221 million at year end.
Discretionary reserve funds remained stable throughout the year. The Building Maintenance reserve fund increased from $14 million to $18 million due to a lower capital requirement for the year.

Trust Funds

Funds segregated and held in trust in accordance with the specific terms of a statute or trust indenture total $6.6 million at December 31, 2021 as detailed in the following table. Interest and investment earnings are allocated based on proportionate balance at year end in accordance with policy and procedures.

2021 Trust Funds
($ Thousands)

Trust Fund	2020 Ending Balance	2021 Activity Contributions	2021 Activity Transfers	Balance at 12/31/2021
Cemetery Marker Care	357.0	15.8	6.4	366.3
Cemetery Perpetual Care	5,801.3	332.2	105.1	6,028.4
Library - Halton Information Providers	95.1	188.5	168.3	115.2
Burloak Canoe Club	35.9	0.6	-	36.5
Bronte Harbour Yacht Club	23.3	0.4	-	23.7
Oakville Power Boat Club	10.8	2.2	-	13.0
Bronte Community Tennis Club	23.6	0.4	-	24.0
Oakville Rugby Club	6.2	3.2	-	9.4
Oakville Yacht Squadron	4.1	2.1	-	6.3
Total	**6,357.4**	**545.4**	**279.8**	**6,622.9**

PURCHASING

In accordance with the town's Purchasing By-law 2017-095, a summary of the competitive bids, contract renewals and sole source awards in excess of $100,000 are reported to Council quarterly. Appendix E provides details of the awards and contract renewals in excess of $100,000 for this quarter.

CASH MANAGEMENT and INVESTMENTS

Cash flows are managed to ensure the funding requirements of the town are met while providing for a reasonable rate of return on invested funds not needed in current operations. The investment strategy follows a conservative approach in order to mitigate term and interest rate risk by maintaining a portfolio structure of high-quality, medium-term investments. For the period ended December 31, 2021, gross investment revenue from realized interest income and capital gains/losses, net of amortized premiums/discounts, was $11.4 million, on a portfolio of cash and investments totaling $676.9 million (book value). The annualized rate of return based on average cash and investment holdings was 1.78%, with an average maturity of 5.6 years.

The Bank of Canada (BOC) held the target for the overnight interest rate at the effective lower bound of 0.25% throughout 2021. In response to increased economic activity and inflation in the second half of 2021, the BOC began to ease monetary policy support by ending quantitative easing (bond purchase program) and has signalled that interest rate hikes can be expected in the middle quarters of 2022 as economic slack is absorbed. An interest rate increase of 50 basis points was made in March 2022, with additional increases expected. Bank interest and investment earnings have faced significant pressure over the past year; however, they are on an upward trend as support measures are being removed in order to combat inflation. Appendix F provides details on the components of the town's investment portfolio.

Inflation Outlook

Inflation accelerated in Canada and around the world in the second half of 2021 with consumer and construction prices increasing at levels not seen in decades. This elevated inflationary environment was driven by higher energy prices and a strong demand for goods, in conjunction with widespread supply shortages and bottlenecks at ports, mainly as a result of the ongoing pandemic. This had an impact on both operational and capital costs for the town, with rising input costs along with labour shortages resulting in a broader inflationary pressure.

In 2022, global supply shortages and commodity price volatility remain a concern given the omicron wave at the beginning of the year, and the geopolitical conflict in eastern Europe. The conflict has kept the global economy in a state of uncertainty, pushing up prices for energy and commodities and introducing new constraints on supply chains. It can be expected that higher inflation will persist in the near term due to these inflationary issues alongside tightening labour markets, resulting in financial pressure for the town. This is evidenced by the latest consumer price index data for February 2022 showing headline inflation at 6.1% in Ontario (5.7% in Canada), the highest level since 1991. The Statistics Canada non-residential building construction price index, which is a good gauge for the impact to capital related costs, increased by 15.3% from the fourth quarter of 2020 to the fourth quarter of 2021 in the Toronto area. While inflation will remain elevated, it is expected that once supply chain issues diminish inflation will ease towards 3% by the end of 2022.

Debt

Debt financing complements the funding of capital works and is generally used for specific initiatives. Issuance of town debt is through Halton Region in compliance with provincial legislation. The Region completed a debt issuance in the May 2021, for which $1.1 million was issued on behalf of the town for the replacement of dockage at Oakville Harbour. Total principal outstanding at the beginning of the year was $105.8 million and has declined to $98.3 million at year end. The town is in a strong financial position with total debt charges for the year at 4% of net own source revenue, which is well within town policy of 12% and the Ministry limit of 25%. Further details are provided in Appendix G.

Development Related Securities

Securities are required to ensure performance to town standards of development related work done by third parties. Staff monitor the progress of the various projects to ensure that adequate security is held by the town relative to the value of the outstanding work, and releases of securities are contingent on satisfactory inspection. Securities are generally held for site plan and subdivision related residential and non-residential development (80%) as well as specific property related works. At December 31, 2021 the town held $159 million in securities, $124 million of which is secured by letters of credit (the remainder are cash).

CONSIDERATIONS:

(A) PUBLIC

This report provides information to the public regarding the town's financial performance for 2021. No specific groups have been notified directly regarding this report.

(B) FINANCIAL

This report and the information contained therein are in compliance with the town's financial policies.

(C) IMPACT ON OTHER DEPARTMENTS & USERS

Financial results have been estimated and reflected in consultation with the other departments

(D) CORPORATE STRATEGIC GOALS

This report addresses the corporate strategic goal(s) to:

- Reporting on the town's financial results is a key component of being an Accountable Government

(E) CLIMATE CHANGE/ACTION

N/A

APPENDICES:

Appendix A – Operating Budget Variance Results
Appendix B – Capital Project Summary by Commission and Department
Appendix C – Summary of Capital Closures
Appendix D – Reserves and Reserve Funds

Appendix E – Purchasing Awards in excess of $100,000
Appendix F – Investment Portfolio
Appendix G – Outstanding Debt
Appendix H – Municipal Act Reporting Requirements Report

Prepared by:
Dalibor Stancovici
Manager of Financial Planning & Policy

Matt Day
Manager of Development Financing & Investments

Recommended by:
Jonathan van der Heiden
Deputy Treasurer and Director of Finance

Submitted by:
Nancy Sully
Commissioner of Corporate Services and Treasurer

APPENDIX A

($ Millions)	2021 Annual Budget	2021 Year-end Actuals	2021 Variance to Budget ($)
Political Governance	3.79	3.59	0.20
Administrative Executive Management	1.82	2.08	(0.27)
Economic Development	0.76	0.76	0.00
Strategy, Policy and Communications	3.48	3.20	0.29
Corporate Asset Management	1.57	1.35	0.23
Financial Services	4.84	4.16	0.67
Human Resources	2.96	2.95	0.01
Information Technology Solutions	12.13	10.99	1.15
Regulatory Services	0.40	0.31	0.09
Legal Services	1.81	1.75	0.05
Facilities & Construction Management	3.17	2.92	0.26
Emergency Services	40.45	41.56	(1.11)
Recreation and Culture	21.98	19.90	2.08
Oakville Public Library	10.21	9.87	0.35
Parks & Open Space	19.14	18.71	0.43
Cemeteries	0.17	0.13	0.03
Harbours	-	(0.47)	0.47
Infrastructure Maintenance	23.46	21.50	1.96
Oakville Transit	28.17	21.88	6.29
Infrastructure Planning & Improvements	2.37	2.28	0.09
Parking	0.48	0.59	(0.11)
Municipal Enforcement	2.33	2.52	(0.19)
Building Services	0.29	(3.97)	4.26
Planning Services	2.08	3.08	(1.00)
Development Services	0.29	0.16	0.12
Strategic Business Services	0.35	0.28	0.07
Total Program Variance	**$ 188.49**	**$ 172.08**	**$ 16.42**
Corporate Hearings and Litigation	0.50	1.63	(1.13)
Corporate Revenue & Expenses	(188.99)	(190.45)	1.46
Town Variance before transfers	**$ -**	**$ (16.75)**	**$ 16.75**
Policy Related and Recommended Transfers for Programs:			
Transfer (to)/from Storm Event Reserve			(0.66)
Transfer Oakville Public Library surplus (to)/from Tax Stabilization Reserve			(0.35)
Transfer (to)/from Building Enterprise Reserve			(4.07)
Transfer (to)/from Cemetery Reserve			(0.03)
Transfer (to)/from Harbours Reserve fund			(0.47)
Transfer (to)/from Parking Reserve fund			not recommended
Transfer (to)/from Election Reserve			(0.02)
Total Town Variance after transfers			**$ 11.15**

2021 CAPITAL PROJECT SUMMARY BY COMMISSION AND DEPARTMENT (in $'000s)

Commission/Department	Total Approved Budget	Prior Years Expenditures	2021 Expenditures	Total LTD Expenditures	Total Funds Remaining
Corporate Initiatives					
Corporate Initiatives	$11,678	$8,278	$753	$9,031	$2,647
Total Corporate Initiatives	**$11,678**	**$8,278**	**$753**	**$9,031**	**$2,647**
Corporate Services					
Clerks	$427	$360	$25	$385	$42
Finance	$300	$55	$31	$86	214
Legal	$12,700	$11,180	$0	$11,180	1,520
Information Technology Solutions	$7,993	$2,416	$2,254	$4,669	3,324
Total Corporate Services	**$21,420**	**$14,011**	**$2,309**	**$16,320**	**$5,100**
Community Services					
Facilities and Construction Management	$10,420	$2,366	$2,800	$5,166	$5,254
Parks and Open Space	$42,416	$23,564	$11,750	$35,315	$7,102
Cemeteries	$201	$25	$57	$82	$119
Harbours	$11,579	$9,754	$1,697	$11,451	$128
Fire Services	$22,376	$17,785	$2,079	$19,864	$2,512
Recreation and Culture	$59,947	$53,342	$3,307	$56,650	$3,297
Oakville Public Library	$1,533	$617	$590	$1,206	$327
Oakville Galleries	$17	$5	$0	$5	$12
Total Community Services	**$148,489**	**$107,457**	**$22,281**	**$129,738**	**$18,751**
Community Development					
Parking Services	$2,814	$430	$697	$1,126	$1,688
Municipal Enforcement	$278	$0	$139	$139	$139
Building Services	$2,363	$304	$347	$651	$1,712
Planning Services	$3,717	$2,115	$104	$2,219	$1,498
Strategic Business Services	$701	$455	$144	$599	$102
Total Community Development	**$9,873**	**$3,303**	**$1,431**	**$4,734**	**$5,139**
Community Infrastructure					
Roads and Works	$25,091	$18,653	$2,948	$21,601	$3,490
Transportation, Engineering and Development	$204,724	$127,335	$20,884	$148,218	$56,506
Oakville Transit	$32,951	$4,874	$8,484	$13,357	$19,594
Asset Management	$3,300	$976	$522	$1,497	$1,803
Total Community Infrastructure	**$266,066**	**$151,838**	**$32,836**	**$184,674**	**$81,392**
TOTAL ACTIVE PROJECTS	**$457,526**	**$284,886**	**$59,611**	**$344,497**	**$113,029**

Note: Projects recommended for closure this period are included in the table above to illustrate total spending.

APPENDIX C

Summary of Capital Closures
Net Impact on Reserves & Reserve Funds

DEPARTMENT	Project Budget vs Actual				Impact on Reserves (Positive = surplus, negative = add'l funds required)						
	TOTAL APPROVED BUDGET	TOTAL ACTUAL EXPENSES	PROJECT LIFE VARIANCE	TOTAL NUMBER OF PROJECTS CLOSED	Capital Reserves	Equipment Reserves	Specific Reserve Funds & Gas Tax	Dev. Charge Reserve Funds	Total to/(from) Reserves/ Reserve Funds	External Revenues	Debt Issuance
Commissioner Authority											
Finance and General Government	560,000	559,999	1	1	0	-	1	-	1	-	-
Information Technology Solutions	602,800	602,850	(50)	2	(50)	-	-	-	(50)	-	-
Facilities and Construction Management	1,017,000	863,396	153,604	2	18,607	-	134,997	-	153,604	-	-
Parks and Open Space	6,536,497	5,242,517	1,293,980	16	125,234	439,494	65,951	663,301	1,293,980	-	-
Cemeteries	70,000	70,596	(596)	1	-	-	(596)	-	(596)	-	-
Harbours	2,215,000	2,245,457	(30,457)	4	-	-	(30,457)	-	(30,457)	-	-
Fire Services	5,846,400	5,453,062	393,338	2	-	-	-	393,338	393,338	-	-
Recreation and Culture	249,400	218,840	30,560	5	2,269	-	28,291	-	30,560	-	-
Oakville Galleries	5,000	5,014	(14)	1	(14)	-	-	-	(14)	-	-
Planning and Development	100,000	89,669	10,331	1	-	-	-	-	-	(10,331)	-
Roads and Works	17,897,200	16,853,839	1,043,361	7	(35,885)	374,669	-	447,985	786,769	893,408	(1,150,000)
Transportation, Engineering and Development	36,277,300	34,800,757	1,476,543	19	745,066	-	-	478,363	1,223,429	(253,114)	-
Oakville Transit	4,789,000	4,631,972	157,028	5	-	139,046	17,982	-	157,028	-	-
Total	**$ 76,165,597**	**$ 71,637,968**	**$ 4,527,629**	**66**	**$ 855,227**	**$ 953,209**	**$ 216,169**	**$ 1,982,986**	**$ 4,007,592**	**$ 629,963**	**$ (1,150,000)**
CAO Authority											
Facilities and Construction Management	50,000	57,617	(7,617)	1	(7,617)	-	-	-	(7,617)	-	-
Information Technology Solutions	121,000	169,849	(48,849)	1	(48,849)	-	-	-	(48,849)	-	-
Roads and Works	30,000	55,900	(25,900)	1	(25,900)	-	-	-	(25,900)	-	-
Parks and Open Space	54,100	63,082	(8,982)	1	(8,982)	-	-	-	(8,982)	-	-
Total	**$ 255,100**	**$ 346,448**	**$ (91,348)**	**4**	**$ (91,348)**	**$ -**	**$ -**	**$ -**	**$ (91,348)**	**$ -**	**$ -**
Net Impact	**$ 76,420,697**	**$ 71,984,416**	**$ 4,436,281**	**70**	**$ 763,879**	**$ 953,209**	**$ 216,169**	**$ 1,982,986**	**$ 3,916,244**	**$ 629,963**	**$ (1,150,000)**

APPENDIX D

2021 Reserve and Reserve Fund Balances
($ Millions)

Reserve/Reserve Fund	2020 Ending Balance (millions)	2021 Activity: Operating Transfers to/(from) Reserve	2021 Activity: Capital Funding Transfers	2021 Activity: Development Charges/ Other Revenues	2021 Activity: Total	Interest/ Capital Gains-Loss	2021 Ending Balance (millions)	2021 Fully Committed Ending Balance[1] (million)
Obligatory Reserve Funds:								
Development Charges	100.9	(3.9)	(10.5)	69.8	156.3	2.3	158.6	130.1
Parkland	45.6	-	(0.4)	32.0	77.1	1.0	78.2	67.1
CCBF[2]/Ontario Gas Tax	26.4	(1.9)	(6.8)	14.9	32.6	0.5	33.1	23.6
Ont. Municipal Commuter Cycling	0.6	0.0	(0.2)	0.0	0.4	0.0	0.5	0.0
sub-total	**173.5**	**(5.8)**	**(17.7)**	**116.7**	**266.7**	**3.9**	**270.4**	**220.8**
Discretionary Reserve Funds:								
Building Maintenance	13.9	3.7	0.5	-	18.1	0.3	18.4	18.4
Parking	2.6	(0.5)	(0.5)	-	1.6	0.0	1.7	1.7
Harbours[3]	(6.2)	0.8	(0.2)	-	(5.7)	(0.1)	(5.8)	(5.8)
Employment Liability	22.8	0.7	-	-	23.4	0.4	23.9	23.9
Bonus Zoning	2.9	-	-	-	2.9	0.0	2.9	2.9
Other	0.2	0.0	0.0	-	0.2	0.0	0.2	0.2
sub-total	**36.2**	**4.7**	**(0.3)**	**0.0**	**40.7**	**0.7**	**41.3**	**41.3**
Total Reserve Funds	**209.7**	**(1.1)**	**(18.0)**	**116.7**	**307.3**	**4.6**	**311.7**	**262.1**
Reserves:								
Operational Reserves[3]	32.6	5.0	(1.5)	0.2	36.3	-	36.3	36.3
Equipment Reserves	20.8	8.4	(8.5)	0.7	21.4	0.4	21.8	21.8
Capital Reserves[3]	71.4	14.9	4.8	11.9	103.0	1.4	104.4	104.4
Stabilization Reserves[3]	73.4	4.7	-	1.0	79.1	(0.0)	79.1	79.1
Total Reserves	**198.2**	**32.9**	**(5.1)**	**13.9**	**239.9**	**1.8**	**241.7**	**241.7**
Total Reserves, Reserve Funds	**407.9**	**31.8**	**(23.1)**	**130.5**	**547.2**	**6.4**	**553.4**	**503.8**

* Note: Schedule may not add due to rounding

1) Balances for Development Charges, Parkland and CCBF/Gas Tax reflect commitments for funds approved for capital in 2021 and prior years that has not yet been transferred. Funds can only be transferred to the project as spending occurs.

2) Canada Community-Building Fund (CCBF), formerly known as Federal Gas Tax

3) Reserves and reserve fund balances include year end policy transactions mentioned in the report but does not include recommended transfers or surplus entry.

APPENDIX E

Q4 2021 Purchasing Awards in excess of $100,000

Competitive Bids Awarded			
Bid #	**Description**	**Awarded To**	**Total Amount Awarded ($)**
RFT-55-2021	Gairloch Gardens Walkway & Stair Renovation (Resulting from Prequal-4-2021)	Pine Valley Corporation	$126,760.00
RFT-63-2021	Parking Lot Milling and Overlay - Various Facilities	Rima Con Ltd.	$194,380.41
RFP-17-2021	Supply and Delivery of Library Materials and Associated Services	Library Bound	$234,200.00
RFP-17-2021	Supply and Delivery of Library Materials and Associated Services	Whitehots	$285,200.00
RFP-31-2021	Master Fire Plan	Dillon Consulting	$124,933.00
RFT-50-2021	Oakville Transit Parking Lot Repairs	Royal Ready Construction Ltd.	$215,144.00
RFT-51-2021	Pedestrian Crossings (PXO) 2020/2021	Aqua Tech Solutions Inc.	$868,481.70
RFT-52-2021	Supply and Delivery of HPE Servers	Softchoice Canada	$391,505.20
RFT-54-2021	Supply and Delivery of Network Switches	Access 2 Networks Inc	$128,389.37
RFT-58-2021	Busby Park Launch Ramp Redevelopment	Enscon Ltd.	$785,145.00
RFT-57-2021	River Oaks Multi-Purpose Room Renovation	Fina Construction Ltd.	$265,786.00
RFT-60-2021	Brantwood School Parkette Storm Sewer	Royal Ready Construction Ltd.	$130,310.00
RFT-61-2021	Vehicle Rentals	Matthews Equipment Limited (operating as Herc Rentals)	$104,800.00
RFT-63-2021	Parking Lot Milling and Overlay - Various Facilities	Rima Con Ltd.	$194,380.41
RFP-34-2021	Solution Architect	Calian Ltd.	$141,300.00
RFT-67-2021	Holyrood Promenade Shoreline Rehabilitation Construction	Cambridge Landscaping	$542,382.82
RFT-68-2021	Crosstown Multi Path, Phase 4	Royal Ready Construction Ltd.	$492,777.50
RFQ-36-2021	Flat Roof Replacements at Fire Station #1 and Bronte Harbour Banquet Centre	Eileen Roofing Inc.	$117,800.00
RFT-69-2021	Laptops and Accessories	QRX Technology Group	$515,592.35
RFP-41-2021	Consulting Services for Invassive Insect Management	Lallemand Inc.	$111,615.00
RFT-70-2021	Woodland Regeneration	Brinkman Reforestation	$943,261.95
RFT-73-2021	Removal & Disposal of LDD Moth Egg Masses	Davey Tree Expert Co. Colonial Tree Services Inc	$164,229.00

Q4 2021 Purchasing Awards in excess of $100,000

Contract Renewals - where provision for such renewal formed part of the original bid document.

Original Bid #	Description	Awarded To	Total Amount Awarded
RFP-27-2020	HVAC Preventative Maintenance Service	Ainsworth Inc	$300,000.00
RFT-2-2020	Rotational Maintenance program focuses on improving the vigor and health of trees. Pruning that is done follows ANSI A300 pruning standards.	Colonial Tree	$478,879.00
RFP-5-2021	Supply and Delivery of Library Audio/Visual Materials	Library Bound, Inc.	$126,000.00

Additional Funds

Original Bid #	Description	Awarded To	Total Amount Awarded
RFP-37-2020	OPL Website Refresh Project -- Purchase Order Increase	PixelShop	$102,220.00
RFSQ-2-2021	Arboricultural Services	Davey Tree Expert Co. Colonial Tree Service Inc. Arborwood Tree Service Inc. Diamond Tree Care and Consulting Inc.	$114,500.00

Single Source Procurement

Department	Description	Awarded To	Total Amount Awarded
Oakville Library	Hoopla - CVS Midwest Tape - 2022	CVS Midwest Tape	$203,400.00
Transit	Collision repair to Oakville Transit Bus # 2025	MTB Transit Solutions	$175,000.00

APPENDIX F

TABLE 1
2021 PORTFOLIO COMPOSITION
YEAR OVER YEAR COMPARISON
(Millions)

Security Type	Book Value	% of Portfolio	Book Value	% of Portfolio
Cash	186.13	27.5%	59.94	12.2%
Federal Bond	34.87	5.2%	30.96	6.3%
Provincial Bond	181.13	26.8%	158.76	32.3%
Municipal Bond	137.09	20.3%	124.41	25.3%
Eligible Financial Institutions	137.70	20.3%	117.49	23.9%
Total	676.92	100.0%	491.56	100.0%
	As of December 31, 2021		As of December 31, 2020	

TABLE 2
2021 PORTFOLIO COMPOSITION BY TERM
YEAR OVER YEAR COMPARISON
(Millions)

Maturity Distribution	Book Value	% of Portfolio	Book Value	% of Portfolio
Cash and cash equivalents	285.85	42.2%	116.97	23.8%
1 - 3 years	42.26	6.2%	64.40	13.1%
3 - 5 years	131.98	19.5%	83.47	17.0%
5 - 10 years	216.84	32.0%	220.99	45.0%
10 years and over	-	0.0%	5.73	1.2%
Total	676.92	100.0%	491.56	100.0%
	As of December 31, 2021		As of December 31, 2020	

	2021 Opening Balance	2021 New Debt issued	2021 Debt Principal Payment	2021 Year End Balance
Tax Levy Supported Debt:				
Roads & Storm Sewers	5,259	-	549	4,710
LED Streetlighting	8,476	-	1,036	7,440
Transit	550	-	179	371
Parks and Pier Rehab	354	-	180	175
sub-total	**$ 14,640**	**$ -**	**$ 1,945**	**$ 12,695**
Self Supported Debt:				
Harbours	1,325	1,100	177	2,248
Development (16 Mile Creek)	3,842	-	3,842	(0)
Pine Glen Soccer Club	5,654	-	482	5,171
sub-total	**$ 10,821**	**$ 1,100**	**$ 4,502**	**$ 7,419**
Hospital Debt:				
Oakville Trafalgar Memorial Hospital[1]	80,308	-	2,131	78,177
TOTAL	**$ 105,769**	**$ 1,100**	**$ 8,578**	**$ 98,291**

1) Debt Principal Payment for Oakville Trafalgar Memorial Hospital reflects the contribution to the sinking fund.

APPENDIX H

MUNICIPAL ACT INVESTMENT REPORTING REQUIREMENTS

Statement of Performance;

The Town of Oakville earned an annualized rate of return of 1.78% for the period ended December 31, 2021 on its cash management and investment program.

Investment in Own Securities;

As the Town of Oakville is a lower tier municipality, for which debt requirements must be issued through the Region of Halton by legislation, none of its investments would be invested in its own long-term or short-term securities.

Statement of Treasurer regarding Investment Quality;

I, Nancy Sully, Commissioner-Corporate Services and Treasurer of the Town of Oakville hereby state that:

All investments made by the town for the period ending December 31, 2021, have met the quality standards outlined in the town's Investment Policy.

Statement of Treasurer regarding Compliance with Investment Policy;

I, Nancy Sully, Commissioner-Corporate Services and Treasurer of the Town of Oakville hereby state that:

All investments made by the town for the period ending December 31, 2021, have complied with the investment policy with the Town of Oakville.

Nancy Sully, CPA, CMA **March 18, 2022**
Commissioner-Corporate Services and Treasurer

OAKVILLE

REPORT

Council

Meeting Date: April 25, 2022

FROM:	Strategy, Policy and Communications Department
DATE:	April 19, 2022
SUBJECT:	**Climate Action: Progress and Directions Report**
LOCATION:	Town-wide
WARD:	Town-wide

RECOMMENDATION:

That the report entitled "Climate Action: Progress and Directions Report" dated April 19, 2022 be received.

KEY FACTS:

The following are key points for consideration with respect to this report:

- On June 24, 2019, Oakville Town Council unanimously declared a Climate Emergency.
- Significant changes due to the pandemic and rapid shifts in understanding around local and global climate risks and opportunities created a need to reflect and reassess the town's climate efforts to ensure ongoing accountability and continuous improvement.
- The Climate Action: Progress and Directions Report (included in Appendix A) provides a high level overview of the Town's climate efforts to date, an assessment of the current state and next steps needed to move the corporation and the community forward in meeting the challenges and opportunities presented by the ongoing climate crisis.
- The Town continues to demonstrate leadership across the spectrum of climate action, however, gaps were noted under the focus area of Foundational Support which covers elements that support the strategy and delivery of climate programming such as governance, data management and training.
- Three priority projects are recommended to fill the observed gaps and provide a well rounded foundation for the town's ongoing climate work. Operational tools embeds climate considerations at the department level;

climate disclosure assessment and reporting supports accountability; and the Climate Action Strategy provides an opportunity to engage the community and pull the pieces together to help clarify and coordinate efforts being made around the four climate focus areas.

BACKGROUND:

On June 24, 2019, Oakville Town Council unanimously declared a Climate Emergency, recognizing the need to address the significant risks and opportunities facing our community resulting from a changing climate. Staff have reported annually on the progress that has been achieved on Council's resolution and a brief summary of progress to date in 2021 is provided as part of this report.

While the town continues to move forward on addressing the emergency, there have been significant changes brought about by the pandemic and rapid shifts in understanding around local and global climate risks and opportunities. Financially, there have been greater strains placed on local governments due to COVID, but also more opportunities for climate funding and partnerships. Locally, we are seeing the impacts to our community first hand from events such as the flooding that occurred around Lake Ontario in 2017 and 2019. Federal and provincial priorities are also increasing regulatory and financial requirements around climate action such as carbon pricing and Net Zero targets around energy, while internationally there is a growing call for rapid action through organizations such as the Intergovernmental Panel on Climate Change (IPCC). With these being just some of the changes seen, staff determined a need to reflect and reassess the town's climate efforts to ensure ongoing accountability and continuous improvement.

Throughout 2021, staff undertook a review and analysis of the Town's climate action activities across the corporation. This work is presented in the Climate Action: Progress and Directions Report included in Appendix A and provides a high level overview of the Town's climate efforts to date and next steps needed to move the corporation and the community forward in meeting the challenges and opportunities presented by the ongoing climate crisis.

COMMENT/OPTIONS:

Since being one of the first municipalities to have an Environmental Strategic Plan in 2005, the Town has demonstrated a longstanding commitment to leadership on sustainability and climate change. To help organize the breadth of work accomplished and ongoing, activities related to climate action were grouped under four areas of focus. These four focus areas were then used as a basis for conducting a qualitative assessment to review the town's existing climate programming against best management practices, municipal benchmarking, the regulatory landscape, as well as the stage of implementation.

Areas of Focus: Assessing Progress

Highlights of the analysis of the town's climate programs and 2021 progress is summarized as follows:

1) Mitigation: Actions that help reduce or reduce the effects of greenhouse gas emissions (GHGs) which are the leading man-made cause of climate change.

Analysis Highlights: Established strategies in place and clear targets through the Conservation and Demand Management Plan (2020) and the Community Energy Strategy (2020). Implementation has been progressing over a number of years with targets for energy and GHG reductions either meeting or exceeding targets. Progressive projects moving forward around District Energy, Residential Energy Retrofit support, and Net Zero pathway recommendations for corporate facilities.	**Progressing well**
2021 Accomplishments: • Completed new strategic plans to address both energy and GHG reductions through the Renewable Energy Strategy and the Greenhouse Gas Reduction Roadmap and Action Plan • GHG reduction of 29.3% for facilities over 2014 baseline • Energy use reduction of 24.7% for facilities over 2014 baseline • Completed study for District Energy • Received funding from FCM to initiate Retrofit project with Oakville Energy Corporation	

2) Adaptation: Actions that help us adjust to the impacts and reduce our risk due to the effects of climate change already underway, such as flooding and more extreme weather.

Analysis Highlights: Strategies underway to address adaptation include Asset Management integration of climate risks and natural assets, Rainwater Management Strategy and Climate Risk assessments and action plans. Established work includes the Stormwater Masterplan (2019) and OakvilleReady partnership hubs. Generally progressing well but not as established as mitigation efforts. Clear targets and metrics still needed.	**In progress**
2021 Accomplishments: • Initiated Rainwater Management Strategy • OakvilleReady partnership agreement, funding formalized and continued implementation	

• Integration of climate risk into Asset Management Plan • Risk and Vulnerability Assessments, department climate plans and climate lens work underway, including establishing a Facilities Climate Team, developing a departmental Climate Resiliency Implementation Plan and integration of a climate lens into all Standard Operating Procedures	

3) Natural Environment: Actions that support our natural environment which helps with both mitigation and adaption and addresses things such as air and water quality, forestry and biodiversity

Analysis Highlights: Established strategies, targets and implementation in place for Forestry and Biodiversity (Urban Forest Strategic Management Plan update in 2022, Oakville Strategy for Biodiversity (2019)). Key partnerships in place with community and leadership on advocacy to support greenspace acquisition.	**In progress**
2021 Accomplishments: • The Town's woodland regeneration program planting efforts which saw 23,634 native trees and 4,382 native shrubs planted by end of 2021 • Stewardship projects in collaboration with community partners including planting of a new meadow at Kingsford Gardens Park to create pollinator and bird habitat.	

4) Foundational Supports: Actions that support climate action strategy and programs such as data and metrics, governance, strategy, training and resourcing.

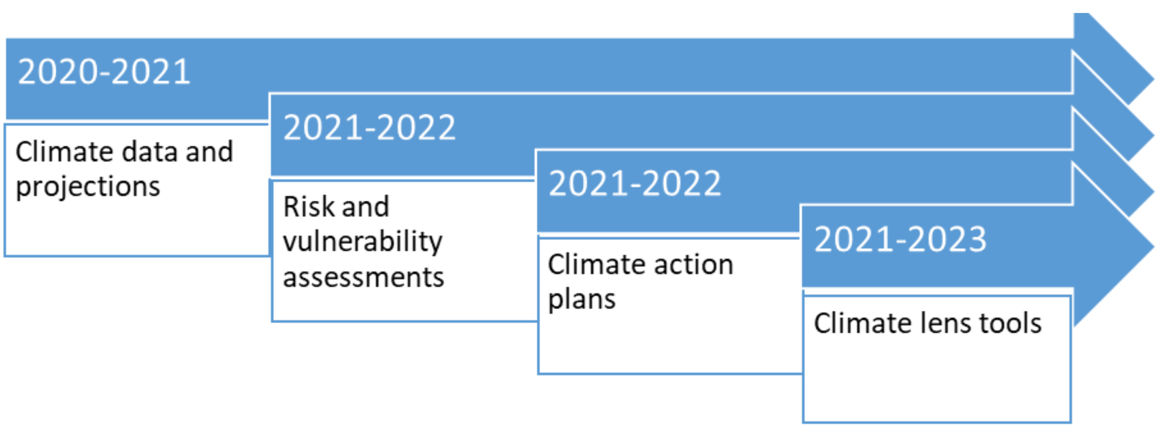
Analysis Highlights: The town's strategy for overseeing climate and environment require significant updates to address areas such as metrics, governance, training and education gaps, coordinated reporting, prioritization and resourcing. While there are gaps, staff have already initiated work to address some of them. For example, work is well underway on the development of climate lenses and risk integration.	**Needs work**
2021 Accomplishments: • Climate Action: Progress and Directions Report • Climate workshop for senior management • Completion of localized climate data and projections report	

Generally, the town is either progressing well or is currently undertaking actions to support a robust response to the climate emergency. To facilitate the continuation of this work, gaps in the Foundational Supports should be addressed.

Next Steps
Strong action needs to be supported by a strong foundation to be effective and efficient. To ramp up the town's capacity to continue growing its climate action efforts and help close the identified gaps, an important area of focus over the next two years will be to strengthen the Foundational Supports area through three major projects that will:

- utilize a data based approach to build greater capacity within departments;
- future proof the organization to better manage risks and opportunities, and;
- strengthen the strategic approach to incorporate greater accountability and connectivity.

Embedding Climate: Develop Data and Operational Tools (2020-2023)
In 2021, staff completed an Oakville-specific climate data and projections report that detailed information around parameters such as wind, precipitation, temperature, and modeled what can be expected in the future. This work has provided a quantitative basis for completing risk and vulnerability assessments that are currently underway to understand the impacts of the changing climate on the town's assets, services and programs. In concert with the risk and vulnerability assessments, this information is being used to develop department level climate work plans offering operational solutions to address these expected impacts.



A key tool to support embedding of climate into operations throughout the corporation are climate lenses. These can be relatively simple or complex and are generally a series of questions or considerations that can be applied to the Town's operations, projects and budgeting to help departments take a critical look at their potential climate impacts and options to address them. To function effectively, they require having an objective in mind (e.g. reducing carbon footprints, reducing flooding impacts, etc.) and some understanding of what actions could help achieve the objective (e.g. plant more trees, install more efficient heating, etc.) which is why the development of tools is often best left until other key pieces are in place, as indicated in the flow diagram. Work on the assessments and operational plans will continue throughout 2022 as will the development of climate lenses through to 2023.

Driving Accountability: Undertake a Climate Disclosure Process (2022)
Council's Strategic Plan sets out Accountable Government as a key area of focus and it is recommended that the town adopt an accountability framework based on the Task Force on Climate-Related Financial Disclosure (TCFD). The TCFD provides an internationally-recognized path to climate accountability around the four key pillars of governance; strategy; risk management; and metrics and targets.

Staff recommend initiating a TCFD disclosure process in 2022 that would:

- identify gaps in the Town's climate action, specifically, around governance, risk management, strategy, and targets/metrics and support solutions;
- provide a framework for annual climate reporting that would be included with the corporation's financial reporting;
- provide a climate lens for finance;
- align climate reporting with leading domestic and international organizations;
- better position the Town for federal climate funding and anticipated requirements around risk-related disclosure;
- set the stage for developing a carbon budget and carbon accounting for the Town;
- frame the work to be completed for the 2023 Climate Action Strategy.

Strategic Planning: Initiate a Climate Strategy (2023)
The Town's Environmental Sustainability Strategy (ESS) was last updated in 2018 and is approaching its five-year update in 2023. To address the gap of an overarching climate strategy, it is recommended that the ESS transition to a Climate Strategy that would:

- provide a common vision, goals and commitments that would better direct the development of climate-related targets and metrics;
- identify a governance structure to provide accountability and oversight for climate action across the organization;
- set out the mechanisms for how climate action will be prioritized and resourced;
- prioritize and manage climate-related risks;
- engage and build buy-in with the broader community and external stakeholders;
- provide a way to understand and communicate the collective impact of climate-related risks or opportunities from a corporate and community wide perspective; and

- weave together the complexity of this portfolio and focus the Town's and community's actions and partnerships.

These three projects, taken together, will fill the observed gaps and provide a well rounded foundation for the town's ongoing climate work. The operational tools provide a focus on action and support embedding climate considerations at the department level. The climate disclosure assessment and reporting support the strategic management and accountability of the town's efforts and the Climate Action Strategy provides an opportunity to engage the community and pull the pieces together to help clarify and coordinate efforts being made around the four climate focus areas.

The climate crisis offers both risks and opportunities. By taking a proactive approach that emphasizes accountability, the Town can more effectively and efficiently address Council's resolutions for addressing the climate emergency and ensure it has a strong foundation to continue building on its success.

CONSIDERATIONS:

(A) PUBLIC

The Climate Action Directions Report provides transparency and accountability to the public by providing an update on the current status of the town's climate action initiatives and climate emergency progress.

(B) FINANCIAL

The report highlights resourcing considerations that will be addressed as part of future work outlined through the three major projects. These projects will support developing a roadmap for the town to take a proactive approach to future climate project related financing. In particular undertaking the development of a Task Force on Climate-Related Disclosure process will support the application of a climate lens on the town's operations and better align climate risks, opportunities and funding.

(C) IMPACT ON OTHER DEPARTMENTS & USERS

Climate action impacts departments across the corporation and the community. This report outlines work underway and planned to address the embedding of climate considerations.

(D) CORPORATE STRATEGIC GOALS

This report addresses the corporate strategic goal(s) to:
Environment and Accountable Government;

(E) CLIMATE CHANGE/ACTION

This report directly supports Climate Action through an assessment of the corporate climate action portfolio, assessment and recommendations for next steps.

APPENDICES:

Appendix A – Climate Action Directions Report

Prepared by:
Donna Hales, Corporate Strategy Program Advisor

Recommended by:
Swaraj Mann, Manager, Corporate Strategy

Submitted by:
Julie Clarke, Director, Strategy, Policy and Communications

Climate Action: Directions Report

April, 2022

OAKVILLE

*Cover image, "Traverse With Us," courtesy of pikpng

Introduction

The Town has a longstanding commitment to leadership on sustainability, as demonstrated by being one of the first municipalities to have an Environmental Strategic Plan (2005). It has achieved this leadership through partnerships with the community and the development of strong environmental policies, strategic plans, programs and initiatives. This commitment continues through Council's Strategic Plan for 2019–2022 which has an ongoing goal of protecting greenspace and promoting environmentally sustainable practices. And, in 2019, in concert with over 500 other Canadian municipalities and the federal government, Oakville's Town Council declared a climate emergency. The declaration is a call to action to recognize and address the significant risks and opportunities facing our community as the result of a changing climate (see Appendix A).

Through the Climate Emergency resolution, Council committed staff to the following:

- address the operations of the corporation;
- identify the public's role in the climate crisis, and actions that can be taken to fight climate change;
- embed a climate crisis lens into the Town's asset management program;
- incorporate climate policies into Livable Oakville – the Town's official plan;
- increase action and ambition for the town's climate-related activities;
- include performance metrics to track progress and timelines for achieving key deliverables/major milestones; and
- develop a strategy to report back publicly on the progress of municipal and public efforts.

Since 2019, staff have reported annually on the progress that has been achieved on all points. The town continues to move forward on climate action; however there is an opportunity to reflect and reassess the town's efforts to ensure ongoing accountability and continuous improvement, particularly given the significant changes brought about by the pandemic, and rapid shifts in understanding around local and global climate risks and opportunities.

Throughout 2021, staff assembled, consulted on and evaluated the Town's existing and planned climate action work to:

- catalogue the Town's climate action efforts across the corporation, including partnerships, to develop a broad-based understanding of the current state;
- benchmark and assess efforts to better understand the opportunities for accelerating climate action progress, and;
- develop recommendations for next steps, based on a more comprehensive understanding of what we are currently doing and where we should be going to ensure accountability in addressing the Climate Emergency.

This document summarizes the results of this evaluation.

KEY AREAS OF FOCUS

Four Focus Areas were confirmed as critical to addressing climate action: Mitigation, Adaptation, Natural Environment and Foundational Supports. These provide a way to better understand and communicate climate action in Oakville.

Mitigation	Adaptation	Natural Environment	Foundation Supports
Mitigate the impacts of climate change by reducing greenhouse gas emissions in Oakville	Adapt to the impacts of climate change by reducing the town's vulnerability and risk	Increase the town's resiliency to climate change by supporting a healthy environment	Support implementation of climate action through tools such as financing, policies and training

MITIGATION

WHAT IT IS: A primary cause of climate change is greenhouse gas emissions (GHGs), largely stemming from the burning of fossil fuels for electricity, heat, and transportation. Mitigation refers to the efforts to reduce, prevent or absorb GHG emissions with the goal of preventing further damage from occurring.

WHY IT'S IMPORTANT: Mitigation is critical if we want to avoid more catastrophic climate impacts. In Oakville, **efforts need to focus on reducing our highest sources of GHGs: buildings and transportation.** Both the Town and community are responsible for mitigation and efforts will need to include developing and retrofitting buildings to be more energy efficient, making choices that reduce the use of single-occupancy vehicles and creating the systems and infrastructure to support those choices.

EXAMPLE: The Town is making use of available funding from the Investing in Canada Infrastructure Program (ICIP) to accelerate greening its transit fleet. Transitioning to battery-operated electric buses will have a significant positive impact on the Town's corporate goal to reduce GHG emissions 80 per cent from 2014 levels by 2050. The transition of the entire Oakville Transit fleet from diesel to electric is planned to be complete by 2036.

ADAPTATION

WHAT IT IS: Adaptation refers to how we prepare for and manage our ability to respond proactively to actual or expected future climate challenges. The goal is to reduce our vulnerability to the harmful effects of climate change such as more intense extreme weather events and food insecurity.

WHY IT'S IMPORTANT: In Oakville, the 2020–2021 climate data and projections report demonstrated that we face a number of significant risks due to climate variability and extreme weather, causing floods, droughts and storms. Preparing our community and the Town's services, programs and infrastructure to navigate risks is vital. Efforts to **reduce and adapt to the impacts of increased precipitation** will be critical. The Town, Conservation Authorities and the community all have key responsibilities for adaptation.

EXAMPLE: The Stormwater Master Plan (SWMP) focuses on the town's more established community areas where stormwater infrastructure systems tend to be older and outdated. The work conducted through the SWMP allows us to determine what needs to be improved to ensure these systems remain stable and functional while minimizing exposure to the risk of urban flooding. It sets out actions to enhance the town's approach to stormwater management and climate change issues and provides advice to property owners on what they can do themselves to reduce flood risk and flood damage on their property. The Town has also recently initiated a Rainwater Management Strategy that will provide a long-term capital plan roadmap, a supporting financing plan and will provide residents and Council information about the town's strategy to improve resiliency and adapt to climate change to help protect both our natural assets and rainwater infrastructure.

NATURAL ENVIRONMENT

WHAT IT IS: Oakville's natural environment includes our local air quality, parks, trails, gardens, trees, and woodlands; shoreline, waterways, harbours, wildlife and biodiversity.

WHY IT'S IMPORTANT: Natural environments play an important role in regulating climate. At the same time, climate change also impacts natural systems. The continuing loss of biodiversity and degradation of ecosystems weakens their ability to provide essential services to the extent that we risk reaching irreversible 'tipping points'. By conserving nature and restoring ecosystems we reduce vulnerability and increase resilience. One of the most important things we can do to build resilience to a changing climate is to support our natural environment with **a focus on biodiversity that includes a healthy tree canopy.**

EXAMPLE: The recently updated Urban Forest Strategic Plan is a 20-year plan that sets out the steps necessary to achieve short-, medium- and long-term goals for urban forests. These include setting out a variety of actions to achieve the Town's goal of 40% forest canopy cover, that will help mitigate the impacts of climate change, and an invasive species strategy to help manage the increasing number of invasive species such as emerald ash borer that threaten our trees.

FOUNDATIONAL SUPPORTS
WHAT IT IS: Foundational supports refers to the elements that are required to develop and implement the strategies, plans, policies, and/or administrative elements needed to address climate change.
WHY IT'S IMPORTANT: Climate action does not happen in a vacuum. The actions associated with this Focus Area are the scaffolding required, across the corporation, to ensure accountable, consistent, targeted, and sustained action on climate change. Foundational supports turn plans and strategies into action and include considerations such as financing, governance, data, targets and metrics, education and training and effective communication. **To ensure we can effectively put our climate strategies and plans into action, we need to focus on putting key foundational supports in place.**
EXAMPLE: Targets and metrics are needed to understand how we're doing and whether we're on track to getting to where we need to be. These have been set out for some of our mitigation efforts such as: GHG reductions of 30% by 2024 for the Town's facilities and operations; and for the community overall, a reduction in GHG emissions of at least a 50% by 2041. Appropriate and science-based measurements are still needed for a number of our focus areas and work is currently underway to establish these so we can effectively prioritize our work and report on results. Work being undertaken in 2022 such as the risk and vulnerability assessments with action plans and the climate-related financial disclosures assessment will be supporting the development of a more robust measurement and reporting system.

ASSESSMENT OF PROGRESS TO DATE

An assessment of the Town's climate action efforts was carried out, benchmarking against priorities outlined in the Oakville Environmental Sustainability Strategy (2018), the 2014 Climate Change Technical Report and current best management practices. The table below outlines some of the initiatives complete and underway as well as gaps under Foundational Supports.

MITIGATION	ASSESSMENT
• Corporate targets and metrics in place • Corporate energy and GHG reductions meeting or exceeding targets • Key corporate strategies and plans in place: Conservation and Demand Management Plan (2020); Renewable Energy Strategy (2022); Greenhouse Gas Reduction Roadmap and Action Plan (2022) • Community Energy Strategy (2020) • Key partnerships with Future Energy Oakville (FEO), Oakville Hydro, Oakville Enterprises Corp, Danish Consulate	

ADAPTATION	ASSESSMENT
• Corporate targets and metrics are still required • Key strategies, plans and programs: Stormwater Master Plan (2019); Rainwater Management Strategy (in progress), Asset Management planning integrating climate impacts, OakvilleReady; Climate Risk Assessments and Action Plans (in progress) • Key partnerships with Halton Environmental Network and Conservation Halton	

NATURAL ENVIRONMENT	ASSESSMENT
• Some corporate targets and metrics are in place • Forestry is resourced. Biodiversity is not currently resourced • Key strategies and plans: Urban Forest Strategic Management Plan (2022); Oakville Strategy for Biodiversity (2019) • Key partnerships with Oakvillegreen, Halton Environmental Network and Conservation Halton	

FOUNDATIONAL SUPPORTS	ASSESSMENT
• Corporate targets and metrics are still required • Key gaps: Mechanism(s) to embed climate considerations corporately and within departments (e.g. climate lenses); financing tools; metrics; reporting; governance; communications; climate education and training; overarching strategy to prioritize and focus climate action • Majority of foundational supports resourced by Climate Action staff under Corporate Strategy	

As highlighted in the table, the analysis found that substantial progress has been made under Mitigation. The Town was an active participant in the development of the Community Energy Strategy (CES) endorsed by Council in 2020. The CES sets out actions, roles and targets for achieving:

- at least a 50% reduction in GHGs from 2016 levels by 2041;
- at least a 40% increase in energy efficiency from 2016 levels by 2041, and;
- a return of at least $7 billion in cumulative energy cost savings to the community by 2041.

As a community Stakeholder under the CES the Town has already led or partnered on a number of priority projects including a district energy feasibility study, business case development for residential energy retrofits, installation of 46 community EV charging stations and initiating the electrification of the Oakville Transit fleet.

The Town’s corporate operations are also progressing, guided by the Conservation and Demand Management Plan that sets out interim targets of:

- a 30% reduction in GHG emissions by 2024 for facilities, based on 2014 baseline (not including fleet or transit) and;
- a 20% reduction in overall energy consumption by 2024 based on 2014 baseline (not including fleet or transit).

As of 2021 the Town has achieved:

- GHG reduction of 29.3% for facilities, which is substantially meeting the interim 2024 target; and
- Energy use reduction of 24.7% which already exceeds the interim 2024 target of 20%.

Recent initiatives that will push the Town’s operations towards even more aggressive targets are the **Greenhouse Gas Reduction Roadmap & Action Plan**, **Net Zero deep energy retrofits** and updated **Sustainable Design Standards** for buildings and the **Corporate Renewable Energy Generation Strategy**. It is recommended that going forward, work should focus on implementation and ensuring sufficient resourcing to support ongoing success.

Under Adaptation, there has been a great deal of progress, however, many of the initiatives are either new or currently under development so are not as established as the work under Mitigation. Strategic work currently underway to address adaptation includes **Asset Management’s integration of climate risks and natural assets**, the **Rainwater Management Strategy** and **Climate Risk assessments and action plans**. Established work includes the **Stormwater Master Plan** (2019) and the **OakvilleReady** partnership hubs.

Likewise, under Natural Environment, the Town has established strategies, targets and implementation in place for both forestry (**Urban Forest Strategic Management Plan** (update in 2022) and biodiversity (**Oakville Strategy for Biodiversity** (2019). Key partnerships are in place with community and leadership on advocacy to support greenspace acquisition. The Town has a longstanding history of leadership and implementation on its forestry initiatives, however, implementation and resourcing for biodiversity are still under development.

Overall, the Focus Area with the greatest number of gaps was Foundational Supports. This includes elements such as data, governance, targets and implementation tools – elements that support a strong foundation when implementing a major initiative. While there are gaps, staff have already initiated work to address some of them. For example, work is well underway on the development of climate lenses. In simple terms, these are a series of questions or other type of process that can be applied to a given activity to help determine the climate impacts it may have and / or ways to help mitigate it. An example of one of the Town’s climate lenses recently developed is found in Appendix B.

DEMONSTRATING ACCOUNTABILITY

To address accountability, it is recommended that the town adopt an accountability framework based on the Task Force on Climate-Related Financial Disclosure (TCFD) to help disclose, assess and respond to climate-related risks and opportunities. This widely accepted framework is used by both public and private organizations, provides a way to embed climate considerations into critical functions and supports transparency and accountability in an organization's climate-related activities.

The framework centres around four core Pillars:

Governance	Strategy	Risk Management	Metrics and Targets
The organization's governance around climate-related risks and opportunities	The actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy and financial planning	The processes used by the organization to identify, assess and manage climate-related risks	The metrics and targets used to assess and manage relevant climate-related risks and opportunities

More information on the TCFD and the framework is provided in Appendix C.

ASSESSMENT OF ACCOUNTABILITY

Based on existing information, the Town's climate accountability processes were assessed at a high level across the four Pillars of the TCFD framework.

GOVERNANCE	ASSESSMENT
• Reporting to Council is done on an annual basis through a number of departments and reports, although no formal requirements exist • Formal management structure for oversight and management of climate risks and opportunities is not identified	
STRATEGY	**ASSESSMENT**
• There are multiple climate-related plans and strategies but no overarching climate strategy • Climate-related risks and opportunities are currently being updated and developed	

• The town has completed scenario planning around climate data and projections and is using this to complete climate related risk and opportunity assessments • A structured process for incorporating climate risks and opportunities is not included as part of the Town's financial planning	
RISK MANAGEMENT	**ASSESSMENT**
• There is no formal process for integrating climate risks into the town's overall risk management although considerations may be done on a departmental basis • Updates to the town's climate risk assessments and plans were initiated in 2021 and will continue into 2022 using updated climate data and projections	
METRICS & TARGETS	**ASSESSMENT**
• Metrics and targets have been set for both community and corporate energy and GHGs to address mitigation. These will need to be updated on an ongoing basis to reflect any changes in standards and/or regulations • Metrics and targets for Adaptation are incomplete • Measurement of performance against targets is only partially in place for those areas that have clear targets	

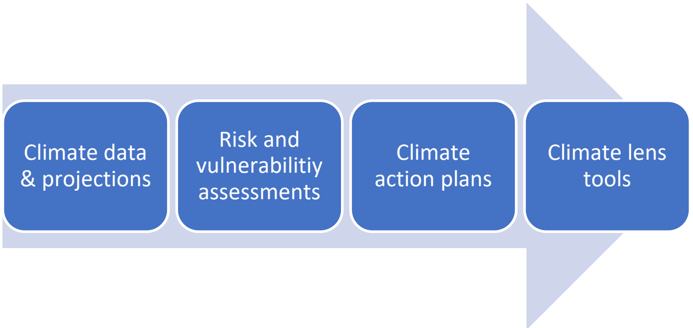
The majority of the gaps found through this assessment fall under the climate action Focus Area of Foundational Supports. To help address the gaps in the town's climate actions across the four Focus Areas and those noted in the accountability framework, three priority actions are recommended to build on the existing success of delivering on Council's direction on Oakville's Climate Emergency.

NEXT STEPS ON ACTION AND ACCOUNTABILITY

To close the gaps identified, it is recommended that in the short term, Climate Action efforts invest in Foundational Supports and strengthening climate accountability through the TCFD framework to ensure the town and its partners build on a strong base. To support this, three key initiatives will move this work forward:

1) **Risk and Vulnerability Assessments; Climate Action Plans; Climate Lens Tools (2021-2022)**:

To ensure the Town's climate action work is science-based and data-driven, the Oakville-specific climate data and projections report was completed in 2021. This data is the foundation to better understand how the Town's assets, infrastructure, and programming will be affected by the changing climate in Oakville and is informing the development of cross-departmental **climate risk and vulnerability assessments** and **climate action plans** that are currently in progress and will continue through 2022.



These assessments and plans will guide the actions of the town and inform the development of department-level **climate lenses** that are also underway. Climate lenses are a series of questions or considerations that can be applied to the Town's operations, projects and budgeting to help departments take a critical look at their potential climate impacts and options to address. An example of one type of climate lens is provided in Appendix B.

2) **Climate Disclosure Assessment and Report (2022)**: Development of a climate reporting program based on the TCFD framework in 2022. This process will be led by Strategy, Policy and Communications and will:
   - provide a framework for annual climate reporting that would be included with the corporation's financial reporting;
   - provide a climate lens for finance;
   - align climate reporting with leading domestic and international organizations;
   - identify gaps in the Town's climate action, specifically, around governance, risk management, strategy, and targets/metrics;
   - better position the Town for federal climate funding and anticipated requirements around risk-related disclosure;
   - help frame the work to be completed for the 2023 Climate Action Strategy; and
   - set the stage for developing a carbon budget and carbon accounting for the Town in 2023.

As noted above, the TCFD provides an internationally-recognized path to climate accountability around the four key pillars of governance; strategy; risk management; and metrics and targets.

3) Climate Action Strategy (2023)

The Town's Environmental Sustainability Strategy (ESS) was last updated in 2018 and is approaching its five-year update in 2023. To address the gap of an overarching climate strategy, the ESS will be transitioned to a Climate Action Strategy that would:

- provide a **common vision, goals and commitments** that would better direct the development of climate-related **targets and metrics**;
- identify a **governance** structure to provide accountability and oversight for climate action across the organization;

- set out the mechanisms for how climate action will be **resourced**;
- **prioritize and manage** climate-related risks;
- **engage and build buy-in** with the broader community and external stakeholders;
- provide a way to understand and **communicate** the collective impact of climate-related risks or opportunities from a corporate and community wide perspective; and
- weave together the complexity of this portfolio and focus the Town's and community's actions and **partnerships**.

The climate crisis offers both risks and opportunities. By taking a proactive approach that emphasizes accountability, the Town can more effectively and efficiently address Council's resolutions for addressing the climate emergency as well as close the gaps identified above under the four focus areas. While the Town and its partners are well-positioned strategically in the Mitigation work, the three key priority initiatives outlined above will not only address the gaps under Foundational Supports but also provide key elements to advance efforts around Adaptation and Natural Environment through a more strategic and data-driven approach.

Together, these three key priority initiatives complement and build on each other. First, the corporate-wide Risk and Vulnerability Assessments, Climate Action Plans and Climate Lens Tools will address operational-level initiatives; second, the climate disclosure assessment and report will provide a greater understanding and recommendations for the Town's management and accountability of its climate actions; and third, the development of a Climate Action Strategy will pull all of these pieces together and provide an opportunity to engage with the community and staff, to ensure the Town and Community are coordinated and clear on climate efforts being made.

The Town remains committed to meeting the challenges of the Climate Emergency. Staff will continue to work in concert with community partners and other orders of government to implement actions to move, meaningfully, towards deep and impactful climate action and ensure accountability in all we do.

APPENDIX A

Council Resolution on the Climate Emergency, Declared June 24, 2019

That the Climate Change Emergency Report dated June 18, 2019, be received and the following resolution be approved:

WHEREAS the Intergovernmental Panel on Climate Change (IPCC) has determined the need for a significant and structural reduction in carbon emissions in the next 11 years to avoid further economic, ecological, and societal losses due to the climate change crisis; and

WHEREAS Canada is, according to the Government of Canada's April 2019 Changing Climate Report, experiencing warming at twice the rate of the rest of the world, with Northern Canada heating up at almost three times the global average; and

WHEREAS infrastructure failures linked to the climate change crisis could cost Canada $300 billion over the next decade unless we change the way we build and move people, goods, and services; and

WHEREAS local governments are at the frontline of taking actions to manage the worst impacts of the climate change crisis, by creating low carbon communities and calling on residents and senior levels of government for a more urgent response in both personal choices and behaviours and governmental policy and operations; and

WHEREAS the Town of Oakville has already experienced consequences attributed to the climate change crisis, such as the 2019 record setting high lake levels, shoreline erosion and flooding of our parks and trails, the ice storm of December 2013, and the effects of Emerald Ash Borer and other invasive species on our local forests; and

WHEREAS Council has adopted key objectives in the Council Strategic Plan 2019-2022 to create a climate change crisis resilient community and transition to a low carbon future; and

WHEREAS the Town of Oakville understands that climate action and a low carbon transition also represents an opportunity for economic stimulation and job development opportunities in a new low carbon economy; and

WHEREAS the Town is currently developing in partnership with Sheridan College and the Oakville Energy Task Force a Community Energy Plan to reduce greenhouse gas emissions in Oakville and advance climate action; and

WHEREAS the Town of Oakville recognizes many local community groups and organizations are already taking collective action on climate change;

NOW THEREFORE BE IT RESOLVED:

THAT the Town of Oakville declare a climate emergency for the purposes of deepening the Oakville community commitment to protecting our economy, environment and community from climate change; and

THAT Council and staff urge the public to immediately increase the priority of the fight against a climate change crisis and apply a climate crisis lens to the plans and actions of the Town of Oakville's public; and

THAT staff are directed to report annually on climate change actions and update the climate change strategy to:

a) address the operations of the corporation of the municipality;
b) identify the publics role in the climate crisis and the actions the community can do to fight climate change;
c) embed a climate crisis lens into the towns asset management program;
d) incorporate climate change crisis policies into Livable Oakville;
e) increase action and ambition for the Town's climate change crisis -related activities; and
f) include performance metrics to track progress and timelines for achieving key deliverables/major milestones, and a strategy to report back publicly on progress of municipal and public efforts

APPENDIX B

Climate Lens Examples (Oakville: SOP Lens and Decision tree)

Environmental Impacts: Check ☒ all that apply – Link to Decision Tree
The process incurs the following impacts:

Utilizes natural resources	☐ Water	☐ Wood / Paper	☐ Raw Materials	☐ Energy
Emits GHG and/or reduces air quality	☐ GhGs	☐ VOCs/ Particulates		
Toxicity	☐ Wildlife	☐ Land	☐ Water	☐ Air
Vulnerable to extreme weather	☐ Increased Temperatures	☐ High Wind	☐ Flooding	☐ Snow/Ice

☐ No Environmental Impact: This process does not utilize natural resources, emit Ghgs, pollute the air, contain toxic materials, or make the town more vulnerable to extreme weather.

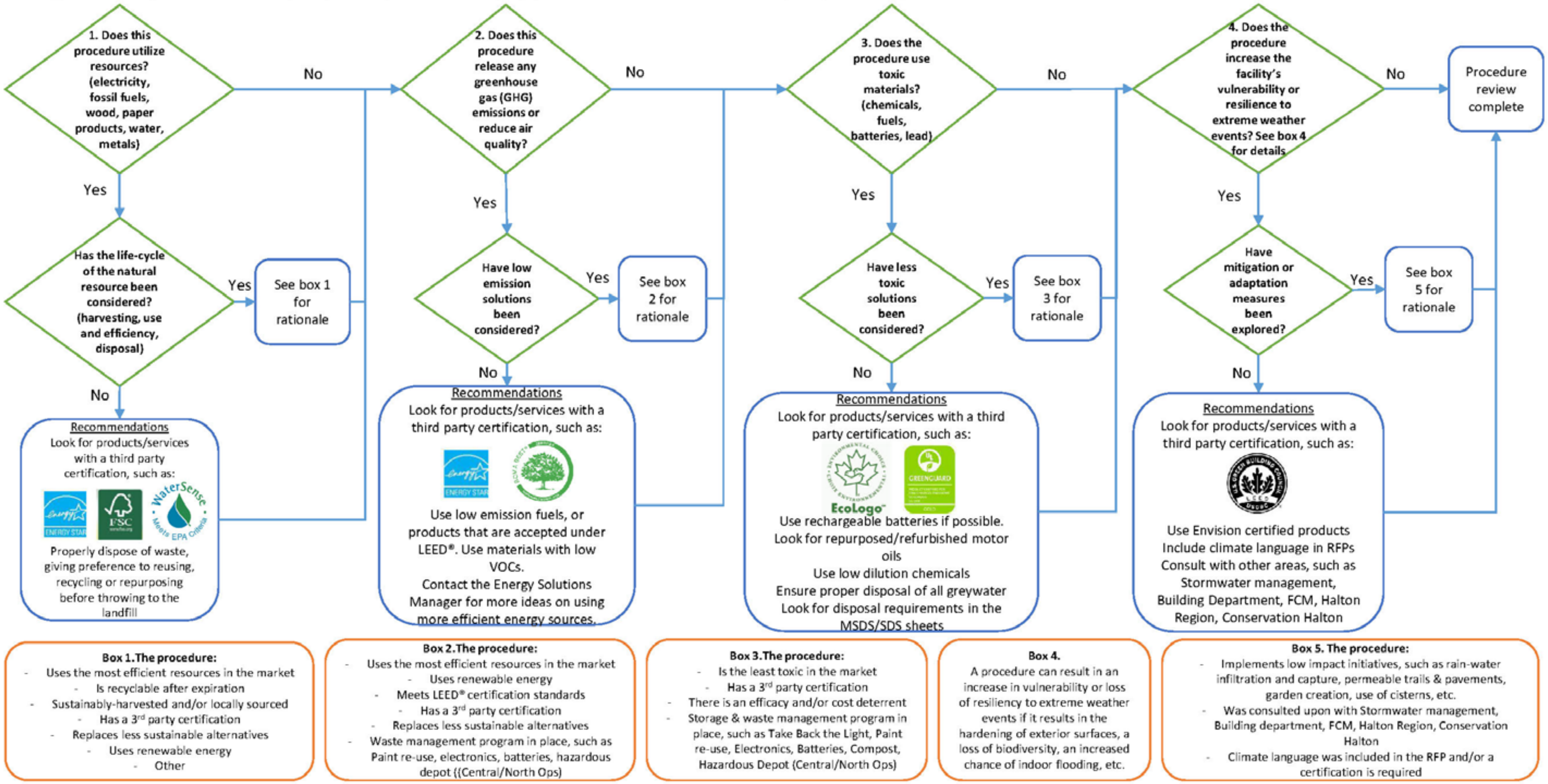
If applicable, please recommend how this could task or its materials can be made more environmentally friendly. Notes: ______________________________

____

Decision Tree: Guidance for SOP Climate Lens

Climate Lens

As you review the standard operating procedure, consider the following questions to determine the impacts it has on the environment. As you identify these impacts, look at the recommendations offered to help mitigate them through sustainable procurement and disposal practices, as well as modifying operation and maintenance tasks as required, whenever possible.



APPENDIX C

Task Force on Climate-Related Financial Disclosure (TCFD) Overview

What is it?

The Task Force on Climate-Related Financial Disclosures (TCFD), co-founded by Mark Carney, Governor of the Bank of England and Michael Bloomberg in 2017 is a standardized framework that organizations can use to **disclose, assess and respond** to climate-related risks and opportunities. It provides guidance rather than prescriptive rules to follow and provides a way to embed climate considerations into critical functions such as finance and asset management. It does not take the place of climate change plans.

The framework centers around four core elements:

1. **Governance** of climate-related risks and opportunities
2. Actual or potential impacts of climate-related risks and opportunities on **Strategy** and financial planning
3. **Risk management** including processes to identify, assess and manage climate-related risks
4. **Metrics and targets** used to assess and manage climate-related risks and opportunities.

Canadian Context

In the 2021 federal budget, the Government of Canada pledged to "engage with provinces and territories, with the objective of making climate disclosures, consistent with the TCFD, part of regular disclosure practices for a broad spectrum of the Canadian economy." Currently, all Crown corporations are required to adopt TCFD requirements and standards as part of corporate reporting by 2024.

In the Fall of 2021, the Canadian Securities Administrators (CSA) also proposed a requirement for all public companies to make climate-related disclosures informed by the TCFD starting in 2024. A majority of financial related organizations (banks, ratings agencies, pension funds) have also adopted the TCFD and greater requirements and regulations to do so are anticipated going forward.

Application to Municipalities

Canadian municipalities are not yet required to implement TCFD, but leading municipalities including Mississauga, Vancouver and Toronto now include it as part of their annual financial reporting. This helps build both internal and public support for climate action, demonstrate good governance and transparency, and actionize municipal climate emergency declarations.

Over the course of 2019, Chartered Professional Accountants (CPA) Canada worked with municipal staff from Montreal, Toronto, and Vancouver (through the Canadian Urban Sustainability Professionals network) along with other partners such as the Public Sector Accounting Board (PSAB), C40 cities, Federation of Canadian Municipalities (FCM), and others to develop a guide for municipalities that included the following recommendations to consider as part of a TCFD process:

TCFD Recommendation Areas	TCFD Recommended Actions (Adapted for Cities)
Governance	Describe mayor and council's oversight of climate-related risks and opportunities.
	Describe management's role in assessing and managing climate-related risks and opportunities.
Strategy	Describe the climate-related risks and opportunities the city has identified over the short-, medium-, and long-term.
	Describe the impact of climate-related risks and opportunities on the strategy and financial planning of the city's businesses.
	Describe the resilience of the city's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario.
Risk Management	Describe the city's processes for identifying and assessing climate-related risks.
	Describe the city's processes for managing climate-related risks.
	Describe how processes for identifying, assessing and managing climate-related risks are integrated into the city's overall risk management.
Metrics and Targets	Disclose the metrics used by the city to assess climate-related risks and opportunities in line with its strategy and risk-management process.
	Disclose Scope 1, Scope 2 and, if appropriate, Scope 3 GHG emissions and the related risks.
	Describe the metrics used by the city to manage climate-related risks and opportunities as well as performance against targets.

Benefits to municipalities noted by CPA include:

- Supporting the application of a **climate risk lens** on short- and long-term financial planning, operational budgets and capital investments;
- Enhancing **data collection** and sharing to improve decision-making and enable comparability across local governments;
- Using cross-functional teams to integrate climate change considerations into existing risk assessment processes and build internal capacity for managing climate risks;
- Quantifying climate-related information in financial terms, such as infrastructure;
- Investment needs and the costs of inaction, health and other social costs, economic;
- Growth potential from clean-economy investments, and the creation of "green" jobs;

- Integrating climate-related risks and opportunities into operational budgeting and long-term capital planning to allocate resources where needed
- Enhancing access to government and other sources of external funding for green infrastructure and projects, as well as attracting new investors and businesses
- Supporting the transition to Net Zero by 2050 as mandated by the Canadian Net-Zero Emissions Accountability Act (June 29, 2021)
- Building public awareness of climate change impacts, and enhancing local support for action

Implementation of the recommendations of TCFD represents a multiyear phased opportunity for municipalities to begin disclosing, assessing, responding to and ultimately quantifying climate-related risks and opportunities.

RESOURCES

Task Force on Climate-Related Financial Disclosure. https://www.fsb-tcfd.org/about/

CPA (Chartered Professional Accountants Canada). Enhancing Climate-related Disclosure by Cities: A Guide to Adopting the Recommendations of the Task Force on Climate-Related Financial Disclosures (TCFD). https://www.cpacanada.ca/en/business-and-accounting-resources/financial-and-non-financial-reporting/sustainability-environmental-and-social-reporting/publications/tcfd-guide-for-cities

Webinar TCFD 101 Back to Basics - Manifest Climate

OAKVILLE

Accessibility Advisory Committee

MINUTES

Date:	**March 10, 2022**
Time:	**4:00 pm**
Location:	**Virtual Meeting**
Members:	Councillor Robertson Peggy Anne Gordon Rosa Bustamante (As of 4:04 p.m.) Matthew Lam (As of 4:03 p.m.) Ruth Sheridan
Regrets:	Deborah Muldoon David Underwood
Staff:	Andrea Coyne, Manager of Elections, Policy and Print Services (In person) Joanne Phoenix, Manager of Planning and Accessible Services, Oakville Transit Nick Valerio, Manager of Capital Projects Andrea Wood (Jones), Project Leader - Accessibility Jill Marcovecchio, Council and Committee Coordinator (In person)
Also Present:	Haitham Hana, Project Manager

A virtual meeting of the Accessibility Advisory Committee was held on March 10, 2022, at the Oakville Municipal Building, commencing at 4:00 p.m.

These minutes will go forward to the Council meeting of April 25, 2022, for approval. Please view those minutes to note any changes Council may have made.

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1. Regrets

As noted above.

A no quorum meeting commenced at 4:01 p.m. and quorum was achieved at 4:03 p.m.

4. Discussion Item(s)

In accordance with Section 2(8) of the Procedure By-law, the items were considered out of order.

4.1 Election of Chair and Vice-Chair 2022

Jill Marcovecchio, Council and Committee Coordinator, called for nominations for the position of Chair and Vice-Chair of the Accessibility Advisory Committee for the year 2022.

It was the consensus of the committee to defer the elections to the next meeting on June 9, 2022 when more members were in attendance.

Jill Marcovecchio chaired the meeting in the absence of a Chair.

Moved by Ruth Sheridan

That election of Chair and Vice-Chair of the Accessibility Advisory Committee for the year 2022, be deferred to the June 9, 2022 meeting.

CARRIED

2. Declarations of Pecuniary Interest

No declarations of pecuniary interest were declared.

3. Confirmation of Minutes of Previous Meeting(s)

Moved by Peggy Anne Gordon

That the minutes of the Accessibility Advisory Committee meeting of December 9, 2021, be approved.

CARRIED

4. Discussion Item(s)

4.2 North Park Community Centre and Public Library

Nick Valerio, Manager of Capital Projects, introduced the town's consulting team retained by the town for the design and contract administration of the North Park Community Centre and Public Library project led by David Dow, Architect (Principal) and Christopher Hughes, Architect (Associate), Diamond Schmitt Architects Inc. (DSAI).

Staff and the consultant reported on the design of the North Park Community Centre and Public Library project as provided in the PowerPoint presentation.

Nick Valerio outlined the project highlights.

David Dow presented on site planning, community centre circulation, and accessibility accommodations. Mr. Dow provided an overview of the parking and accessible walkways exterior of building, highlights of the plan, and an overall summary.

The committee provided the following comments for consideration:

- the parking spaces located on the northwest area of the plan are not connected to anything;
- consider the location of parking spaces that are closer to the playground for parents;
- consider putting up railings along the hallways;
- consider a drop off area, such as the one at the hospital;
- consider pool change rooms and accessibility, and the lift to get in to access the pool;
- consider if there is enough space for a wheelchair, if needed for staff at the reception desk; and
- the use of rooms for rental in the library for seniors and special needs.

Staff advised that they will investigate the questions from the committee.

The architect responded to questions regarding the community centre and public library project, advising of the following:

- with respect to the railings along the hallways, the current design drawings are not at that level of detail;
- the pool change room universal washroom is accessible off the main corridor, it's possible to reconfigure the main entrance into the

washroom to come off from the change room proper, however the design of the change rooms is for gender free, but two gender change rooms could still be possible, and flexibility would be a little compromised for any relocation of the entrance leading into the universal washroom; and

- taking a look at refining the reception desk area, and trying to improve some of the clearance and turning around the desk.

Moved by Peggy Anne Gordon

That all aspects of Oakville Universal Design Standard (OUDS), applicable to the North Park Community Centre and Public Library project, be endorsed.

CARRIED

4.3 Facilities and Construction Management (FCM) Update

Andrea Wood (Jones), Project Leader – Accessibility, reported on the Facilities and Construction Management (FCM) Update as provided in the PowerPoint presentation. Ms. Wood (Jones) highlighted the categories of the AODA Design of Public Spaces (DOPS) compliance areas that were targeted which will be the focus of the 2021-2024 work plan, and the town facilities planned to have work done in 2022. She advised of the improvements being made to the accessible parking spaces for all town parking lots with highly visible signage, painted symbols on the ground, and new access aisles (Sir John Colborne Community Centre was provided as an example).

Andrea Wood (Jones) advised that annual accessibility status updates will be provided in December for work completed during the year, as audited facilities are completed they will be updated in the town's asset management program, and consulting with the committee will be ongoing as required.

The committee provided the following comments for consideration:

- most of the washrooms on the list of town facilities having work done in 2022 are very old and are not accessible in the older buildings; and
- how does the town budget to upgrade to accessible washrooms in designated town facilities?

Staff responded to questions regarding upgrading to accessible washrooms for town facilities, advising of the following:

- washrooms do not fall under the *Accessibility for Ontarians with Disabilities Act, 2005 (AODA)*, and fall under the *Ontario Building Code Act* and Oakville Universal Design Standards which are being upgraded;
- upgrades are being planned for all washroom fixtures to touchless; and
- most washrooms currently are accessible, and the ones that are not are being targeted for major and minor projects over the next few years (for example, Central Library is a project planned for the following year).

Moved by Ruth Sheridan

That the report dated March 1, 2022 from Facilities & Construction Management be received.

CARRIED

4.4 AAC 2021 Accomplishments and Proposed 2022 Work Plan

Andrea Coyne, Manager of Elections, Policy, Print Services, reported on the AAC 2021 Accomplishments and Proposed 2022 Work Plan as provided in the PowerPoint presentation. Ms. Coyne recognized the challenges and impacts that the evolving pandemic continues to have on individuals and organizations, advising that compliance with all appropriate accessibility requirements under the *Accessibility for Ontarians with Disabilities Act, 2005 (AODA)* must still happen as organizations react and adapt their operations. Ms. Coyne asked for the committee’s feedback on the proposed work plan.

Andrea Coyne congratulated Ruth Sheridan who was a recipient of a Community Spirit Award from the Town of Oakville.

Andrea Coyne advised that staff will be reporting on the Accessibility Plan for the committee's feedback at the next meeting on June 9, 2022.

The committee asked that staff report back on accessible parking spaces in paid public parking lots and accessible on street parking. The committee expressed a desire to be inclusive in terms of providing accessible parking similar to other communities, such as Burlington. It was indicated that this issue was being raised by a member in response to a concern that was received from a resident regarding accessible paid parking.

Andrea Coyne advised that she will reach out to staff on arranging a potential presentation for a future meeting.

Moved by Peggy Anne Gordon

1. That the report dated March 1, 2022, entitled AAC 2021 Accomplishments and Proposed 2022 Work Plan, from the Clerk's department, be received.
2. That the 2021 Accomplishments and Proposed 2022 Work Plan be endorsed.

CARRIED

5. Information Item(s)

5.1 A CNIB Community Consultation in Oakville – Tuesday, March 15 – Help us Build the Plan – Developing CNIB's next strategic plan

Ruth Sheridan provided updated information regarding the session which will now be held at the Trafalgar Community Centre, 325 Reynolds Street on March 30, 2022 from 2:30 p.m. to 4:00 p.m.

5.2 Ontario's Assistive Devices Program

5.3 CNIB - Ontario's Assistive Devices Program (ADP) Survey Report

Moved by Matthew Lam

That the information items be received.

CARRIED

6. Date and Time of Next Meeting

June 9, 2022

Oakville Municipal Building

Virtual Meeting - 4:00 p.m.

7. Adjournment

Moved by Rosa Bustamante

That this meeting be adjourned.

CARRIED

The meeting adjourned at 5:08 p.m.

THE CORPORATION OF THE TOWN OF OAKVILLE

BY-LAW NUMBER 2022-057

A by-law to confirm the proceedings of a meeting of Council.

COUNCIL ENACTS AS FOLLOWS:

1. Subject to Section 3 of this by-law, every decision of Council taken at the meeting at which this by-law is passed and every resolution passed at that meeting shall have the same force and effect as if each and every one of them had been the subject matter of a separate by-law duly enacted.

2. The execution and delivery of all such documents as are required to give effect to the decisions taken at the meeting at which this by-law is passed and the resolutions passed at that meeting are hereby authorized.

3. Nothing in this by-law has the effect of giving to any decision or resolution the status of a by-law where any legal prerequisite to the enactment of a specific by-law has not been satisfied.

PASSED this 13th day of April, 2022

Rob Burton	Mayor	Vicki Tytaneck	Town Clerk