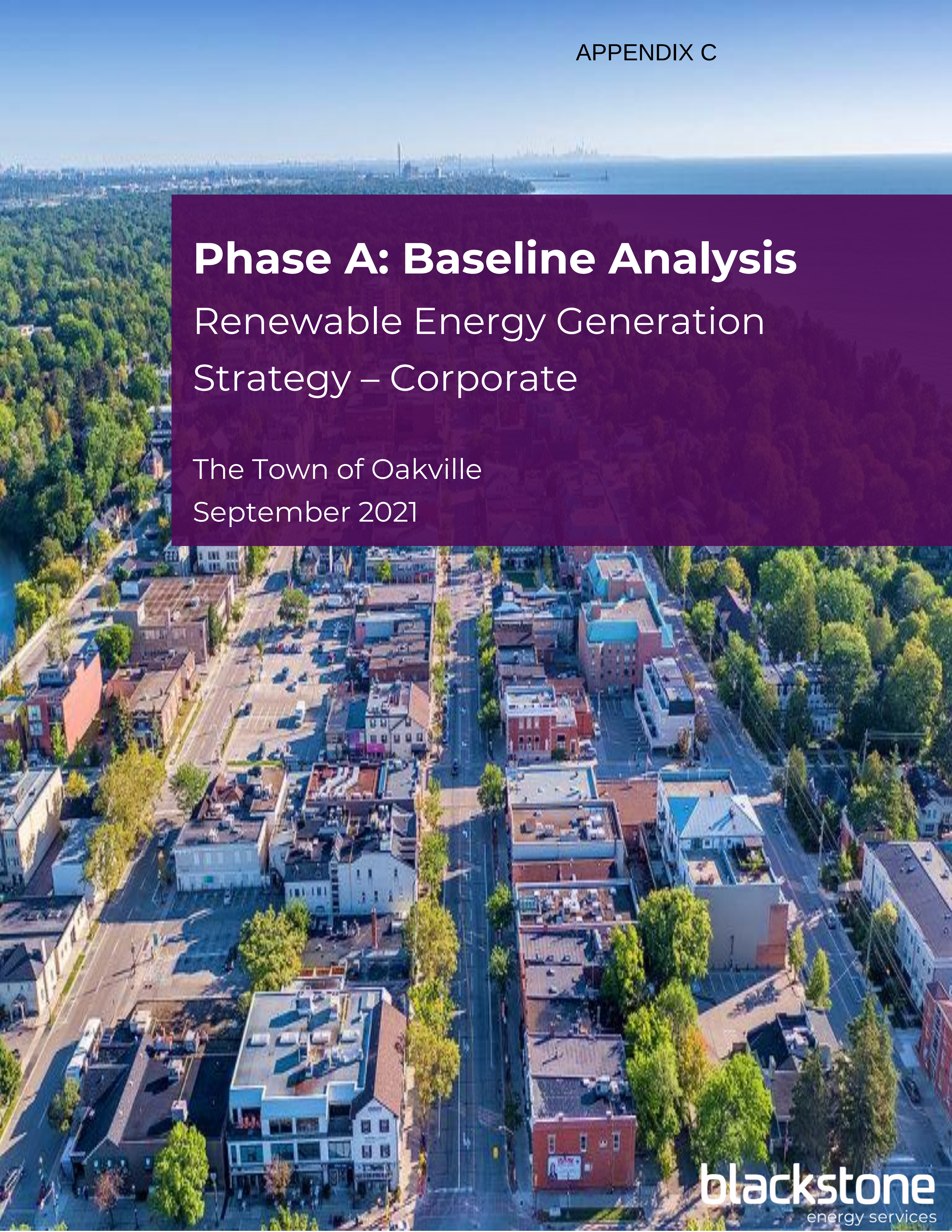
APPENDIX C

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.

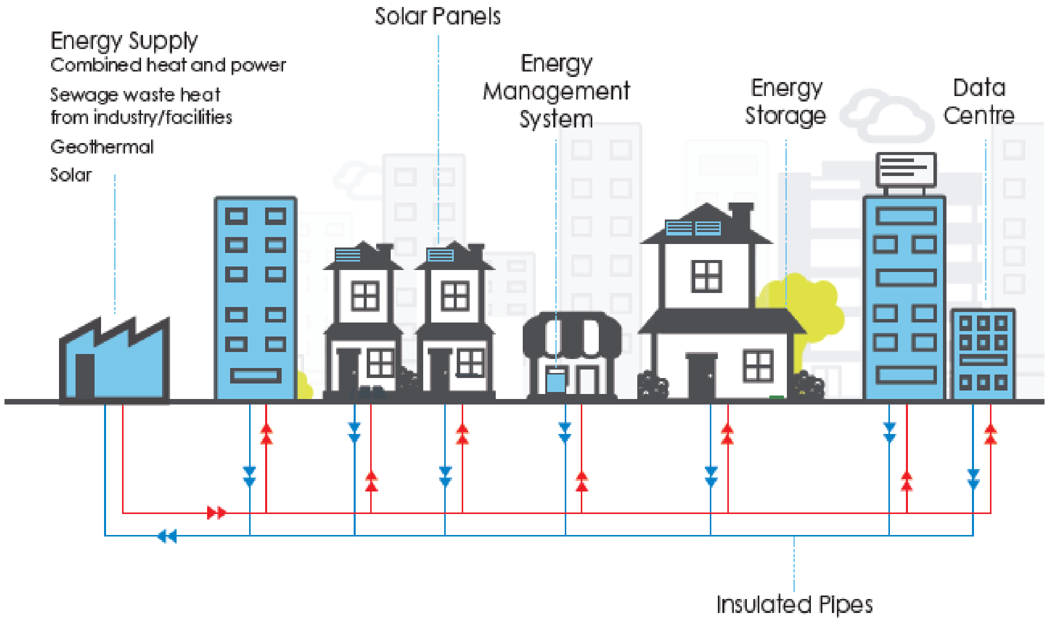
The community and Town share many facilities (libraries, arenas, community centres). Having a coordinated approach to promoting and implementing conservation plans that benefit both will be beneficial to the community. It will be in the best interest of the community and corporation to share their activities 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

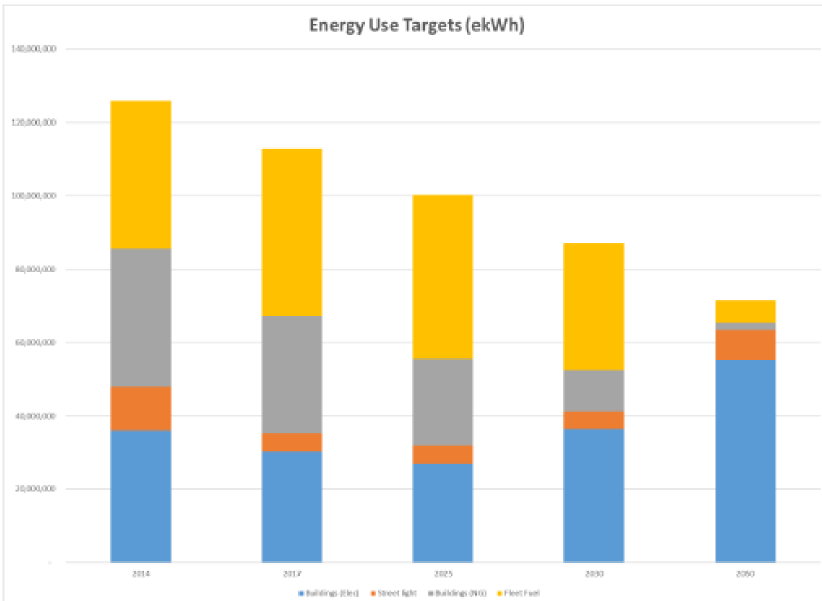
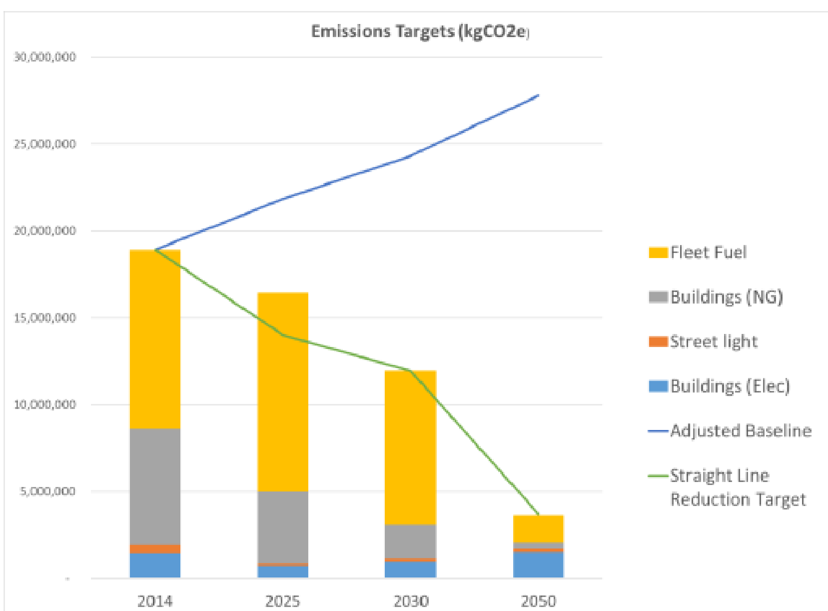


Figure 6 – GHG Emission Milestone Targets



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						
	(yellow)	Information entered by project manager										
	(green)	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/m² and m³/m² (a relative measure). For existing buildings, (where possible) reduce the energy consumption measured in kWh/m² and m³/m² 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.

[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.

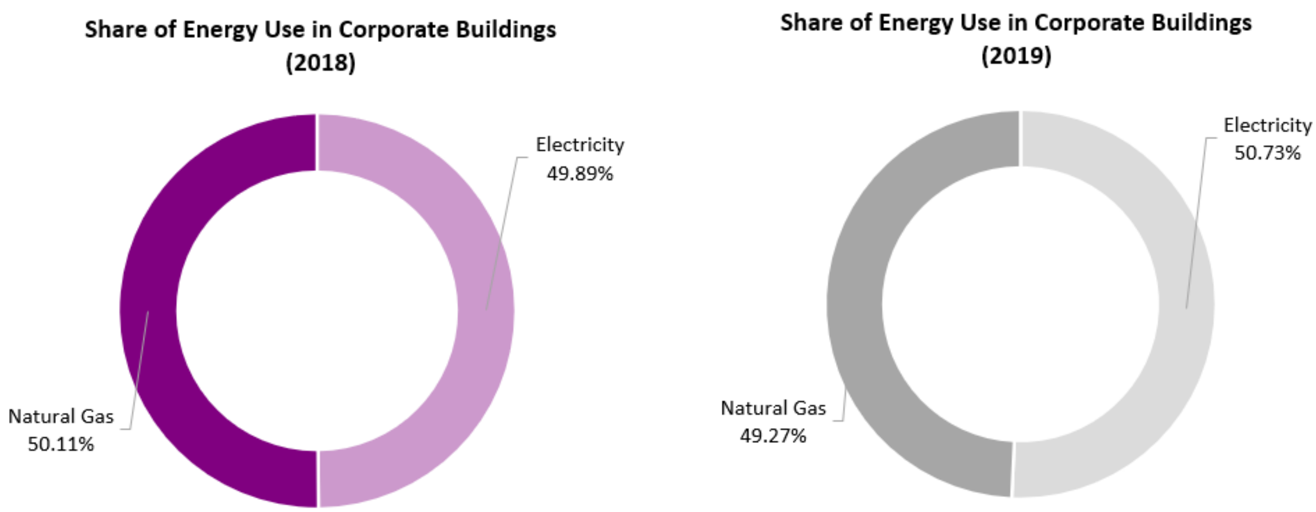


Figure 5 : Energy use share by utility, 2018 – 2019 for Corporate facilities

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.

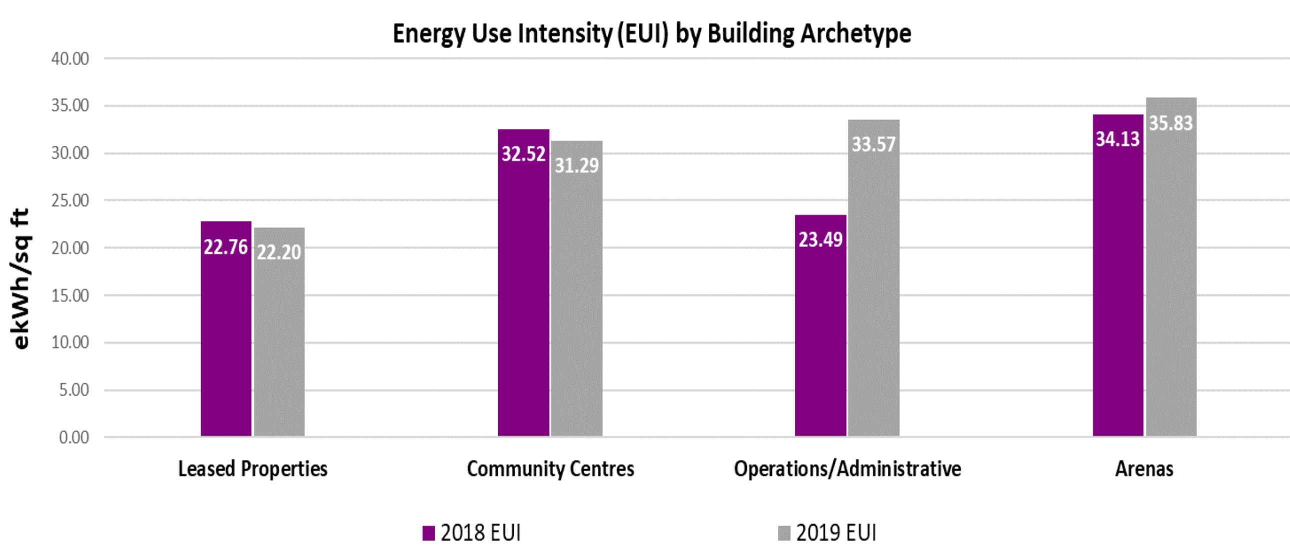


Figure 6: Energy use intensity (equivalent kWh/ sq.ft of floor area) for corporate archetypes, 2018 & 2019

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.

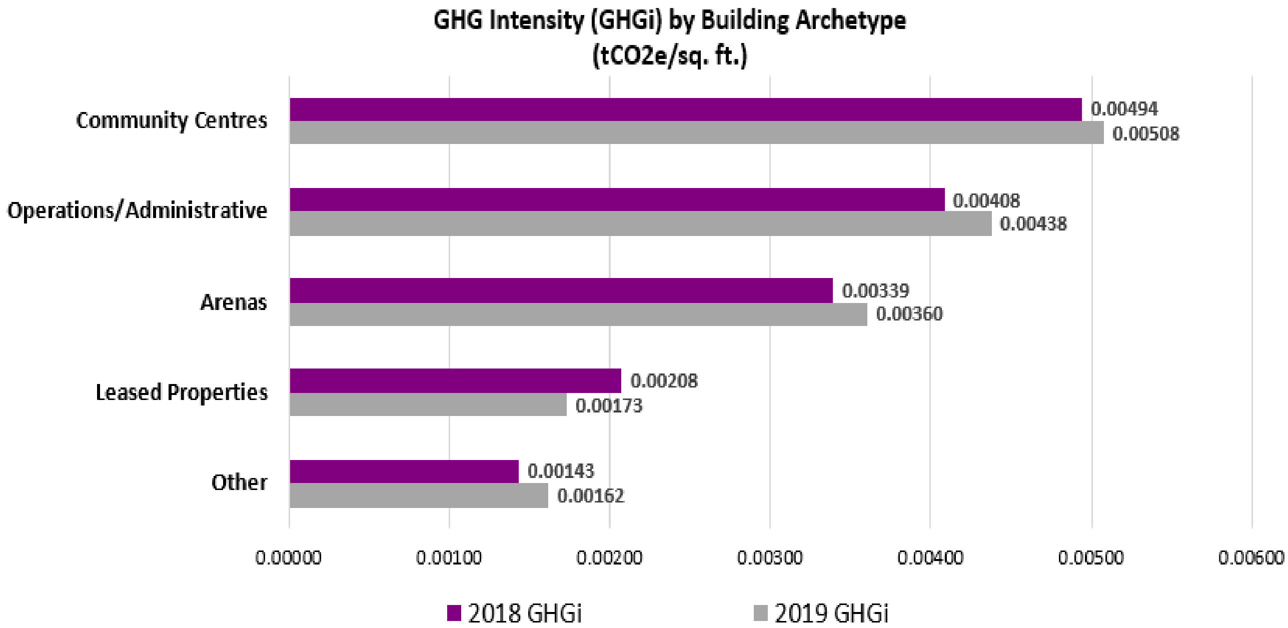


Figure 7: GHG Intensity for archetypes, 2018 and 2019, corporate facilities.

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.

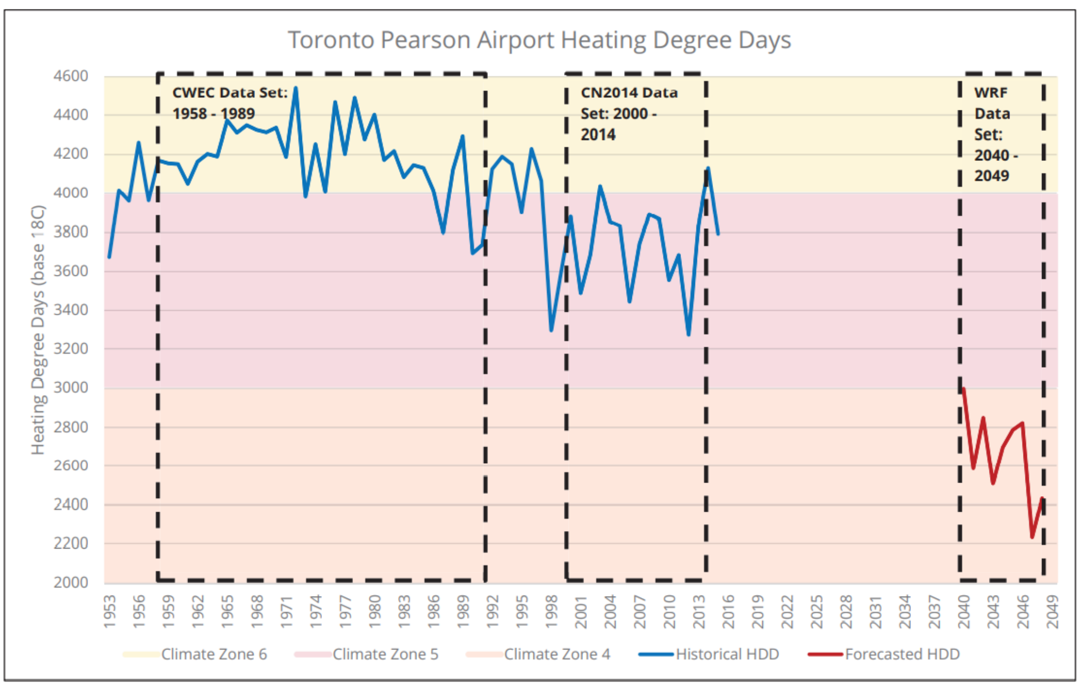
The general strategy for The Town's corporate facilities is to continue energy conservation and demand management plans with increasing levels of PV (as net metered PV and possibly PPA) to offset electricity use as natural gas is removed (electrification) and replaced with increased use of heat pumps. 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.

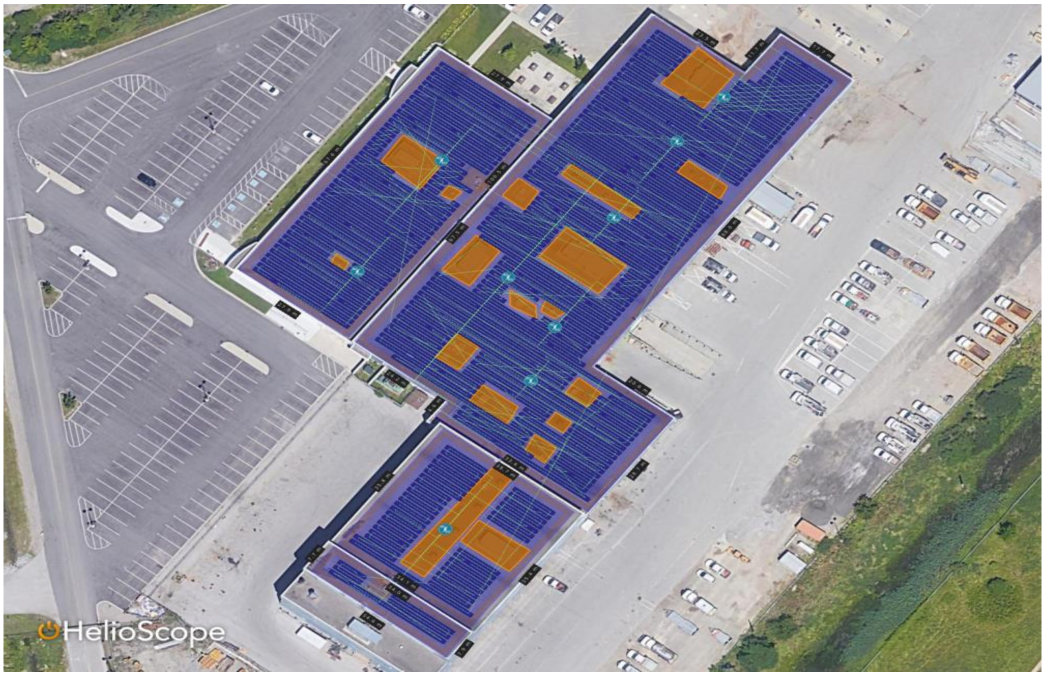


Figure 9: Conceptual roof PV array at 594 kW_{AC} (718 kW_{DC})

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.

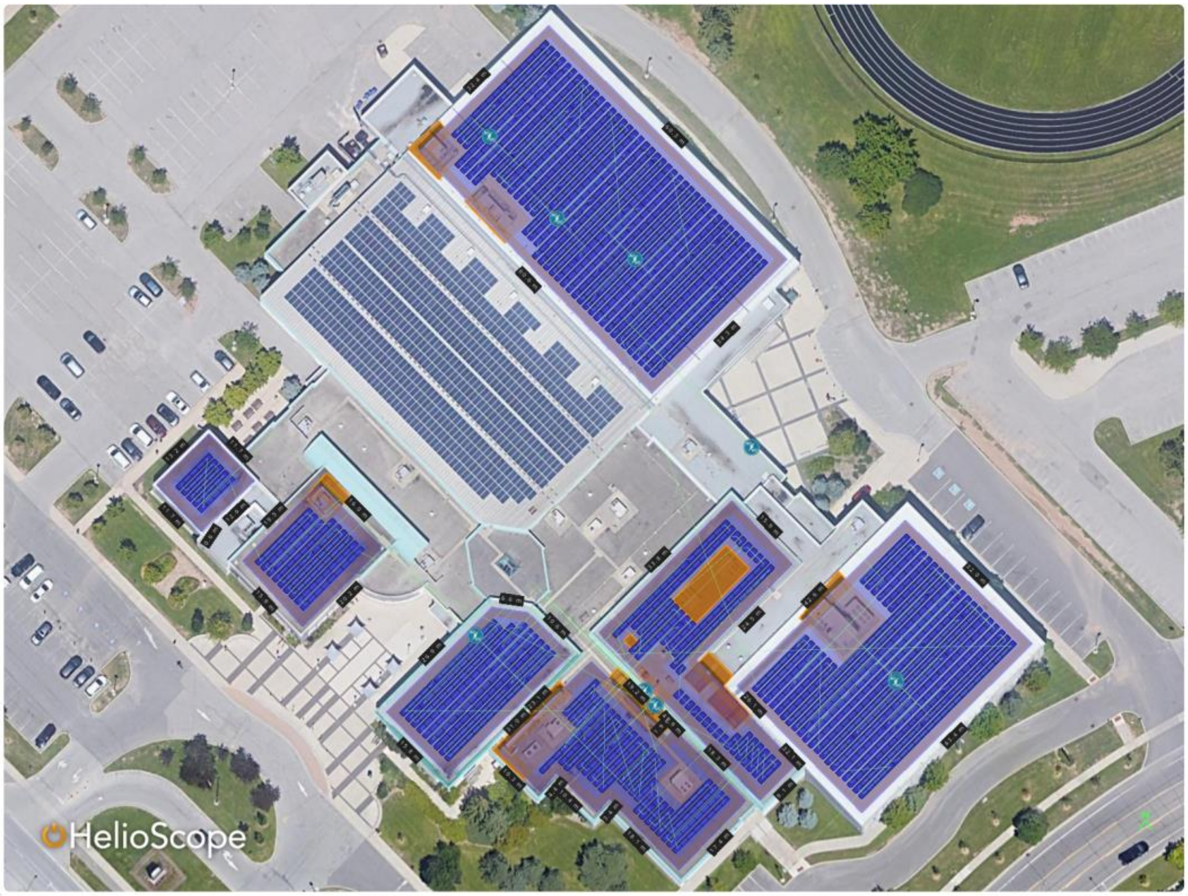


Figure 12: Conceptual PV arrays at Glen Abbey complex, total 504.7 kW_{DC}(450 kW_{AC})

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.

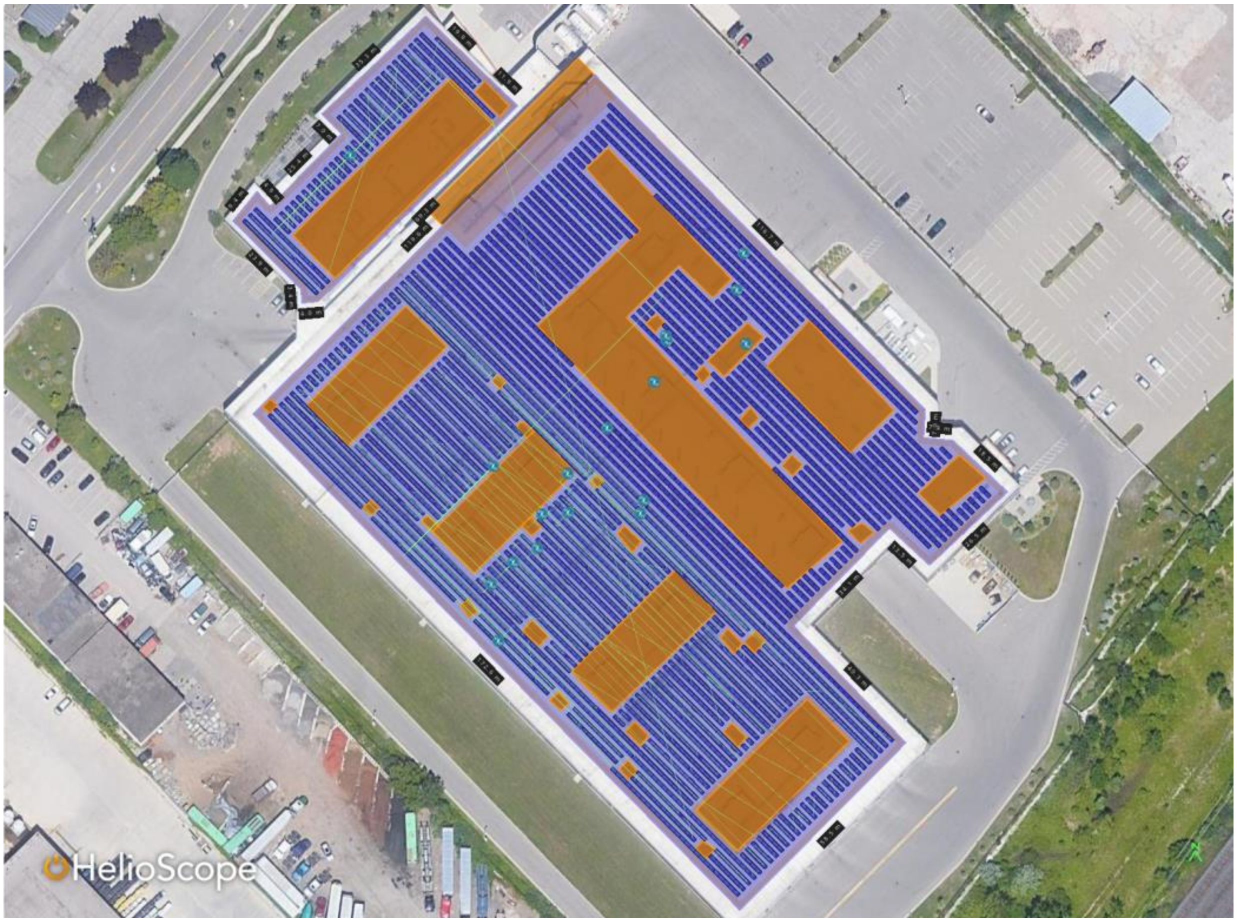


Figure 16: Conceptual layout for PV at Transit, 1.13 MW_{DC} (950 kW_{AC})

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

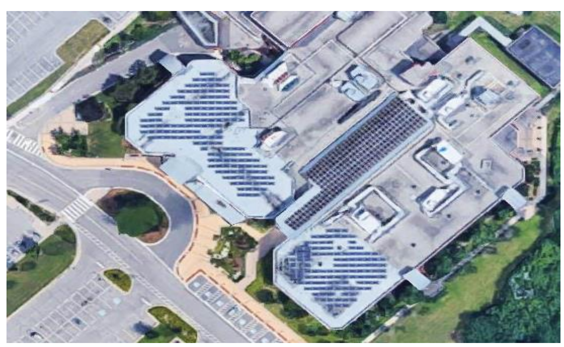
The following is an analysis of the existing renewable energy generation infrastructure at The Town as it pertains to Solar PV Energy Systems. Blackstone and our solar PV electrical contractor, Toews Power Inc. visited the following four (4) Town of Oakville solar PV systems on September 30, 2020:

- ✓ 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:

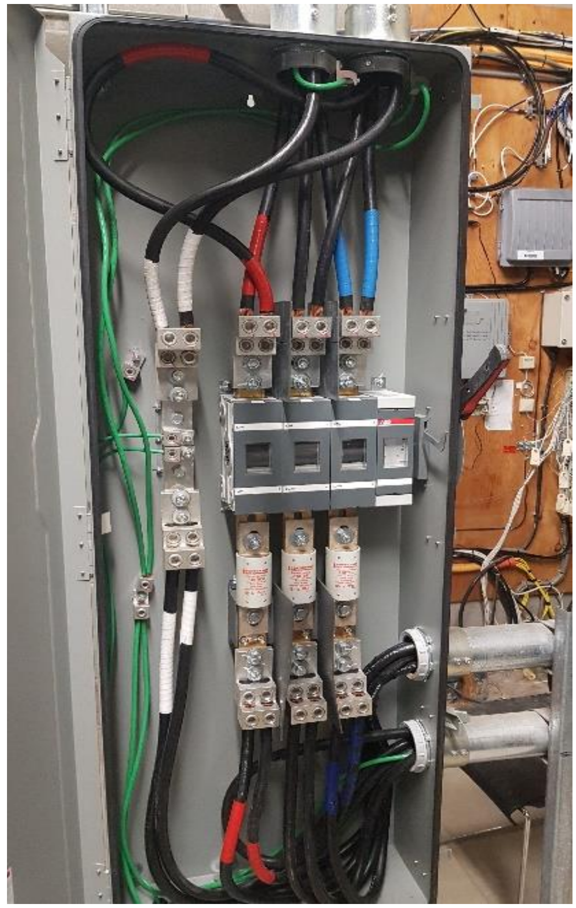
- More granular production data: production data should be available on a per hour basis (presently, we were only provided monthly summary data).
- Inverter and/or production alarms should be sent via email or text to notify owner immediately of production issues.
- Site specific issues were limited; 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

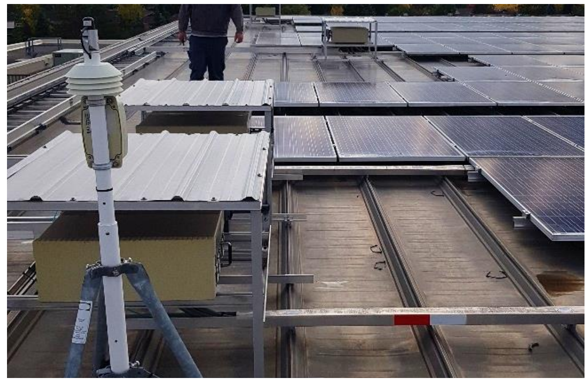


Picture 7: Electrical Room Wiring

- 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)*
- 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. *(see picture to right)*



Picture 8: Inverters Installation

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.

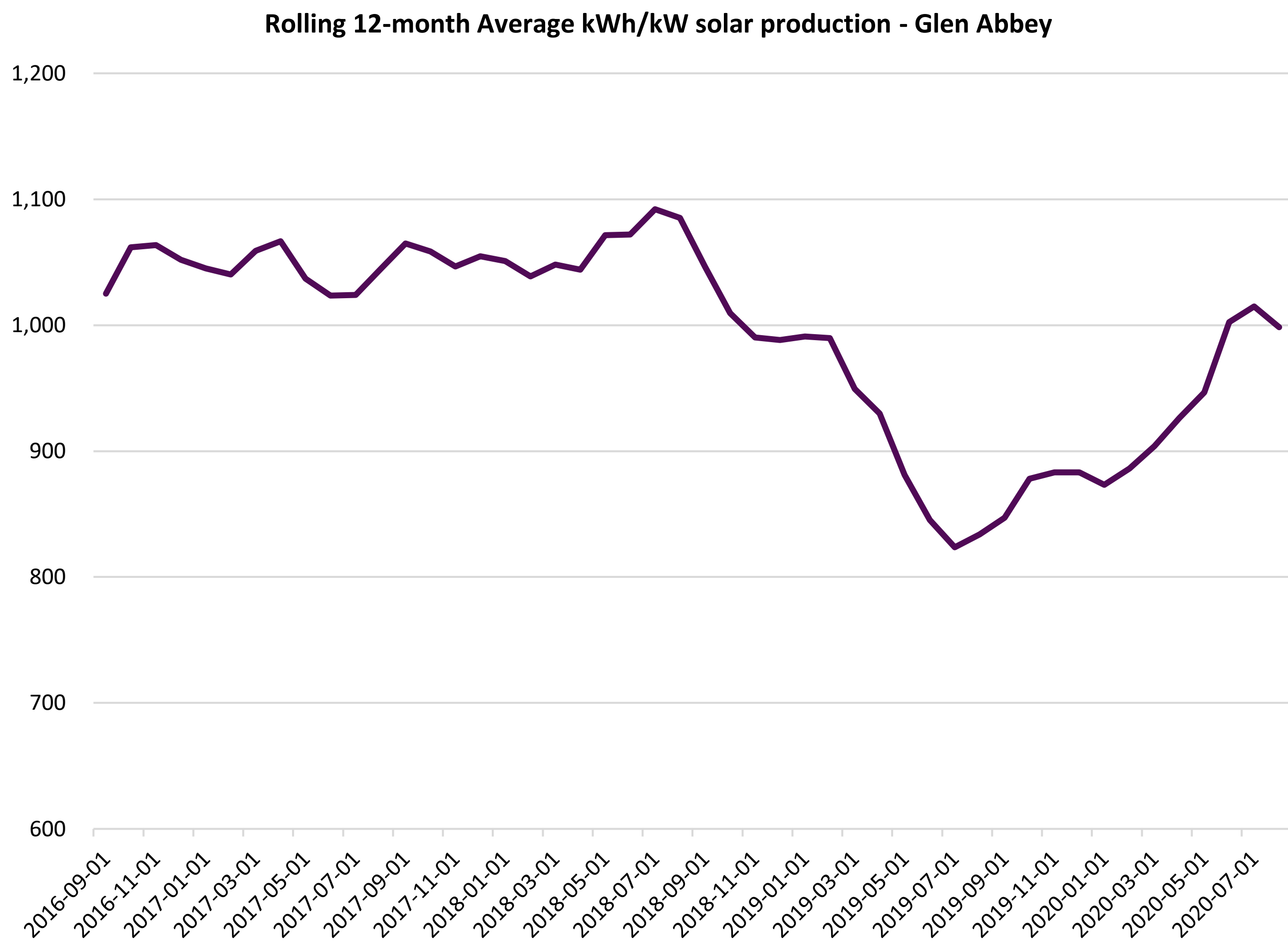


Figure 18: Summary of average kWh/kW solar system performance

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.

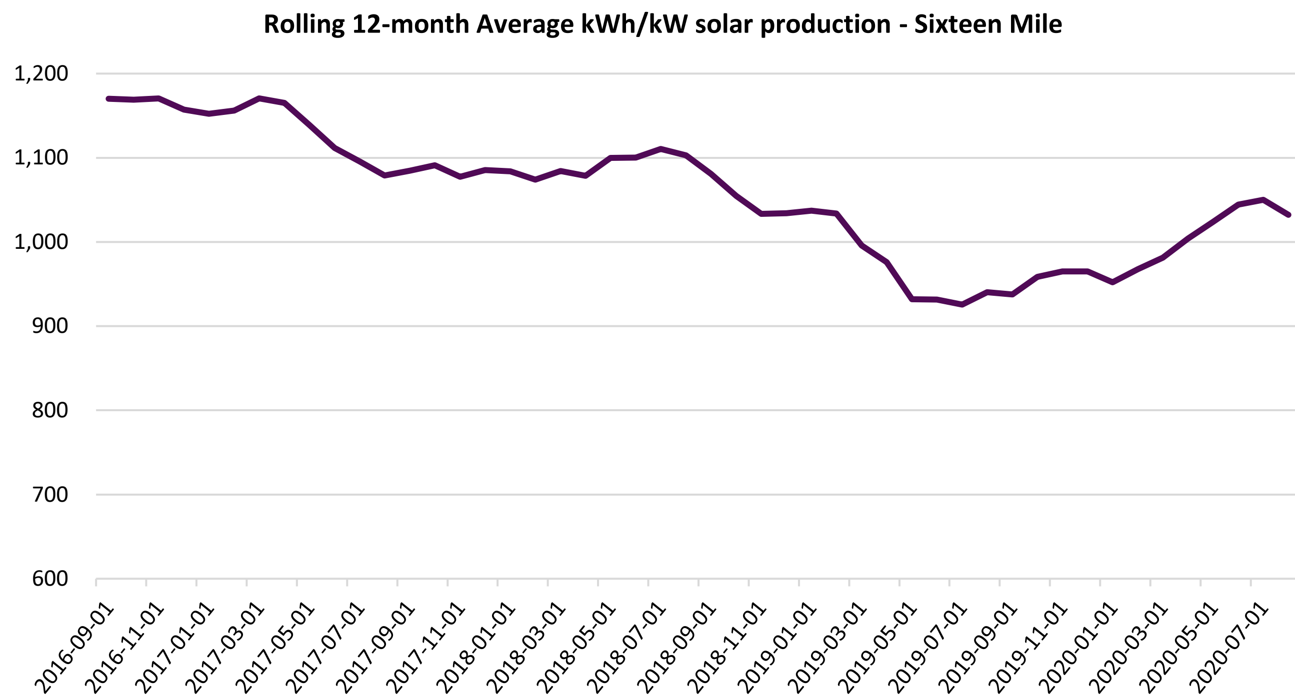


Figure 19: Summary of performance at Sixteen Mile, kWh/kW installed

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^{o} tilt to maximize solar production. Having said, the cost the create that 30^{o} 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.

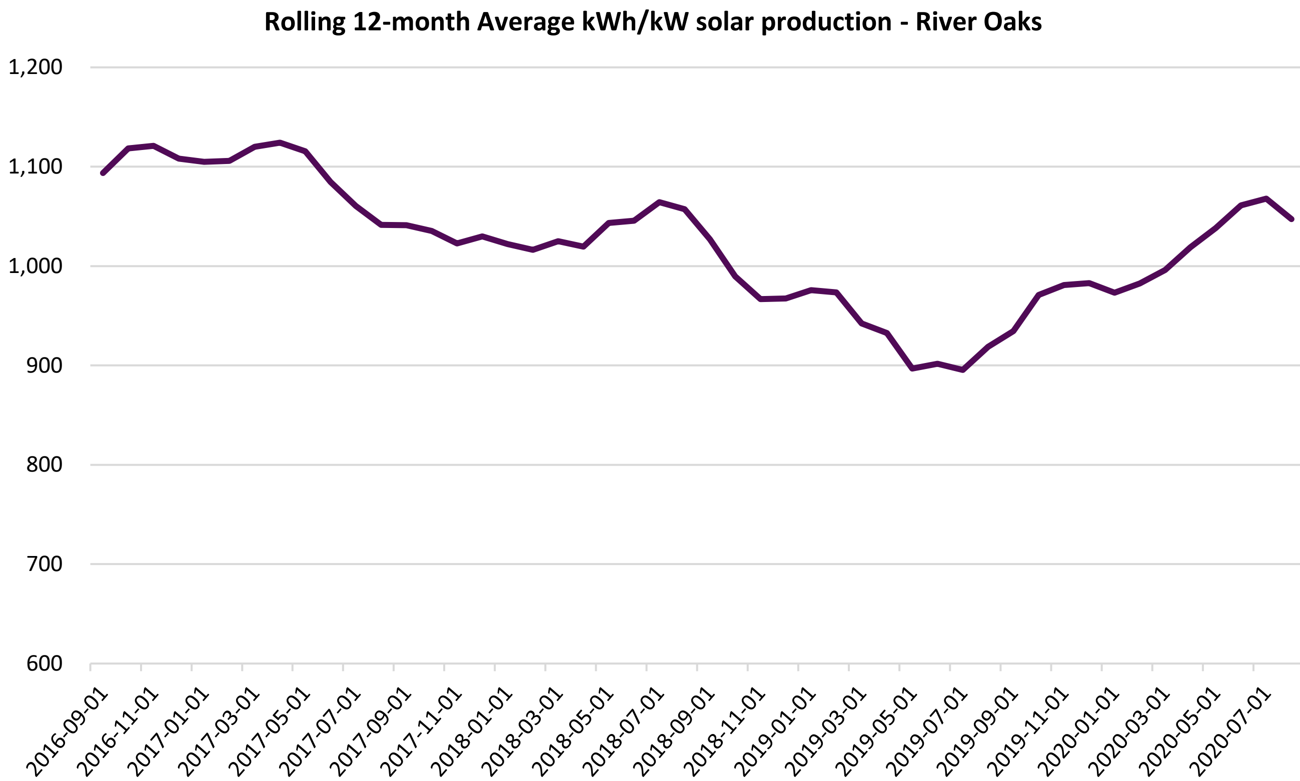


Figure 20: Summary of PV performance at River Oaks, kWh/kW installed

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

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.