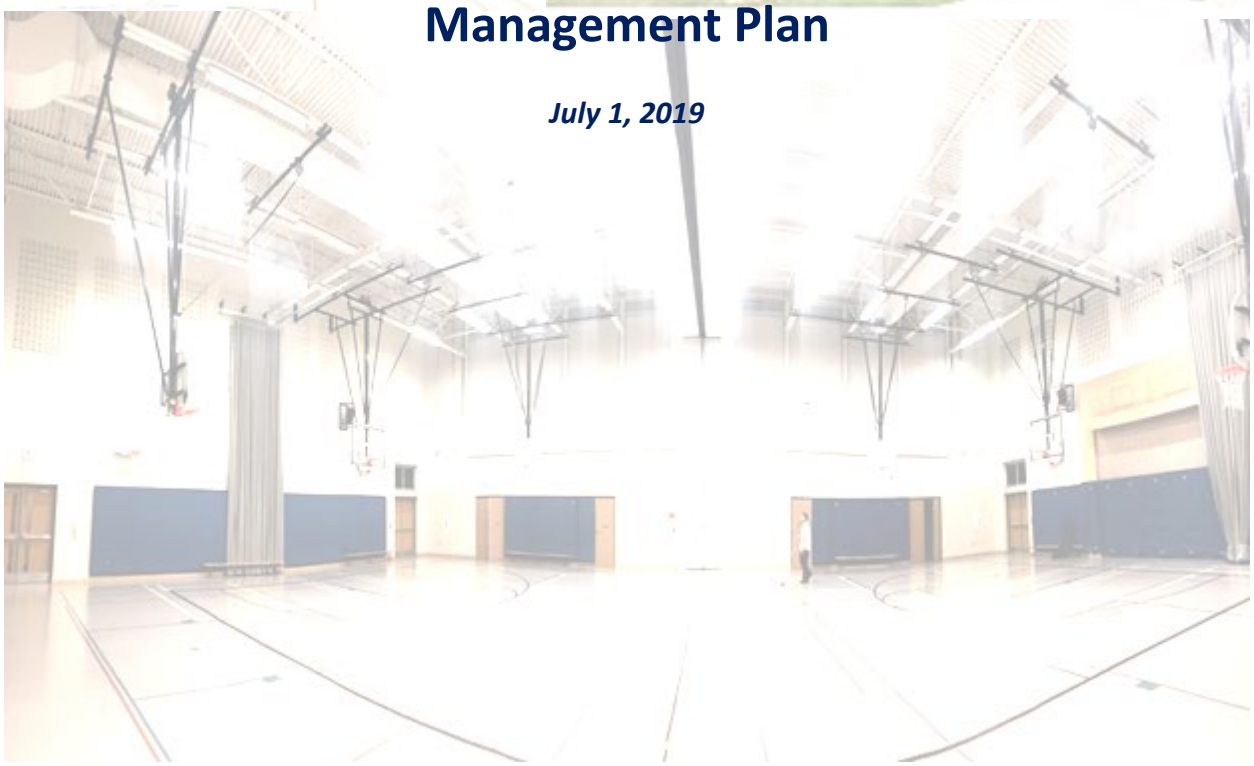
BRANT HALDIMAND NORFOLK
CATHOLIC DISTRICT SCHOOL BOARD

BHNCDSB 5-Year Energy Conservation and Demand Management Plan

July 1, 2019



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Education Sector Background

Funding and Energy Management Planning

All school boards receive 100% of their funding from the Ministry of Education.

The Ministry announces each Board's funding assignment in March for the next school board Fiscal Year (September 1st to August 31st). The Ministry gives funding only on a year-by-year basis.

While a school board may have a five-year energy management strategy, the ability to implement their strategy depends on the funding that is received for each of the five years covered by their plan.

Over the past five years, the Brant Haldimand Norfolk Catholic District School Board (BHNCDSB) has made great strides in energy efficiency and project implementation. Numerous projects have been completed using various funding sources. One of the most impactful funding resources was allocated in 2016 through the Green House Gas Reduction Funding that was given to school boards across the province.

Asset Portfolios and Energy Management Planning

The education sector is unique in that a school board's asset portfolio can experience important changes that crucially impact a board's energy consumption over a five-year period.

The following is a list of some of the most common variables and metrics that change in the education sector.

Facility Variables:

- Construction
  - Year built
  - Number of floors
  - Orientation of the building

- Building Area
  - Major additions
  - Sites sold/closed/demolished/leased
  - Portables
    - Installed
    - Removed
  - Areas under construction
- Equipment/Systems
  - Age
  - Type of technology
  - Lifecycle
  - Percentage of air-conditioned space
- Site Use
  - Elementary school
  - Secondary school
  - Administrative building
  - Maintenance/warehouse facility
  - Community Hubs
- Shared Site Use, i.e., two or more boards share common areas and/or partnered with a municipality
  - Swimming pools
  - Libraries
  - Lighted sports fields
  - Sports domes

Other Variables:

- Programs
  - Childcare
  - Before/After School Programs
  - Summer School
  - Community Use
    - Outdoor ice rinks

- Occupancy
    - Significant increase or decrease in number of students
    - Significant increase in the hours of operation
    - New programs being added to a site
- Air Conditioning
    - Significant increase in air-conditioned space
    - Portables

PART I: A REVIEW OF PROGRESS AND ACHIEVEMENTS in the PAST FIVE YEARS

A. The Board's Asset Portfolio

The following table outlines the energy-related variables and metrics in the Board's asset portfolio that changed from the baseline Fiscal Year 2012 to 2013 to the end of the five-year reporting period Fiscal Year 2017 to 2018.

Table 1: Board's Asset Portfolio

Key Metrics	(Baseline Year) Fiscal Year 2012 to 2013	Fiscal Year 2017 to 2018	Variance
Total Number of Buildings	39	35	4
Total Number of Portables/Portapaks	52	61	9
Total Floor Area	1,438,109	1,456,622	18,513
Average Operating Hours	58	100	42
Average Daily Enrolment	8,720	9,526	805

B. Energy Usage Data for the Board

The following table lists the "metered"[1] consumption values in the common unit of Equivalent Kilowatt Hours (ekWh) and Kilowatt Hours (kWh).

Table 2: Metered Usage Values

Utility	Fiscal Year 2012 to 2013 (Baseline year)	Fiscal Year 2017 to 2018
Total Electricity (kWh)	11,120,380	11,424,290
Total Natural Gas (ekWh)	13,287,170	13,060,960
Total Heating Fuel (Type 1 and 2) (ekWh)	24,407,550	24,485,250
Total Heating Fuel (Type 4 and 6) (ekWh)	0.00	0.00
Total Propane (ekWh)	0.00	0.00
Total Wood (ekWh)	0.00	0.00
Total District Heat (ekWh)	0.00	0.00
Total District Cool (ekWh)	0.00	0.00

1 Metered consumption is the quantity of energy used and does not include a loss adjustment value (the quantity of energy lost in transmission).

C. Weather Normalized Energy Consumption Values

In Ontario, 25% to 35% of energy consumption for a facility is affected by weather.

To demonstrate the effect of weather, the following table shows the Weighted Average Heating Degree Days (HDD)[2] and Cooling Degree Days (CDD)[3] for the six most common Environment Canada weather stations in the Ontario education sector.

Table 3: Ontario Degree-days

Ontario Degree Days	Fiscal Year 2012 to 2013	Fiscal Year 2013 to 2014	Fiscal Year 2014 to 2015	Fiscal Year 2015 to 2016	Fiscal Year 2016 to 2017	Fiscal Year 2017 to 2018
HDD	3698	4285	4091	3355	3583	3989
CDD	289	217	271	462	303	432

The best way to compare energy usage values from one year to another is to use weather normalized values as they take into consideration the impact of weather on energy performance and allows an “apple-to-apple” comparison of consumption across multiple years.

However, a straight comparison of Total Energy Consumed between one or more years does not take into consideration changes in a board’s asset portfolio, such as changes in buildings’ features (refer to the Facility Variables listed on Pages 5 and 6), and newly-implemented programs (refer to the Note to Readers on pages 10-12), which will greatly impact energy consumption.

As a result, weather normalized Energy Intensity[4] is the most accurate measurement that allows the evaluation of a board’s energy use from one year to another as it cancels out any change in floor area. The unit of measurement used is either equivalent kilowatt hours per square foot (ekWh/ft2) or equivalent kilowatt hours per square metre (ekWh/ft2).

[2] Heating Degree Day (HDD) is a measure used to quantify the impact of cold weather on energy use. In the data above, HDD are the number of degrees that a day's average temperature is below 18C (the balance point), the temperature at which most buildings need to be heated.
[3] Cooling Degree Day (CDD) is a measure used to quantify the impact of hot weather on energy use. In the data above, CDD are the number of degrees that a day’s average temperature is above 18C, the temperature at which most buildings need to be cooled. It should be noted that not all buildings have air conditioning and some building have partial air conditioning. The UCD only applies CDD to meters that demonstrate an increase in consumption due to air conditioning.
4 Energy Intensity (known as EI) is the quantity of total energy consumed divided by the total floor area. EI is typically expressed as equivalent kilowatt hours per square foot (ekWh/ft2), gigajoule per square metre (GJ /m2), etc., depending on the user’s preference.

Table 4: Weather Normalized Values

Weather Normalized Values	Fiscal Year 2012 to 2013 (Baseline Year)	Fiscal Year 2017 to 2018 (Most Recent Data Available)
Total Energy Consumed (ekWh)	23,184,900	22,973,920
Energy Intensity (eKWh/ft2)	16.12	15.77

D. Review of Previous Energy Conservation Goals and Achievements

In 2014, the Board set annual energy conservation goals for the following five fiscal years. The following table compares the Energy Intensity Conservation Goal with the Actual Energy Intensity Reduced for each year.

Table 5: Comparison of Energy Intensity Conservation Goal and Actual Energy Intensity Reduced

Fiscal Year	Conservation Goal ekWh/ft2	Conservation Goal Percentage %	Actual Energy Savings ekWh/ft2	Actual Energy Percentage
2013 to 2014	16.12	0.00	16.43	-0.31
2014 to 2015	16.12	0.00	16.90	-0.47
2015 to 2016	16.12	0.00	17.00	-0.11
2016 to 2017	16.12	0.00	16.67	0.33
2017 to 2018	16.12	0.00	15.77	0.90

NOTE TO READERS:

The Conservation Goals were forecasted in Spring 2014. Since that time, several factors which impact energy use, have been introduced to the education sector that may either raise or limit a board's ability to make the forecasted Conservation Goals.

Some of these factors include:

Full Day Kindergarten (also known as FDK)

The introduction of FDK created many new spaces through new additions or major renovations of existing facilities. The result was more floor area and sometimes more energy-intensive designs due to factors such as:

- Higher ventilation requirements,
- Use of air conditioning, etc.

These factors increase the energy intensity of a building. Under FDK, spaces for more than 470,000 new students were added to the education sector.

Before and After School Programs

These programs were implemented to help the introduction of FDK spaces. However, Before-School and After-School Programs need a facility's Heating, Ventillation and Air Conditioning (also known as HVAC) system to operate for an extended period of time on a daily basis, which will increase the overall energy intensity.

Community Use of Schools

The Ministry of Education introduced funding to all school boards, so they can make school space more affordable for use after hours. Both indoor and outdoor school space is available to not-for-profit community groups at reduced rates, outside of regular school hours. The use of spaces in schools, typically gymnasiums and libraries, increased to maximum usage. The use of these spaces during non-school hours requires a facility's HVAC system to operate for an extended period of time on a daily basis, which will increase the overall energy intensity.

Community Hubs

In 2016, the Ministry of Education introduced funding for boards to carry out Community Hubs within their asset portfolios. As a result, many schools now offer a greater range of:

- events (cultural),
- programs (arts, recreation, childcare), and
- services (health, family resource centres).

The dramatic increase in community use means that many schools now run from 6:00 a.m. until 11:00 p.m. during weekdays and are open many times on weekends. The use of these spaces during non-school hours requires a facility's HVAC system to operate for an extended period of time on a daily basis, which will increase the overall energy intensity.

Air Conditioning

Historically, schools have not had air conditioning, or it has been a minimal space in the facility. However, with changing weather patterns, "shoulder seasons" such as May, June and September are experiencing higher than normal temperatures. Parents are demanding that schools have air conditioning. Air conditioning significantly increases a facility's energy use.

BHNCDSB aims to abide by the High Temperature Guidelines, outlined by the Ministry of Education, under the Education Act of Ontario. All heating and cooling set points controlled throughout the Board meet the "Comfortable Criteria" outlined in Appendix A.

Where the capacity exists, the Board will manage, monitor and control to standard heating, cooling and ventilation setpoints. The setpoints are outlined in the table below.

Table 6: Thermal Comfort and Ventilation Guidelines

Set Point Type	Heating (C°)	Cooling (F°)
Occupied Temp	21	23
Unoccupied Temp	18	28
$C0^2$ PPM	1000	1000
Ventilation (CFM)	ASHRAE 62.1 STDS	

Compliance with Current Ontario Building Code (also known as OBC)

When renovations or an addition is built onto an existing school, in-place equipment such as HVAC systems, lighting etc., may be required to meet up-to-date OBC standards, which may result in increased energy use.

For example, under the OBC, buildings built today have increased ventilation requirements, meaning more outside air is brought into a facility. As a result, HVAC systems need to work longer to heat or cool the outdoor air to bring it to the same temperature as the standard indoor temperature for the building.

E. Cumulative Energy Conservation Goal

The following table compares the 2014 Forecasted Cumulative Energy Intensity Conservation Goal with the Actual Cumulative Energy Intensity Reduced Savings.

Table 7: Cumulative Energy Intensity Goal from Fiscal Year 2013 to 2014 through Fiscal Year 2017 to 2018

Cumulative Energy Intensity	(ekWh/ft2)
Forecasted Cumulative Energy Intensity Conservation Goal of Fiscal Year 2013 to 2014 through Fiscal Year 2017 to 2018 Source: http://www.bhncdsb.ca/sites/content/files/resources/bhncdsb_conservation_demand_plan_2014_2018.pdf	16.12
Forecasted Cumulative Energy Intensity Conservation Goal as a Percentage Source: http://www.bhncdsb.ca/sites/content/files/resources/bhncdsb_conservation_demand_plan_2014_2018.pdf	0%
Actual Cumulative Energy Intensity Reduced or Increased from Fiscal Year 2013 to 2014 through Fiscal Year 2017 to 2018 – Weather Normalized	15.77
Variance between 2014 Forecast Cumulative Conservation Goal and Actual Cumulative Energy Intensity – Weather Normalized	0.35
% of Cumulative Energy Intensity Conservation Achieved - Weather Normalized	2.17

F. Measures Implemented from Fiscal Year 2012 to 2013 to Fiscal Year 2017 to 2018

A list of the measures implemented, the related costs, and the fiscal year that the measure was implemented within the Board are outlined below.

Design, Construction and Retrofit Investments

- Lighting & Controls
- BAS
- Unitary A/C
- HVAC Systems
- Motors and VFDs
- Heat Recovery
- Sensors
- Building Envelope
- Fans and Blowers
- Ventilation
- Refrigeration
- Heat Pumps
- Condensing Hot Water Boiler
- Condensing Hot Water Heater
- Energy Recovery Ventilators
- Demand Control Ventilation

Operations and Maintenance Investments

- Optimizing existing BAS
- Schedules
- Set points
- Repair malfunctioning/non-calibrated equipment
- Integrated systems optimization

Occupant Behaviour Investments

- Eco Schools Program

NOTE TO READERS:

Important Consideration - It takes a minimum of one full year after an energy management strategy has been implemented before an evaluation can figure out the related actual energy savings achieved.

PART II – ENERGY CONSERVATION and DEMAND MANAGEMENT PLAN for FISCAL YEAR 2018 to 2019 to FISCAL YEAR 2023 to 2024

Part II outlines the Board's plan to reduce energy consumption through renewable energy and energy management strategies including:

1. Design, Construction and Retrofit;
2. Operations and Maintenance; and lastly
3. Occupant Behavior.

For a complete list of completed projects, please refer to Appendix B. The majority of these projects were included the previous CDM plan.

Background

Historically, BHNCDSB has addressed Energy Conservation & Demand Management on a project-by-project basis within the Facilities Department. Energy is a primary driver in many of the decisions made within the department with respect to new construction, operations and maintenance and occupant awareness.

In 2009, BHNCDSB embarked on a strategic energy auditing project, leveraging the available funding through Independent Electricity System Operator. These audits uncovered numerous energy efficiency measures which were included in the first Five-Year CDM plan in 2013. Over the next five years, many of the measures were implemented as per the plan, which has helped the Board lower their overall energy use.

Currently, the Board leverages the Utility Consumption Database in order to analyze, monitor and benchmark each facilities energy consumption. In addition to the Utility Consumption Database, the Board has made significant investments in upgrading the building automation system (BAS), including fully-integrated real-time energy monitoring at each facility. This provides in-depth insight on energy usage at a very granular level, providing evidence for daily issues that may occur along with energy saving opportunities.

Project Identification and Analysis

Multiple methods have been implemented to identify potential energy conservation projects within the BHNCDSB: Energy Monitoring, Benchmarking, Energy Efficiency Measures Tracking Database, Incentive Programs, work order & capital projects review. These methods are summarized below.

Energy Monitoring and Targeting

Energy monitoring and targeting is one of the most important tools to identifying energy efficiency projects and to ensuring that each energy efficiency measure is performing as expected. The BHNCDSB will utilize all available resources for monitoring the energy consumption of all its schools. These resources include the ministry-funded utility consumption database (UCD), online utility accounts with local electric distribution companies and other internal resources.

- Consult the internal management system (eBase) to check if any work orders, projects, or accommodations that could potentially have attributed to the unusual consumption reading.
- Consult the Custodial Supervisor and/or Maintenance Supervisor.
- Potential site visits to investigate building systems and their day-to-day operations.

If an issue is found, it will be documented within a database and all stakeholders will be notified of the issue. This approach will allow staff to take a more proactive approach to prevent these issues in the future.

In terms of energy analysis, schools' utility consumption will undergo CUSUM analysis on a regular basis and energy savings determination will be done by using ASHRAE Guideline 14. Once "low hanging fruit" projects are exhausted, building energy models will be conducted to investigate energy efficiency measures. Energy models also help determine the affect multiple retrofits on integrated building systems will have on the building.

Benchmarking

An extension of the Energy Monitoring method is to use the benchmarks provided to serve as potential targets to identify high energy consuming schools. On an annual basis at fiscal end, each school will be evaluated on its respective energy consumption for the past fiscal year. The top ten energy consuming schools will be listed as priority. Careful attention will be given to these schools and energy conservation measures will determined through various means. These projects will be prioritized and the top measures will be implemented to lower the facilities overall energy intensity.

Energy Efficiency Measure Tracking Database

The BHNCDSB maintains an Energy Conservation Measure Tracking database that includes past measures implemented and potential energy conservation measures that are applicable to schools. Energy conservation measures will be assigned to specific systems within a school (e.g. HVAC, lighting, BAS, scheduling etc.) and will serve as a living document to be used for presenting data to Board stakeholders. In addition, these energy conservation measures will be assembled as a checklist when making site visits to ensure all potential energy savings are checked.

Incentive Programs and Incentive Funding

Incentive Programs, through the IESO & Enbridge Incentives, provide excellent resources on how to save energy and financial assistance in energy conservation projects. The following areas currently provide incentives for:

- Lighting & Controls
- BAS
- HVAC Systems
- Motors, pumps and VFDs
- Heat Recovery
- Sensors
- Building Envelope
- Fans and Blowers
- Ventilation
- Refrigeration
- Heat Pumps
- Condensing Hot Water Boiler
- Condensing Hot Water Heater
- Energy Recovery Ventilators
- Demand Control Ventilation

Going forward, the Facilities Department would like to use incentive payments received to fund future energy related projects. A revolving energy fund will ensure that the Board is able to implement energy projects and commit to reducing its overall consumption over the next five years.

Work Orders and Capital Projects

Facilities Department staff will review energy-related work orders and capital projects on a weekly basis to assess for potential energy efficiency projects. Work orders and projects that appear to serve ample opportunity for energy conservation projects will be pursued. A separate category has been created for Energy Efficiency Projects so that potential projects will be assessed on an individual basis.

Budget Implementation

Energy-related project funds are allocated based on a project-by-project basis. Project proposals are presented to management and are approved based on project feasibility. Factors that determine a projects feasibility are the following:

- Simple Payback
- Internal Rate of Return
- Net Present Value
- 20-Year Life Cycle Cost Analysis

The BHNCDSB is committed to promoting and supporting environmental education, environmental action and care of the environment. It is the policy of Board to facilitate the implementation of programs and curriculum initiatives to deepen and broaden student learning about the environment. As part of the Board's continuing commitment to implement environmentally responsible practices, understanding of environmental impact will be consistently utilized to inform decision-making. This methodology will help create a comfortable, safe and sustainable learning environment for all staff and students.

1. The Board has an energy management position, which includes the following options.

   ☒ In-house including:
      a. Full time
      b. Part time
      c. Shared job function
   ☐ Contracted third party, or
   ☐ None

2. Energy Management Strategies

   Energy management strategies fall into three key categories:

   1. Design/Construction/Retrofit
   2. Operations and Maintenance
   3. Occupant Behaviour

Design/Construction/Retrofit

Definition

Design, construction and retrofit includes the original and ongoing intent of how a building and its systems are to work through the combination of disciplines such as architecture and engineering.

For the Board's relevant projects over the next five years, please refer to **Calculating Energy Conservation Goals Fiscal Year 2019 to Fiscal Year 2023, Appendix B: Design, Construction and Retrofit.**

Operations and Maintenance

Definition

Operations and maintenance include the strategies the Board uses to ensure that the existing buildings and equipment performs at maximum efficiency. For the Board's relevant projects over the next five years, please refer to **Calculating Energy Conservation Goals Fiscal Year 2019 to Fiscal Year 2023, Appendix C: Operations and Maintenance.**

Occupant Behaviour

Definition

Strategies that the Board uses to teach occupants, including staff, students and community users, with an emphasis on changing specific actions to reduce energy consumption. For the Board's relevant projects over the next five years, please refer to **Calculating Energy Conservation Goals Fiscal Year 2019 to Fiscal Year 2023, Appendix D: Occupant Behaviour.**

A. Future Energy Conservation Goals

The Board has set-out the following energy intensity reduction conservation goals for the next five fiscal years.

Table 8: Annual Energy Intensity Conservation Goals

Annual Energy Intensity Conservation Goal	Fiscal Year 2018 to 2019	Fiscal Year 2019 to 2020	Fiscal Year 2020 to 2021	Fiscal Year 2021 to 2022	Fiscal Year 2022 to 2023
ekW/ft2	15.61	15.45	15.30	15.15	14.99
Percentage Decrease	1%	1%	1%	1%	1%

The following table shows the Board's Cumulative Energy Intensity Conservation Goal for the next five fiscal years.

Table 9: Cumulative Conservation Goal

Cumulative Conservation Goal	Fiscal Year 2018 to 2019 through Fiscal Year 2022 to 2023
ekWh/ft2	14.99
Percentage Decrease	5%

NOTE TO READERS:
There are many factors that influence a school board's ability to meet energy conservation goals. A list of some of these factors include, but are not limited to, in the following changes:

1. Changes in Programming

   For example:
   - Introduction of Before and After School Programs to schools meant that the number of hours that a facility's HVAC system operates daily was expanded by four or more hours per weekday to reflect the longer occupancy hours.

2. Changes to the Ontario Building Code

   For example:
   - Regular changes/updates to the Ontario Building Code can impact energy use. For example, an increase in levels of ventilation in newly-constructed buildings or other requirements. As a result, more fresh air is brought into a school to meet the ventilation requirements throughout the day and requires heating and cooling of the air (dependent on the season) to meet standard classroom temperatures.

3. Changes to School Board Funding Models
   - Forecasted Conservation Goals are based on current funding models being in place throughout the next five years.
   - School board funding is determined on an annual basis. Any changes to the funding model will impact forecasted values.

4. Changes in Technology
   - Forecasted Conservation Goals are based on current technologies and related energy savings. If new technologies become available, anticipated energy savings may increase.

B. Environmental Programs

In Fiscal Year 2018 to 2019, schools within the Board participated in environmental programs.

1. Eco Schools:
   _5_ number of schools participate
2. Earth Care Schools:
   _0_ number of schools participate
3. Enbridge: The School Energy Challenge
   _0_ number of schools participate

C. Energy Efficiency Incentives

1. The Board applies to incentive programs to support the implementation of energy efficient projects on a regular basis.

   ☒ Yes ☐ No

   If yes, between Fiscal Year 2013 to 2014 and Fiscal Year 2017 to 2018, the Board has applied for over $90,000 in incentive funding from different agencies to support the implementation of energy efficient projects.

2. The Board uses the services of the sector's Incentive Programs Advisor (IPA).

   ☒ Yes ☐ No

D. Energy Procurement

1. The Board participates in a consortia arrangement to purchase electricity.

   ☒ Yes ☐ No

   If yes,

   ☒ OECM's Strategic Electricity Management and Advisory Services

2. The Board participates in a consortia arrangement to purchase natural gas.

   ☒ Yes ☐ No

   If yes,

   ☒ Ontario Education Collaborative Marketplace's (also known as OECM) Natural Gas Management and Advisory Services
   ☒ Catholic School Board Services Association' (also known as CSBSA) Natural Gas Management and Advisory Services

E. Demand Management

1. The Board uses the following method(s) to monitor electrical demand:
   ☐ Invoices
   ☒ Real-time data
   ☒ Online data from the Local Distribution Company (LDC)

2. The Board uses the following methodologies to cut down electrical demand:
   ☒ Equipment scheduling
   ☐ Phased/staged use of equipment
   ☐ Demand-limit equipment
   ☒ Deferred start-up of large equipment (e.g. chiller start-up in spring)

F. Senior Management Approval of this Energy Conservation and Demand Management Plan

I confirm that Brant Haldimand Norfolk Catholic District School Board's senior management has reviewed and approved this Energy Conservation and Demand Management Plan.

Signature: 

Full Name: Scott Keys

Job Title: Superintendent of Business & Treasurer

Date: July 9, 2019

Appendix A: High Temperature Guideline Reference Chart

APPENDIX A: HIGH TEMPERATURE GUIDELINE REFERENCE CHART

AWARENESS INITIATIVES		PREVENTION MEASURES		REACTIVE MEASURES	
Employer Representatives (Designated School Board Staff)	Provide information to supervisors and workers to recognize factors which may increase the risk of developing a heat related illness and the signs and symptoms of heat stress	**Employer Representatives** (Designated School Board Staff)	Encourage the use of mechanical or other specialized equipment to reduce physical demands of work related tasks	**Supervisor Representatives** (Principals, Vice-Principals, Designates, Supervisors)	Provide scheduled daily access to cooler areas in the building when possible
Supervisor Representatives (Principals, Vice-Principals, Designates, Supervisors)	Monitor of environmental conditions (including humidex) and the possibility of heat stress related illness, especially during the first week of elevated temperatures while individuals are acclimatizing		Maintain insulating and reflective barriers which are designed to control the heat at its source (e.g. insulated furnace walls)		Review schedules for individuals exposed to high temperature conditions and increase the frequency and or length of rest breaks when possible
	Ensure that trained First Aid providers are available to respond to heat related illnesses throughout periods during which heat stress related illness is likely to occur		Maintain and maximize the use of existing equipment which is designed to exhaust hot air and humidity from occupied areas		Schedule strenuous jobs to be done during cooler times of the day
	Develop a clear and concise hot weather action plan which includes outdoor activities		Maintain and monitor the effectiveness of equipment designed to reduce the temperature and humidity through air cooling		Ensure that education workers have access to cooler areas of the building to take their scheduled breaks where possible
	Communicate heat stress related information and recommendations to all workers		Maximize the efficiency of building automation systems (BAS) to regulate indoor air temperatures during periods of extreme heat		Investigate and follow-up on any high temperature related incidents which are reported or observed
Worker Members (Education workers)	Acknowledge and promote information in regards to key factors which may increase the risk of developing a heat related illness and the signs and symptoms of heat stress		Consider American Society of Heating, Refrigerating and Air-Conditioning (ASHRAE) standards as it pertains to ventilation based on occupancy levels and air exchange requirements		Consult with employer representatives and Public Health Unit representatives for additional advice as required
Joint Health and Safety Comittee Members	Review information provided in regards to high temperature guidelines and make recommendations	**Supervisor Representatives** (Principals, Vice-Principals, Designates, Supervisors)	Provide access to cool, shaded work areas in the building if practical and safe to do so	**Worker Members** (Education workers)	Use available ventilation equipment to increase air movement if the indoor temperature is below 35°C
			Assess the physical demands of work related tasks and confirm reasonable monitoring and control strategies to implement during high temperature periods		Turn off or limit the use of heat generating equipment and appliances if safe and practical to do so
			Consider additional controls to prevent exposure to high temperatures which may be required for vulnerable individuals such as education workers and students with special needs or medical conditions		Where mechanical cooling is not possible, open interior doors and perimeter windows to increase the exchange of fresh air (when exterior temperatures are cooler)
		Joint Health and Safety Committee Members	Promote discussions, recomendations and relevant information to all education workers		Consume enough potable water to stay hydrated
					Be conscious of medications side effects and avoid beverages which contain sugars and caffeine as this may contribute to dehydration
					Avoid exposure to direct sunlight, especially during high heat periods of the day
					Consider wearing light and breathable clothing and avoiding clothing fabricated with synthetic fabric which may limit the cooling of the body
					Wear light-coloured clothing (preferably a long-sleeve shirt and pants) and cover the head to prevent exposure to direct sunlight when outdoors
					For very hot environments, consider air, water or ice–cooled insulated clothing
					Consider wearing reflective clothing when working in areas with high radiant heat sources
					Be aware of risks related to the use of vapour-barrier clothing (i.e. chemical protective clothing) as this may limit cooling of the body
TEMPERATURE RANGE INCLUDING HUMIDEX	**DEGREES OF COMFORT**			**Joint Health and Safety Committee Members**	Review incident details (if any) and compare to policies, procedures and awareness initiatives in place. Make recommendations in order to prevent reoccurrence where possible
19-24	**Comfortable**		**A temperature range in which most individuals are comfortable**		
26-34	**Some discomfort**		**Some individuals may experience discomfort**		
35-44	**Great discomfort**		**Most individuals will experience high levels of discomfort (initiate hot weather action plan and avoid exertion)**		
45 and above	**HEALTH RELATED ILLNESS LIKELY TO OCCUR**				

Appendix B: Calculating Energy Conservation Goals 2019-2023 Design, Construction and Retrofit

Calculating Energy Conservation Goals for FY 2019 to FY 2023

Design, Construction and Retrofit Strategies

	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023	
Lighting	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Saving (ekWh)**	**Estimated Total Accumulated Energy Savings (ekWh)**	**Energy Payback Period**
High Efficiency Lighting Systems	$ 100,000	190,476	$ 200,000	380,952	$ 250,000	476,190	$ 300,000	571,429	$ 200,000	380,952	5,428,571	3
Outdoor Lighting	$ 50,000	57,143	$ 100,000	114,286	$ 20,000	22,857	$ 10,000	11,429	$ 10,000	11,429	845,714	5
Occupancy Sensors	-	-	$ 20,000	22,857	$ 20,000	22,857	$ 20,000	22,857	$ 20,000	22,857	228,571	5
Other (Describe)	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	0

	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023	
H.V.A.C.	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Total Accumulated Energy Savings (ekWh)**	**Energy Payback Period**
Efficient Boilers (near condensing)	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	15
High-efficiency Boilers (condensing)	$ 550,000	1,529,158	$ 300,000	834,086	$ 150,000	417,043	$ -	-	$ -	-	12,233,266	10
High-efficiency Boiler Burners	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	5
Geothermal	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	35
Heat Recovery/Enthalpy Wheels	$ 300,000	647,445	$ -	-	$ -	-	$ 200,000	431,630	$ 350,000	755,352	4,855,836	8
Economizers	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	7.5
Energy Efficient HVAC systems	$ 25,000	3,274	$ 300,000	39,283	$ 25,000	3,274	$ 25,000	3,274	$ 25,000	3,274	193,142	75
Energy Efficient Rooftop Units	$ 450,000	147,312	$ 140,000	45,830	$ -	-	$ -	-	$ -	-	919,879	30
High Efficiency Domestic Hot Water	$ 50,000	98,809	$ -	-	$ 25,000	49,405	$ -	-	$ -	-	642,261	10
Efficient Chillers and Controls	$ -	-	$ -	-	$ 300,000	17,143	$ -	-	$ 150,000	8,571	60,000	100
High-efficiency Motors	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	10
VFD	$ -	-	$ 40,000	57,798	$ 75,000	108,372	$ 40,000	57,798	$ 40,000	57,798	729,703	5
Demand Ventilation	$ -	-	$ 50,000	98,208	$ 20,000	39,283	$ -	-	$ -	-	510,680	5
Entrance Heater Controls	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	5
Destratification Fans	$ -	-	$ 30,000	24,490	$ -	-	$ -	-	$ -	-	97,959	7
Other (Describe)	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	0

	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023	
Controls	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Total Accumulated Energy Savings (ekWh)**	**Energy Payback Period**
Building Automation Systems - New		-	$ -	-	$ -	-	$ -	-	$ -	-	-	1
Building Automation Systems - Upgrade	$ 10,000	98,208	$ 300,000	2,946,231	$ 150,000	1,473,116	$ 50,000	491,039	$ 50,000	491,039	18,168,426	1
Real-time energy data for operators to identify and diagnose building issues	$ -	-	$ 5,000	49,104	$ -	-	$ -	-	$ -	-	196,415	1
Voltage Harmonizers	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	1
Other (Describe)	$ -	-	$ -	-	$ -	-	$ -	-		-	-	0

	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023	
Building Envelope	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Total Accumulated Energy Savings (ekWh)**	**Energy Payback Period**
Glazing	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	80
Increased Wall Insulation	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	40
New Roof	$ 2,180,000	188,191	$ 1,140,000	98,412	$ 1,100,000	94,959	$ 1,100,000	94,959	$ 900,000	77,693	1,887,086	200
New Windows	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	80
Treatments	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	10
Shading Devices	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	20
Other (Describe)	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	0

	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023
Design, Construction & Retrofit Strategies Total	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Total Accumulated Energy Savings (ekWh)**
Total	**$ 3,715,000**	**2,960,015**	**$ 2,625,000**	**4,711,537**	**$ 2,135,000**	**2,724,498**	**$ 1,745,000**	**1,684,413**	**$ 1,745,000**	**1,808,965**	**46,997,510**

= **Default value**
= **Calculated Value**
= **cost of 1 ekWh electricity**
= **cost of 1 ekWh natural gas**
("B" = 1 ekWh (as per NRCan conversion table)
= **cost of 1 m³ of natural gas**

Appendix C: Calculating Energy Conservation Goals 2019-2023 Operations and Maintenance

Calculating Energy Conservation Goals for FY 2019 to FY 2023

Operations and Maintenance Strategies		2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023			
Policy and Planning	**Quantity of Time that Measure will be in place (years)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Total Accumulated Energy Savings (ekWh)**	**Energy Payback Period**	**% related to Electricity**	**% related to Natural Gas**
New School Design/Construction Guidelines and Specifications	5	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	5	50	50
Day and Night Temperature Guidelines for all Schools	10	$ 500	1,727	$ -	-	$ 1,000	3,453	$ -	-	$ -	-	18,992	5	20	80
Nighttime Blackout of Sites - Interior	10	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	7	100	-
Nighttime Blackout of Sites - Exterior	10	$ 5,000	4,092	$ 20,000	16,327	$ -	-	$ -	-	$ -	-	85,714	7	100	-
Procures Only Energy Star Certified Appliances	5	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	5	100	-
Demand Ventilation (servicing)	3		-	$ 5,000	9,821	$ 10,000	19,643	$ 10,000	19,642	$ 10,000	19,642	157,132	5	50	50
HVAC Optimization (coil cleaning, re-calibration of equipment)	3	$ -	-	$ 10,000	49,104	$ 15,000	73,656	$ 15,000	73,656	$ 15,000	73,656	638,350	2	50	50
Commissioning (retro and re)	10	$ -	-	$ 30,000	29,462	$ 30,000	29,462	$ 30,000	29,462	$ 30,000	29,462	294,623	10	50	50
Other (Describe)		$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	0		100

		2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023			
Energy Audits	**Quantity of Time that Measure will be in place**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Total Accumulated Energy Savings (ekWh)**	**Energy Payback Period**	**% related to Electricity**	**% related to Natural Gas**
Walk Through Audit	5	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	1000	50	50
Engineering Audit	5	$ -	-	$ -	-	$ 10,000	98	$ 10,000	98	$ 10,000	98	589	1000	50	50
Other (Describe)		$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-	0		100

		2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023			
Operations and Maintenance Strategies Total	**Quantity of Time that Measure will be in place**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh**	**Estimated Total Accumulated Energy Savings (ekWh)**			
Total		$ 5,500	5,819	$ 65,000	104,712	$ 66,000	126,311	$ 65,000	122,858	$ 65,000	122,858	1,195,491			

Keys	
$0.175	= cost of 1 ekWh electricity
$0.0287	= cost of 1 ekWh natural gas
0.0655	m³ = 1 ekWh
$0.30	= cost of 1 m³ of natural gas

Appendix D: Calculating Energy Conservation Goals 2019-2023
Occupant Behaviour

Occupant Behaviour Strategies

		2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023
Training and Education	**Quantity of Time that Measure will be in place (years)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Cost of Implementation**	**Estimated Annual Energy Savings from all projects (ekWh)**	**Estimated Total Accumulated Energy Savings (ekWh)**
Building Operator Training	3	$ 500	1,431	$ 500	1,431	$ 500	1,431	$ 500	1,431	$ 50	143	20,179
Energy Benchmarking Program	5	$ 500	982	$ 900	1,768	$ 900	1,768	$ 900	1,768	$ 900	1,768	22,588
Building Automation Training (site specific)	3	$ 500	4,293	$ 1,000	8,587	$ 1,000	8,587	$ 1,000	8,587	$ 1,000	8,587	107,333
Ongoing Training and Awareness Programs for Energy Conservation	5	$ 1,000	624	$ 1,000	624	$ 1,000	624	$ -	-	$ -	-	7,483
Detailed Information on Building Operational Costs	1	$ 5,000	49	$ 10,000	98	$ 10,000	98	$ -	-	$ -	-	933
Detailed Information on Energy Consumption (e.g. via the Utility Consumption Database or other database)	1	$ 5,000	49	$ 1,000	10	$ 1,000	10	$ 1,000	10	$ 1,000	10	344
Participate in Environmental Programs, such as EcoSchools, Earthcare	1	$ 500	624	$ 500	624	$ 500	624	$ 500	624	$ 500	624	9,354
Other Tools (Define)		$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	-
Occupant Behaviour Strategies Total		**$ 13,000**	**8,052**	**$ 14,900**	**13,141**	**$ 14,900**	**13,141**	**$ 3,900**	**12,419**	**$ 3,450**	**11,131**	**168,213**

Keys	
$0.175	**= cost of 1 ekWh electricity**
$0.0287	**= cost of 1 ekWh natural gas**
0.0955	**m^3 = 1 ekWh**
$0.30	**= cost of 1 m^3 of natural gas**

Appendix E: Calculating Energy Conservation Goals 2019-2023 Conservation Goals

Calculating Energy Conservation Goals for FY 2019 to FY 2023

Conservation Goal

	FY 2018	
Total Building Area (includes portables) (m^2)	135,325	Enter from UCD. - use square meters
Total Building Area (includes portables) (ft^2)	1,456,622	Enter from UCD - use square feet
Energy Consumption for the board (ekWh)	15.77	Enter from UCD

1 ft^2 = 0.0929 m^2

	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023	
	Estimated Cost of Implementation	Estimated Annual Energy Savings from all projects (ekWh)	Estimated Cost of Implementation	Estimated Annual Energy Savings from all projects (ekWh)	Estimated Cost of Implementation	Estimated Annual Energy Savings from all projects (ekWh)	Estimated Cost of Implementation	Estimated Annual Energy Savings from all projects (ekWh)	Estimated Cost of Implementation	Estimated Annual Energy Savings from all projects (ekWh)
Appendix B: Design, Construction and Retrofit Strategies Total	$ 3,715,000	2,960,015	$ 2,625,000	4,711,537	$ 2,135,000	2,724,498	$ 1,745,000	1,684,413	$ 1,745,000	1,808,965
Appendix C: Operations and Maintenance Strategies Total	$ 5,500	5,808	$ 65,000	104,713	$ 66,000	126,311	$ 65,000	122,858	$ 65,000	122,858
Appendix D: Occupant Behaviour Strategies Total	$ 13,000	8,052	$ 14,900	13,141	$ 14,900	13,141	$ 3,900	12,419	$ 3,450	11,131
TOTAL	**$ 3,733,500**	**2,973,875**	**$ 2,704,900**	**4,829,392**	**$ 2,215,900**	**2,863,950**	**$ 1,813,900**	**1,819,690**	**$ 1,813,450**	**1,942,954**