

Hamilton-Wentworth Catholic District School Board Energy Conservation and Demand Management Plan

REVISED JULY 5, 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 board may have a five-year energy management strategy, the ability to implement their strategy depends on the funding that's received for each of the five years covered by their plan.

Asset Portfolios and Energy Management Planning

The education sector is unique in that a 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
 - 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 (For example: two or more boards share common areas and/or partnered with a municipality)
 - Libraries
 - Lighted sports fields

Other Variables:

- Programs
 - Child care
 - Before/After School Programs
 - Summer School
 - Community Use

- Occupancy
 - Significant increase in number of students (ie; HWCDSB saw a ~7% increase in average daily enrollment over the past 5 years)
 - Significant increase in the hours of operation (ie; HWCDSB saw a ~10% increase in community use hours over the past 5 years)
 - New programs being added to a site

- Air Conditioning
 - Significant increase in air-conditioned space
 - Portables

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

A. HWCDSB'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 2012-13 to the end of the five-year reporting period Fiscal Year 2017-18.

Table 1: Board's Asset Portfolio

Key Metrics	(Baseline Year) Fiscal Year 2012-13	Fiscal Year 2017-18	Variance
Total Number of Buildings*	77	81	4
Total Number of Portables/Portapaks	82	82	0
Total Floor Area (m2)	337,792	341,273	3,481
Average Operating Hours	49	49	0
Average Daily Enrolment	25,543	27,457	1,913

*Please note that these counts do not reflect the number of active HWCDSB buildings in 2013 or 2018 (counts include inactive buildings)

B. Energy Usage Data

The following table lists the “metered”¹ consumption values in the common unit of Equivalent Kilowatt Hours (ekWh) and Kilowatt Hours (kWh) (these values are raw, not weather normalized)

Table 2: Metered Usage Values

Utility	Fiscal Year 2012-13 (Baseline year)	Fiscal Year 2017-18
Total Electricity (kWh)	36,299,400	36,801,950
Total Natural Gas (ekWh)	47,707,500	45,832,560
Total Heating Fuel (Type 1 and 2) (ekWh)	n/a	n/a
Total Heating Fuel (Type 4 and 6) (ekWh)	n/a	n/a
Total Propane (ekWh)	n/a	n/a
Total Wood (ekWh)	n/a	n/a
Total District Heat (ekWh)	n/a	n/a
Total District Cool (ekWh)	n/a	n/a

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.

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

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.

Table 3: Ontario Degree-days

Ontario Degree Days	Fiscal Year 2012-13	Fiscal Year 2013-14	Fiscal Year 2014-15	Fiscal Year 2015-16	Fiscal Year 2016-17	Fiscal Year 2017-18
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 6 and 7), and newly implemented programs (refer to the Note to Readers on pages 11-15) which will greatly impact energy consumption.

As a result, weather normalized Energy Intensity⁴ 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/m²).

Table 4: Weather Normalized Values

Weather Normalized Values	Fiscal Year 2012-13 (Baseline Year)	Fiscal Year 2017-18 (Most Recent Data Available)
Total Energy Consumed (ekWh)	79,389,920	75,874,550
Energy Intensity (ekWh/ft ²)	21.83	20.65
Energy Intensity (ekWh/m ²)	235.03	222.33

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.

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 ekWh/m2	Conservation Goal Percentage	Actual Energy Savings ekWh/ft2	Actual Energy Savings ekWh/m2	Actual Energy Savings Percentage
2013-14	0.09	0.98	0.4%	2.42	26.1	11.1%
2014-15	0.09	0.98	0.4%	0.23	2.51	1.2%
2015-16	0.09	0.98	0.4%	-0.4	-4.28	-2.07%
2016-17	0.09	0.98	0.4%	-1.58	-16.96	-8.05%
2017-18	0.09	0.98	0.4%	0.49	5.32	2.34%
Total	0.45	4.9	2%	1.16	12.69	4.52%

NOTE TO READERS:

The Conservation Goals were forecasted in Spring 2014. Since then several factors that impact energy use have been introduced to the education sector that have an impact on the 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 greater ventilation requirements, more use of air conditioning and more lighting. These factors increase the energy intensity of a building.

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, Ventilation, and Air Conditioning (also known as HVAC) system, as well as lighting systems, to operate for an extended period of time on a daily basis, which increases 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 these spaces (gymnasiums, classrooms, libraries) during non-school hours requires a facility's HVAC and lighting system to operate for an extended period of time on a daily basis, which will increase the overall energy intensity of the building.

HWCDSD saw an increase in total community use hours of ~10% since 2013/2014, seeing a total of 114,557 permitted community use hours in the 2017/2018 school year.

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 and lighting systems 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.

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 6: Cumulative Energy Intensity Goal from Fiscal Year 2013-14 through Fiscal Year 2017-18

Cumulative Energy Intensity	(ekWh/ft2)	(ekWh/m2)	Variance
Forecasted. Cumulative Energy Intensity Conservation Goal of Fiscal Year 2013-14 through Fiscal Year 2017-18	-0.45	-4.9	n/a
Forecasted Cumulative Energy Intensity Conservation Goal as a Percentage	n/a	n/a	-2%
Actual Cumulative Energy Intensity Reduced or Increased from Fiscal Year 2013-14 through Fiscal Year 2017-18 – Weather Normalized	-1.18	-12.7	n/a
Variance between 2014 Forecast Cumulative Conservation Goal and Actual Cumulative Energy Intensity– Weather Normalized	0.72	7.8	n/a
% of Cumulative Energy Intensity Conservation Goal Achieved - Weather Normalized	n/a	n/a	259.27%

F. Measures Implemented from Fiscal Year 2013-14 to Fiscal Year 2017-18

A list of the measures implemented, the related costs, and the fiscal year that the measure was implemented within the Board are outlined in the following appendices:

Page 22: **Appendix A: Design, Construction and Retrofit Investments (2014-2018)**

Page 23: **Appendix B: Operations and Maintenance Investments (2014-2018)**

Page 24: **Appendix C: Occupant Behaviour Investments (2014-2018)**

Page 25: **Appendix D: Summary of All Investment Types (2014-2018)**

NOTE TO READERS:

Important Consideration - It takes a minimum of one full year after an energy management strategy has been implemented before achieved energy savings can be seen.

PART II – ENERGY CONSERVATION and DEMAND MANAGEMENT PLAN for FISCAL YEAR 2018-19 to FISCAL YEAR 2023-24

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

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

Background

Since HWCDSB's previous 5-Year Energy Conservation and Demand Management Plan was released, the Board has taken significant steps towards reducing energy consumption and intensity in its buildings, particularly in recent years.

Over the past 5+ years, the Board has periodically contracted Energy Management consultants to create ministry-required reports (ie; the previous CDM plan, annual Green Energy Act reporting) and a few energy audits on select high-intensity buildings. Energy conservation projects during this time were generally borne out of necessity of replacing old equipment, and new equipment naturally came with improved efficiency in most cases, which reduced energy intensity in many buildings.

In January 2018 a permanent, full-time Energy Management position was created, a move that demonstrated and cemented the Board's commitment to Stewardship of Creation through energy conservation. Note that very little of the impact of the projects undertaken since the creation of this role can be seen in this report (given the date range), but will be fully appreciated in future reports.

Throughout the past 5 years the Board's Social and Ecological Responsibility in Education (SERE) Committee has introduced several behavioural change campaigns, and has overseen our Ontario Eco Schools program, in which 51 of our sites are currently enrolled.

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 page 26:
Appendix E: Occupant Behaviour Investments (2019-2023)

Operations and Maintenance

Definition

Operations and maintenance include the strategies the Board uses to make sure that the existing buildings and equipment performs at maximum efficiency.

For the Board's relevant projects over the next five years, please refer to page 27:
Appendix F: Occupant Behaviour Investments (2019-2023)

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 page 28:
Appendix G: Occupant Behaviour Investments (2019-2023)

A. Future Energy Conservation Goals

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

Table 7: Annual Energy Intensity Conservation Goals

Annual Energy Intensity Conservation Goal	Fiscal Year 2018-19	Fiscal Year 2019-20	Fiscal Year 2020-21	Fiscal Year 2021-22	Fiscal Year 2022-23
ekW/ft2	0.84	0.59	0.29	0.27	0.27
ekW/m2	9	6.38	3.1	2.94	2.94
Percentage Decrease	4.05%	2.87%	1.39%	1.32%	1.32%

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

Table 8: Cumulative Conservation Goal

Cumulative Conservation Goal	Fiscal Year 2018-19 through Fiscal Year 2022-23
ekWh/ft2	2.26
ekWh/m2	24.37
Percentage Decrease	10.96%

NOTE TO READERS:

There are many factors that influence a 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
 - 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

- 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 requires heating and cooling of the air (dependent on the season) to meet standard classroom temperatures.

2. Changes to School Board Funding Models

- Forecasted Conservation Goals are based on current funding models being in place throughout the next five years.
- All boards' funding is determined on an annual basis. Any changes to the funding model will impact forecasted values.

3. 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 2018-19, 51 schools within the Board participated in the Eco Schools certification program. The Board plans on continuing its active involvement in this program over the coming years.

C. Energy Efficiency Incentives

The Board applies to incentive programs to support the implementation of energy efficient projects on a regular basis. Between Fiscal Year 2013-14 and Fiscal Year 2017-18, the Board has applied for \$384,000 in incentive funding from different agencies to support the implementation of energy efficient projects. The Board used the assistance of an Incentive Programs Advisor to assist with incentives up until the Energy Management Officer role was created in early 2018. The Energy Management Officer will continue to take advantage of all available incentives for the Board over the coming years.

D. Energy Procurement

The Board participates in the Hamilton Gas Consortium to purchase natural gas, and is not part of a consortium for the purchase of electricity. The Board plans to continue their participation in this consortium.

E. Demand Management

The Board uses the following method(s) to monitor electrical demand:

- Invoices
- Sub-metering real-time systems
- Online data directly from Local Distribution Companies (LDCs)
- Online data from Utilities Consumption Database (UCD)

The Board uses equipment scheduling (via Building Automation Systems and timers) to reduce demand, as well as Variable Frequency Drives in some pieces of equipment.

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

I confirm that Hamilton-Wentworth Catholic District School Board's senior management has reviewed and approved this Energy Conservation and Demand Management Plan.

Full Name: Paul Ferrie

Job Title: Senior Manager, Facility Management Services

Signature:  _____

Date: July 5, 2019

Appendix A: Design, Construction and Retrofit Investments (2014-2018)

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Lighting	Investments in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies
High-efficiency Lighting Systems (T-8, T-5, CFL, LED ...)	\$ 40,269	\$ -	\$ 197,145	\$ 187,720	\$ 360,312
Daylight Sensors	\$ -	\$ -	\$ -	\$ -	\$ -
Outdoor Lighting	\$ -	\$ -	\$ 54,967	\$ 13,281	\$ -
Occupancy Sensors	\$ -	\$ -	\$ -	\$ -	\$ -
Daylight Harvesting	\$ -	\$ -	\$ -	\$ -	\$ -
Other (Describe)	\$ -	\$ -	\$ -	\$ -	\$ -

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
HVAC	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies
Efficient Boilers (near condensing)	\$ -	\$ -	\$ 243,926	\$ 113,785	\$ 739,934
High-efficiency Boilers (condensing)	\$ -	\$ -	\$ -	\$ 26,797	\$ 14,082
High-efficiency Boiler Burners	\$ -	\$ -	\$ -	\$ -	\$ -
Geothermal	\$ -	\$ -	\$ -	\$ -	\$ -
Heat Recovery/Enthalpy Wheels	\$ -	\$ -	\$ -	\$ 19,470	\$ 606,714
Economizers	\$ -	\$ -	\$ 91,924	\$ -	\$ -
Energy Efficient HVAC Systems	\$ -	\$ -	\$ 84,698	\$ 1,333,820	\$ 1,816,705
Energy Efficient Rooftop Units	\$ 84,179	\$ 139,689	\$ 196,208	\$ 593,696	\$ 135,837
High-efficiency Domestic Hot Water	\$ 10,037	\$ -	\$ 86,019	\$ -	\$ 10,083
Efficient Chillers and Controls	\$ 84,451	\$ -	\$ 130,287	\$ 20,194	\$ 283,147
High-efficiency Motors	\$ -	\$ -	\$ -	\$ -	\$ -
VFD	\$ -	\$ -	\$ -	\$ -	\$ -
Demand Ventilation	\$ -	\$ -	\$ -	\$ -	\$ -
Entrance Heater Controls	\$ -	\$ -	\$ -	\$ -	\$ -
Other (Describe)	\$ -	\$ -	\$ -	\$ -	\$ -

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Controls	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies
Building Automation Systems - New	\$ -	\$ -	\$ 24,688	\$ 465,854	\$ 580,643
Building Automation Systems - Upgrade	\$ -	\$ -	\$ -	\$ -	\$ -
Other (Describe)	\$ -	\$ -	\$ -	\$ -	\$ -

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Building Envelope	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies
Glazing	\$ -	\$ -	\$ -	\$ -	\$ -
Increased Wall Insulation	\$ -	\$ -	\$ -	\$ -	\$ -
New Roof	\$ 607,291	\$ 1,525,857	\$ 1,603,330	\$ 4,251,268	\$ 1,893,224
New Windows	\$ 66,158	\$ 171,187	\$ 171,216	\$ 26,735	\$ 450,346
Treatments	\$ -	\$ -	\$ -	\$ -	\$ -
Shading Devices	\$ -	\$ -	\$ -	\$ -	\$ -
Other (Describe)	\$ -	\$ -	\$ -	\$ -	\$ -
Total Investment in Design, Construction and Retrofit Strategies	\$ 892,385	\$ 1,836,733	\$ 2,884,408	\$ 7,052,620	\$ 6,891,027

Appendix B: Operations and Maintenance Investments (2014-2018)

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Policy and Planning	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies
New School Design/Construction Guidelines and Specifications	\$ -	\$ -	\$ -	\$ -	\$ -
Day and Night Temperature Guidelines for all Schools	\$ -	\$ -	\$ -	\$ -	\$ -
Nighttime Blackout of Sites - Interior	\$ -	\$ -	\$ -	\$ -	\$ -
Nighttime Blackout of Sites - Exterior	\$ -	\$ -	\$ -	\$ -	\$ 7,063
Procures Only Energy Star Certified Appliances	\$ -	\$ -	\$ -	\$ -	\$ -
Daylight Harvesting (servicing)	\$ -	\$ -	\$ -	\$ -	\$ -
Demand Ventilation (servicing)	\$ -	\$ -	\$ -	\$ -	\$ -
Other (Describe)	\$ -	\$ -	\$ -	\$ -	\$ -
Energy Audits	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies
Walk Through Audit	\$ -	\$ -	\$ -	\$ -	\$ -
Engineering Audit	\$ -	\$ -	\$ -	\$ -	\$ -
Other (meters)					3503
Total Investment in Operations and Maintenance Strategies	\$ -	\$ -	\$ -	\$ -	\$ 10,566

Appendix C: Occupant Behaviour Investments (2014-2018)

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Training and Education	Estimated Cost of Implementation	Estimated Cost of Implementation	Estimated Cost of Implementation	Estimated Cost of Implementation	Estimated Cost of Implementation
Building Operator Training	\$ -	\$ -	\$ -	\$ -	\$ -
NRCan Benchmarking Program	\$ -	\$ -	\$ -	\$ -	\$ -
Building Automation Training (site specific)	\$ -	\$ -	\$ -	\$ -	\$ -
Ongoing Training and Awareness Programs for Energy Conservation	\$ -	\$ -	\$ -	\$ -	\$ -
Provide Detailed Information on Building Operational Costs	\$ -	\$ -	\$ -	\$ -	\$ -
Provide Detailed Information on Energy Consumption (e.g. via the Utility Consumption Database or other database)	\$ 13,150	\$ 12,192	\$ 12,192	\$ 12,192	\$ 12,192
Participate in Environmental Programs, such as EcoSchools, Earthcare	\$ -	\$ -	\$ -	\$ -	\$ -
Other tools (describe)	\$ -	\$ -	\$ -	\$ -	\$ -
Total Investment in Occupant Behaviour Strategies	\$ 13,150	\$ 12,192	\$ 12,192	\$ 12,192	\$ 12,192

Appendix D: Summary of All Investment Types (2014-2018)

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2013/2014-2017/2018
Total Investments in Energy Management Strategies FY 2012-13 to FY 2017-18	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Investment in Energy Management Strategies	Total Investment in Energy Management Strategies
Design, Construction and Retrofit Investments Total	\$ 892,385	\$ 1,836,733	\$ 2,884,408	\$ 7,052,620	\$ 6,891,027	19,557,173
Operations and Maintenance Investments Total	\$ -	\$ -	\$ -	\$ -	\$ 10,566	10,566
Occupant Behaviour Investments Total	\$ 13,150	\$ 12,192	\$ 12,192	\$ 12,192	\$ 12,192	61,918
Renewable Energy Investments Total	\$ -	\$ -	\$ -	\$ -	\$ -	0
Total Investment Per Fiscal Year	\$ 905,535	\$ 1,848,925	\$ 2,896,600	\$ 7,064,812	\$ 6,913,785	19,629,657

Appendix E: Design, Construction and Retrofit Investment Goals (2019-2023)

Lighting	Quantity of Time that Measure will be in place (years)	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023	Energy Payback Period	% related to Electricity	% related to Natural Gas
		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)				
High Efficiency Lighting Systems	15	\$ 695,000	567,347	\$ 500,000	408,163	\$ 25,000	20,408	\$ 25,000	20,408	\$ 25,000	20,408	4,591,837	7	100	0
Outdoor Lighting	15	\$ 155,000	126,531	\$ 100,000	81,633	\$ 10,000	8,163	\$ 10,000	8,163	\$ 10,000	8,163	1,008,163	7	100	0
Occupancy Sensors	10	\$ -	-	\$ 10,000	11,429	\$ 5,000	5,714	\$ 5,000	5,714	\$ 5,000	5,714	80,000	5	100	0
Other		\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	0		100

H.V.A.C.	Quantity of Time that Measure will be in place	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023	Energy Payback Period	% related to Electricity	% related to Natural Gas
		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)				
Efficient Boilers (near condensing)	30	\$ 75,000	139,014	\$ 75,000	139,014	\$ 50,000	92,676	\$ 50,000	92,676	\$ 50,000	92,676	1,807,187	15	5	95
High-efficiency Boilers (condensing)	15	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	10	5	95
High-efficiency Boiler Burners	10	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	5	5	95
Geothermal	20	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	35	100	0
Heat Recovery/Enthalpy Wheels	30	\$ 368,000	794,199	\$ 250,000	539,537	\$ 150,000	323,722	\$ 150,000	323,722	\$ 150,000	323,722	8,071,478	8	20	80
Economizers	15	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	7.5	50	50
Energy Efficient HVAC systems	30	\$ 1,950,000	255,340	\$ 1,500,000	196,415	\$ 1,000,000	130,944	\$ 1,000,000	130,944	\$ 1,000,000	130,944	2,848,024	75	50	50
Energy Efficient Rooftop Units	15	\$ 900,000	294,623	\$ 600,000	196,415	\$ 300,000	98,208	\$ 300,000	98,208	\$ 300,000	98,208	2,848,024	30	50	50
High Efficiency Domestic Hot Water	15	\$ 5,000	9,881	\$ 5,000	9,881	\$ 5,000	9,881	\$ 5,000	9,881	\$ 5,000	9,881	148,214	10	15	85
Efficient Chillers and Controls	25	\$ 50,000	2,857	\$ 50,000	2,857	\$ 50,000	2,857	\$ 50,000	2,857	\$ 50,000	2,857	42,857	100	100	0
High-efficiency Motors	20	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	10	100	0
VFD	15	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	5	75	25
Demand Ventilation	10	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	5	50	50
Entrance Heater Controls	20	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	5	50	50
De-stratification Fans	10	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	7	100	0
Other (Describe)		\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	0		100

Controls	Quantity of Time that Measure will be in place	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023	Energy Payback Period	% related to Electricity	% related to Natural Gas
		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)				
Building Automation Systems - New	10	\$ 200,000	130,944	\$ 150,000	98,208	\$ 100,000	65,472	\$ 100,000	65,472	\$ 100,000	65,472	1,440,380	15	50	50
Building Automation Systems - Upgrade	10	\$ 25,000	16,368	\$ 20,000	13,094	\$ 20,000	13,094	\$ 20,000	13,094	\$ 20,000	13,094	212,763	15	50	50
Real-time energy data for operators to identify and diagnose building issues	10	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	3	50	50
Voltage Harmonizers	15	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	7	100	0
Other (digital timers for lights/fans)	15	\$ 10,000	80,000	\$ -	-	\$ -	-	\$ -	-	\$ -	-	400,000	0		100

Building Envelope	Quantity of Time that Measure will be in place	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023	Energy Payback Period	% related to Electricity	% related to Natural Gas
		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)				
Glazing	30	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	80	20	80
Increased Wall Insulation	50	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	40	20	80
New Roof	25	\$ 3,500,000	302,141	\$ 2,500,000	215,815	\$ 1,500,000	129,489	\$ 1,500,000	129,489	\$ 1,500,000	129,489	3,150,898	200	20	80
New Windows	30	\$ 1,400,000	302,141	\$ 1,000,000	215,815	\$ 500,000	107,907	\$ 250,000	53,954	\$ 250,000	53,954	2,859,548	80	20	80
Treatments	10	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	10	20	80
Shading Devices	30	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	20	100	0
Other (Describe)		\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	0		100

Design, Construction & Retrofit Strategies Total	Quantity of Time that Measure will be in place	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023
		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)	
Total		\$ 9,333,000	3,021,385	\$ 6,760,000	2,128,277	\$ 3,715,000	1,008,536	\$ 3,465,000	954,583	\$ 3,465,000	954,583	29,509,392

Keys	
colour: yellow	= Default value
colour: blue	= Calculated Value
\$0.175	= cost of 1 ekWh electricity
\$ 0.0287	= cost of 1 ekWh natural gas
0.0955	m ³ = 1 ekWh (as per NRCan conversion)
\$0.30	= cost of 1 m ³ of natural gas

Appendix F: Operations and Maintenance Investment Goals (201

Policy and Planning	Quantity of Time that Measure will be in place (years)	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023	Estimated Total Accumulated Energy Savings (ekWh)	Energy Payback Period	% related to Electricity	% related to Natural Gas
		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)					
New School Design/Construction Guidelines and Specifications	5	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	-	5	50	50
Day and Night Temperature Guidelines for all Schools	10	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	-	5	20	80
Nighttime Blackout of Sites - Interior	10	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	-	7	100	-
Nighttime Blackout of Sites - Exterior	10	\$ -	-	\$ 500	408	\$ 500	408	\$ 500	408	\$ 500	408	4,082	4,082	7	100	-
Procures Only Energy Star Certified Appliances	5	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	-	5	100	-
Demand Ventilation (servicing)	3	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	-	5	50	50
HVAC Optimization (coil cleaning, re-calibration of equipment)	3	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	-	2	50	50
Commissioning (retro and re)	10	\$ 30,000	29,462	\$ 30,000	29,462	\$ 30,000	29,462	\$ 30,000	29,462	\$ 30,000	29,462	441,935	441,935	10	50	50
Other (Describe)		\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	-	0		100

Energy Audits	Quantity of Time that Measure will be in place	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023	Estimated Total Accumulated Energy Savings (ekWh)	Energy Payback Period	% related to Electricity	% related to Natural Gas
		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)					
Walk Through Audit	5	\$ 2,000	20	\$ 2,000	20	\$ 2,000	20	\$ 2,000	20	\$ 2,000	20	295	295	1000	50	50
Engineering Audit	5	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	-	1000	50	50
Other (meters)	10	\$ 1,000	20,000	\$ 1,000	20,000	\$ 1,000	20,000	\$ 1,000	20,000	\$ 1,000	20,000	300,000	300,000	0		100

Operations and Maintenance Strategies Total	Quantity of Time that Measure will be in place	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023	Estimated Total Accumulated Energy Savings (ekWh)	Energy Payback Period	% related to Electricity	% related to Natural Gas
		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)					
Total		\$ 33,000	49,462	\$ 33,500	49,890	\$ 33,500	49,890	\$ 33,500	49,890	\$ 33,500	49,890	746,311	746,311			

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 G: Occupant Behaviour Investment Goals (2019-2023)

Training and Education	Quantity of Time that Measure will be in place (years)	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023			
		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)	Estimated Total Accumulated Energy Savings (ekWh)	Energy Payback Period	% related to Electricity	% related to Natural Gas
Building Operator Training	3	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	3	60	40
Energy Benchmarking Program	5	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	1000	50	50
Building Automation Training (site specific)	3	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	1	60	40
Ongoing Training and Awareness Programs for Energy Conservation	5	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	10	90	10
Detailed Information on Building Operational Costs	1	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	1000	50	50
Detailed Information on Energy Consumption (e.g. via the Utility Consumption Database or other database)	1	\$ 3,254	-	\$ 3,254	-	\$ 3,254	-	\$ 3,254	-	\$ 3,254	-	-	1000	50	50
Participate in Environmental Programs, such as EcoSchools, Earthcare	1	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	5	90	10
Other Tools (Define)		\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	-	0		100
Occupant Behaviour Strategies Total		\$ 3,254	-	\$ 3,254	-	\$ 3,254	-	\$ 3,254	-	\$ 3,254	-	-			

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 H: Summary of All Investment Goal Types (2019-2023)

	FY 2018	
Total Building Area (includes portables) (m²)	341,273	
Total Building Area (includes portables) (ft²)	3,673,436	
Energy Consumption for the board (ekWh)	75,874,550	1 ft² = 0.0929 m²

	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2018/2019-2022/2023
	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)	Estimated Total Accumulated Energy Savings (ekWh)
Appendix E: Design, Construction and Retrofit Strategies Total	\$ 9,333,000	3,021,385	\$ 6,760,000	2,128,277	\$ 3,715,000	1,008,536	\$ 3,465,000	954,583	\$ 3,465,000	954,583	29,509,382
Appendix F: Operations and Maintenance Strategies Total	\$ 33,000	49,482	\$ 33,500	49,890	\$ 33,500	49,890	\$ 33,500	49,890	\$ 33,500	49,890	746,311
Appendix G: Occupant Behaviour Strategies Total	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	0
TOTAL	\$ 9,366,000	3,070,867	\$ 6,793,500	2,178,167	\$ 3,748,500	1,058,426	\$ 3,498,500	1,004,473	\$ 3,498,500	1,004,473	30,255,703
Percentage reduction		4.05		2.87		1.39		1.32		1.32	10.96
Conservation Goal (ekWh/m²)		9.00		6.38		3.10		2.94		2.94	24.37
Conservation Goal (ekWh/ft²)		0.84		0.59		0.29		0.27		0.27	2.26