Waterloo Region District School Board

Energy Conservation and Demand Management Plan 2019

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Part 1. Overview of Energy Conservation at WRDSB

At the Waterloo Region District School Board we constantly strive to be more energy efficient, in a comprehensive manner. Most importantly, design, construction and retrofit strategies incorporate energy conservation as a prime consideration. The Facility Services department is continually working to identify and implement projects that will conserve energy while enhancing the learning environment and exercising sound fiscal management. Energy efficient measures are incorporated into all areas of building operations including maintenance, building automation and controls, and custodial practices. In addition, the training and educating of staff and students remains a focus for energy conservation activities, and has been crucial to accomplishing the board's goals in the last 5 years and will continue to be relevant.

This report details energy conservation efforts and accomplishments for the previous five-year reporting period (Fiscal Year 2013-14[1] through FY2017-18) against the baseline year of FY2012-13 and the goals established in the 2014 Energy Conservation and Demand Management Plan,[2] and details plans for the coming 5-year reporting period, FY2018-19 through FY2023-24. This report is made to fulfill the requirements of O.Reg. 507/18.

1.1. Energy Conservation in the Ontario Education Sector

While the Board puts plans in place and makes every effort to anticipate coming changes, there are a variety of realities of the Ontario Education Sector that impacts how energy conservation programs can be run and implemented.

The first and most important constraint is that all school boards receive nearly 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 this strategy depends on the funding received for each of the five years covered by the plan.

The second factor is a collection of facility variables that can both have a high impact on energy consumption and shift significantly across a board's asset portfolio in a five-year period. Table 1 lists many of these facility variables. Air conditioning, weather, programming changes and enrollment are some of the most significant for WRDSB. Waterloo Region was the second fastest growing census metropolitan area in the country with population growth of 2.6% in 2018.[3] The Province of Ontario's Growth Plan expects Waterloo Region's population to grow from 583,000 in 2016 to 742,000 in 2031.[4] This means that WRDSB continues to build new schools and additions which increases total energy consumption, and splits the efforts of the Facility Services department between new construction, and maintenance and renovation.

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[1] The Board's fiscal year is September 1st through August 31st. Here-on-out Fiscal Year will be abbreviated FY.

[2] https://www.wrdsb.ca/facilities/operations/energy/

[3] Nielsen, K. 2019. "Waterloo region 2nd fastest-growing census metropolitan area in Canada: StatCan." Globe and Mail. https://globalnews.ca/news/5145700/waterloo-region-2nd-fastest-growing-cma-canada/

[4] https://www.regionofwaterloo.ca/en/doing-business/demographics.aspx

Table 1.1 Variables Impacting Energy Consumption

Facility Variables	Other Variables
• Year of Construction • Building Area • Major Additions • Sites Sold • Portables (installed & removed) • Site type (elementary, secondary, administrative building, maintenance facility) • Shared Use Sites (swimming pools, libraries, lighted sports fields) • Technology (lighting, HVAC) • Air Conditioning	• Weather • Child care • Before/after school programs • Summer school • Community use occupancy • Number of students • New programs at a site • Occupant behaviour

Since 2014, Full Day Kindergarten (FDK), Before and After School Programs, Community Use of Schools, and Community Hubs have been introduced as new programs in Ontario schools.

Full Day Kindergarten added 470,000 new students across Ontario, requiring new additions or major renovations of existing facilities. The result was more floor area and sometimes higher ventilation requirements and air conditioning, both of which increase the energy use.

Before and After School Programs were implemented to help the introduction of FDK spaces, and provide childcare for students outside of regular school hours in school buildings.

Community Use of Schools is a Ministry-funded program that makes 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. Gymnasiums and libraries are heavily booked across the system.

Community Hubs is another Ministry-funded program introduced in 2016 that encourages school boards to use their asset portfolio to offer a greater range of cultural events, arts, recreation and childcare programs, and health and family resource services.

The combination of Before and After School Programs, Community Use of Schools and Community Hubs means that many school buildings are now occupied from 6:00am to 11:00pm throughout the week, and many times on the weekend. This is a significant increase in the number of hours in a year a facility's heating, ventilation and air conditioning (HVAC) system and lighting must operate, which will increase the overall energy usage.

Air conditioning of schools is increasingly being requested by students, teachers, and parents. While air conditioning improves learning environments especially in increasingly warm autumns and springs, air conditioning significantly increases a facility's energy use.

1.2. WRDSB Energy Conservation Strategy

WRDSB has a long tradition of energy conservation efforts, and the transition between these two reporting periods does not mark a change in strategy. The following approaches have been

important in the last 5 years, and will continue to play a significant role in the board's approach. In general these approaches fall into three categories: Design, Construction and Retrofit; Operations and Maintenance; Occupant Behavior; and, Demand Management.

Design, Construction and Retrofit

The WRDSB has created a standard for the design and construction of new schools and additions so that they are 25% more energy efficient than baseline code, paying careful attention to the building envelope, windows, roofing and insulation values. Renovation projects strive to increase energy efficiency as much as possible despite greater structural and financial limitations.

When selecting HVAC equipment for a new building or a retrofit project an emphasis is placed on efficiency. WRDSB requires a minimum efficiency rating for gas equipment of 90%, and an electrical Energy Efficiency Ration of 12 or higher for electrical equipment.

It has been a priority to replace old inefficient lighting equipment with more efficient technologies. The Board is currently replacing all old lighting technology with high-efficiency LED fixtures as quickly as financially and logistically possible.

Operations and Maintenance

The majority of the Board's asset portfolio is operated using a web-based building automation system (BAS) that is controlled centrally. Staff are constantly monitoring and addressing issues that need immediate attention. The BAS controls electrical demand through a strategic demand reduction program, and schedules equipment with tight operating parameters so that equipment only operates when necessary for occupant comfort and building health.

The Board also places a large emphasis on demand control ventilation to keep indoor air quality high while controlling the amount of outside air brought into a building by the HVAC equipment. This reduces the energy used to move air throughout the building, and to heat or cool outside air to the desired indoor air temperature. The Board meets ASHRAE standard 62, using CO_2 sensors to monitor the amount of outside air the HVAC equipment is required to supply a given space based on its current use, and to take advantage of the natural air changes that occur when a large number of people enter or exit a building, such as at recesses.

Occupant Behaviour

Behavioral programs continue to be important. The Board trains staff and students about energy conservation and the actions they can take to reduce energy such as shutting off lights, computers, printers and monitors when not needed. Schools in the Board also participate in a variety of environmental programming that raises awareness about environmental issues in general, and energy conservation in particular. See Section 1.5 for details.

Demand Management

Electrical use at sites with large consumption is billed by both how much electricity is used, and the highest rate of usage, called demand. The Board tracks electrical demand through invoices, real-time data, online data from the Local Distribution Company, and through EYDRO meters. Electrical demand at WRDSB is controlled through equipment scheduling, staged use of equipment, demand-limiting equipment, and the deferred start-up of large equipment.

Energy procurement is an important part of a conservation strategy. WRDSB does not participate in a consortia agreement for the purchase of energy. However, both electricity and natural gas are purchased from ECNG Energy to minimize costs and take advantage of their energy spend optimization services.

This conservation strategy is developed and coordinated by the Board's Supervisor of Energy Conservation, managed by the Manager of Mechanical, Electrical and Environmental Systems and the Controller, Facility Services, and supported by the remainder of the Facility Services department. The full-time in-house energy management role has existed for over a decade.

1.3. Asset Portfolio

The following table outlines the energy-related variables and metrics in the Board's asset portfolio for both the baseline year, FY2012-13, and the end of the five-year reporting period.

Table 1.2 WRDSB Asset Portfolio FY2012-13 and FY2017-18

Key Metrics	FY2012-13 (Baseline)	FY 2017-18	Variance
Total Number of Buildings	125	125	0
Total Number of Portables/Portapaks	477	365	-112
Total Floor Area (ft^2)	7,798,947	8,007,038	+208,091
Average Weekly Operating Hours	62	72	+10
Average Daily Enrolment	57,160	60,222	+3,062

WRDSB experienced significant growth in this period. The growth in enrollment was accommodated without an increase in the number of buildings and with a decrease in potables through two mechanisms. First, WRDSB built 18 additions on existing buildings in this timeframe, largely to accommodate Full Day Kindergarten. These additions had an average floor area of 6,164 ft^2. Second, in this timeframe WRDSB closed 5 small school buildings (average floor area of 23,000 ft^2) and constructed 5 new large school buildings (average floor area of 68,000 ft^2). Appendix A includes a complete list of these additions, closed sites, and new construction.

1.4. Renewable Energy

While renewable energy projects do not reduce energy consumption, they do reduce the amount of energy purchased from the electrical grid and natural gas supply network, and reduces environmental impact. Renewable energy projects also generate revenue for the board.

Renewable energy installations are listed in Table 1.3. WRDSB has 10 kW solar photovoltaic installations at Blair Road Public School, Forest Glen Public School, Forest Heights Collegiate Institute, Lincoln Heights Public School, Waterloo Collegiate Institute. The two solar air installations used the sun to pre-heat outside air being brought into the building, and are at John Mahood Public School and John Darling Public School. The solar water system heats the pool at Cameron Heights Collegiate Institute.

Table 1.3 WRDSB Renewable Energy Assets and Generation

Renewable Energy	Define	System Count	Total Size (kW)	Estimated Generation (ekWh/yr)
Solar photovoltaic	10 kW solar PV	5	52	55,000
Solar air		2		Not Available
Solar water	Heating Swimming Pool	1	30	26,000

1.5. WRDSB Participation in Environmental Programs

WRDSB is an observing member of Sustainable Waterloo Region (SWR), a local NGO that empowers local organizations to achieve sustainability goals by encouraging goal-setting, providing expertise and resources, and building a community of practice. WRDSB is in the process of setting a public greenhouse gas reduction goal that will be tracked and reported through SWR.

WRDSB also operates five Outdoor Education Centres that provide nature-based experiential curriculum-linked programming for students with the goal of cultivating environmental citizens by immersing students in outdoor and experiential learning opportunities.[5] The centres collectively host as many as 900 classes, or 20,000 students, each year.[6]

EcoSchools Canada is the Canadian National Operator of the International EcoSchools program of the Foundation for Environmental Education.[7] For a school to be certified, the school must have an EcoClub that has the staff and students engage in a variety of activities aimed at reducing the school's environmental impact, including energy conservation and waste minimization activities. WRDSB had 15 schools certified in 2018-19, including 3 Platinum, 5 Gold, 4 Silver and 3 Bronze schools. Schools run green bin programs, boomerang lunches, climate labs, and educate community members about environmental issues.

Student Transportation Services of Waterloo Region[8] has a variety of programs that support active and sustainable transportation options. 17 WRDSB schools participated in in 2018-19.

WRDSB schools partner with many other organizations offering environmental programs. Focus on Nature[9] runs a nature photography program to connect students to nature. They ran 69 workshops in 30 WRDSB schools in 2018-19. The Cambridge-based urban land trust *rare* Charitable Reserve[10] runs environmental education programming, and 25 WRDSB schools participated in 2018-19. Eastwood Collegiate Institute's Impact EcoClub won Earth Day Canada's Superpower your School contest last year and received $20,000 in new technology.[11] Schools also participated in programming run by Learning for a Sustainable Future, and the Canadian Geographic Classroom Energy Diet Challenge.[12]

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[5] https://schools.wrdsb.ca/environmental-education/blair/,
[6] https://schools.wrdsb.ca/environmental-education/
[7] https://ecoschools.ca/about/about-us/
[8] https://www.stswr.ca/walkzone/
[9] http://www.focusonnature.ca/
[10] https://raresites.org/about-us/
[11] https://eci.wrdsb.ca/2019/04/26/impact-wins-20000-earth-day-canada-superpower-your-school-contest/
[12] http://lsf-lst.ca/, http://energydiet.canadiangeographic.ca/

Part 2. Progress and Achievements in the Past Five Years

2.1. Energy Use Data for the Board

The following table lists the 'metered'[13] consumption values in the common unit of Equivalent Kilowatt Hours (ekWh). The unit ekWh allows electricity, normally measured in kWh, and natural gas and propane, normally measured in cubic meters and liters, respectively, to be compared in the same unit of measure.

Table 2.1 Measured Energy Consumption

Utility	FY2012-13 (Baseline year)	FY2017-18
Total Electricity (kWh)	56,016,580	50,318,430
Total Natural Gas (ekWh)	107,684,500	104,464,121
Total Heating Fuel (ekWh)	none	none
Total Propane (ekWh)	47,971	43,723
Total Wood (ekWh)	none	none

Weather Normalized Values

In Ontario, 25% to 35% of energy consumption for a facility is affected by weather. The amount of energy required to heat and cool a building depends on many weather variables, but the most important is outside air temperature. The following table shows the Weighted Average Heating Degree Days (HDD)[14] and Cooling Degree Days (CDD)[15] for the six most common Environment Canada weather stations in the Ontario education sector. HDD and CDD are used to demonstrate how the weather-dependent component of the heating and cooling load varies year to year. Notice for instance FY2013-14 was a cold year (high heating demand and thus high HDD, low cooling demand and thus low CDD).

Table 2.2 Ontario Degree-days

Ontario	FY2012-13	FY2013-14	FY2014-15	FY2015-16	FY2016-17	FY2017-18
HDD	3698	4285	4091	3355	3583	3989
CDD	289	217	271	462	303	432

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

[14] 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.

[15] 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.

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 the various factors that impact energy consumption discussed in Part 1, such as changes in a board's asset portfolio and facility variables, and newly implemented programs.

As a result, weather normalized Energy Intensity[16] 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. Table 2.3 presents the energy consumption data for the board, weather-normalized to both HDD and CDD.[17] Note that between FY2015-16 and FY2016-17, total consumption increased while Energy Intensity decreased because of a significant increase in total square footage.

Table 2.3 Weather-normalized Energy Consumption and Intensity

	FY2012-13	FY2013-14	FY2014-15	FY2015-16	FY2016-17	FY2017-18
Total Energy (eMWh)	162,076	150,132	157,080	154,716	156,317	149,735
Consumption year-over-year change (%)		-7.37	5.63	-1.51	1.03	-4.21
Energy Intensity (eKWh/ft^2)	20.78	19.04	20.05	19.55	19.45	18.70

2.2. Previous Energy Conservation Goals and Achievements

In 2014, the Board set annual energy conservation goals for the coming 5 year reporting period, FY2013-14 though FY2017-18, against the baseline of FY2012-13. For sake of clarity in comparing to what actually happened, the goals will be referred to as 'Target Changes'.[18] Table 2.4 presents the target change in energy intensity set in 2014, and the actual change, year-over-year, that occurred during the reporting period. These targets were set by estimating how much energy the planned investments in energy conservation for each year would save. However, as discussed at length in Section 1.1, weather-normalizing the data does not correct for all impacts to energy consumption other than energy efficiency projects, especially given the large number of unforeseen program changes in the education sector seen since these goals were set. In addition, these targets assume that the energy savings from a project will occur in the same year

[16] 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.

[17] It should be noted that not all buildings have air conditioning and some building have partial air conditioning. A building's energy consumption is only normalized with CDD if the energy use demonstrates an increase in consumption due to air conditioning. All building's energy consumption is normalized to HDD.

[18] This allows a consistent sign convention: in all places in this report discussing a 'change' in an energy variable, a negative value is desirable as it is a reduction in energy consumption.

the money is spent. In reality it can take a year or two to realize the full energy savings. This is why the actual changes tend to vary in magnitude and sign.

Table 2.4 Energy Intensity Target Change and Actual Change

	Target Change		Actual Change	
Fiscal Year	ekWh/ft²	%	ekWh/ft²	%
2013-14	-0.41	-2.0	-1.74	-8.38
2014-15	-0.40	-2.1	+1.01	+5.29
2015-16	-0.58	-2.9	-0.50	-2.50
2016-17	-0.37	-1.9	-0.09	-0.48
2017-18	-0.37	-1.9	-0.75	-5.65
Cumulative from Baseline[19]	-2.13	-10.2	-2.08	-10.0

Given this variability, energy conservation goals are best assessed over the full reporting period, and by considering the overall trend. As can be seen in Table 2.4, there is a clear downward trend in the Board's total energy intensity. Given the large number of upward pressures on energy consumption discussed in Section 1.1, the Board's ability to maintain this trend is significant. The Board achieved 98% of its Energy Intensity Target Change goal. This decrease in energy consumption saves the Board approximately $1.2 million each year.

2.3. Energy Conservation Investments and Measures, FY2013-14 to FY2017-18

Energy Conservation Investment strategies can be divided into three broad categories. First, 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. Repairs and upgrades of the building and equipment are included in this category. Second, Operations and Maintenance include the strategies the Board uses to make sure that the existing buildings and equipment performs at maximum efficiency. Finally, Occupant Behaviour includes 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. This includes environmental education programming.

A summary of the financial investment made in each category in each fiscal year is summarized in Table 2.5. New Roofs and Windows make up between 40% and 75% of the Design,

[19] The format of this table and the values reported in it do not match the template recommended by the Ministry for this report. The table format was modified to present the data more clearly and concisely. The values are different because the methodology for calculating the Energy Intensity Target Change goals suggested by the Ministry for the 2019 report differs from the methodology suggested for the 2014 report. The values in Table 2.4 use the 2019 methodology to maintain consistency with the rest of this report, and as the new calculation makes more physical sense. To maintain comparability with other boards, the Ministry-recommended format and values are presented in Appendix B.

Construction, and Retrofit Total. Lighting, boilers, building automation systems and replacement HVAC systems make up the majority of the remaining. The Board's focus in each category is discussed in Section 1.2.

To support these investments, the Board has applied to incentive programs. The Board has secured $225,000 in incentive money between FY2013-14 and FY2017-18, without the use of the sector's Incentive Program Advisor.

Table 2.5 Summary of Energy Conservation Investments, FY2013-14 to FY2017-18

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Design, Construction and Retrofit	$4,543,500	$4,997,000	$13,066,000	$13,356,000	$10,166,000
Operations and Maintenance	$3,000	$3,000	$3,000	$3,000	$3,000
Occupant Behaviour	$21,500	$21,500	$21,500	$21,500	$21,500
Total	$4,568,000	$5,021,500	$13,090,500	$13,380,500	$10,190,500

Part 3. Energy Conservation FY2018-19 to FY2022-23

The same energy conservation strategies and investments will be used to produce further savings in the next 5-year reporting period, FY2018-19 to FY2022-23. Energy Intensity Target Change goals, detailed in Table 3.1, have been set using the same methodology as in 2014. The Board's capital plan is reviewed to estimate the energy conservation investments that will be made over the 5 years. These estimates are summarized in Table 3.2, and presented in Appendix D. The resulting energy savings are then estimated using expected payback periods and energy prices. These are only estimates of the energy savings that will result from these projects because projects of a given type can have very different payback periods depending on the engineering design and project scope, but standard payback periods and budgetary estimates for costs are being used as the projects are only in the planning phase. Recall also the various reasons energy use varies from predictions discussed in Sections 1.1 and 2.2.

Table 3.1 Energy Intensity Target Change, FY2018-19 to FY2022-23

	Target Change	
Fiscal Year	**ekWh/ft²**	**%**
2018-19	-0.50	-2.7
2019-20	-0.46	-2.4
2020-21	-0.47	-2.5
2021-22	-0.38	-2.0
2022-23	-0.40	-2.1
Cumulative from FY2017-18	-2.2	-11.8

Table 3.2 Summary of Energy Conservation Investments, FY2018-19 to FY2022-23

	2018-19	**2019-20**	**2020-21**	**2021-22**	**2022-23**
Design, Construction and Retrofit	$10,194,000	$9,002,500	$11,432,500	$7,639,000	$7,784,000
Operations and Maintenance	$39,300	$39,200	$39,000	$27,500	$37,500
Occupant Behaviour	$29,100	$60,500	$60,500	$60,500	$60,500
Total	**$10,262,400**	**$9,102,200**	**$11,532,000**	**$7,727,000**	**$7,882,000**

New roofs and windows continue to represent approximately 50% of the total annual investment in energy savings strategies. WRDSB is also planning on making significant investments in LED lighting technology, and will have converted all lighting to LED within the coming reporting period. Replacing old boilers and other HVAC equipment with high efficiency units also makes up a large portion of the investment strategy. Variable frequency drives and demand control ventilation continue to be deployed.

WRDSB is also exploring less traditional approaches. The feasibility of using high volume low speed destratification fans in place of air conditioning is being explored. These fans create a draft in classrooms that creates a cooling effect, but does not disturb paper or students. Even if air conditioning is also necessary, these fans allow a room to be comfortable at a higher temperature. In addition, WRDSB has allocated funds to assess the feasibility of making one outdoor education centre a Net-Zero Energy building through both efficiency upgrades and renewable energy technologies. This building will then also serve to educate students.

3.1. Summary

WRDSB remains committed to energy conservation for both financial and environmental reasons. Energy efficient buildings are also comfortable and safe buildings that provide good learning environments, and this is ultimately the primary goal of WRDSB Facility Services. The investment strategy and energy conservation program outlined in this report serves as a guiding document for the coming 5 years.

3.2. Senior Management Approval of this ECDM Plan

I confirm that Waterloo Region District School Board senior management has reviewed and approved this Energy Conservation and Demand Management Plan.

Signature: _____ Date: FEBRUARY 11, 2020

Full Name: IAN GRAHAM

Job Title: CONTROLLER, FACILITY SERVICES

Appendix A. Additions, New Construction and Sites Closed, FY2012-13 to FY2017-18

Table A.1 Additions, FY2012-13 through FY2017-18

School Name	Addition Floor Area (ft^2)
Breslau	22,238
Brigadoon	5,000
Clemens Mill	2,145
Conestogo	400
Country Hills	800
Edna Staebler	5,906
Grandview (NH)	1,000
Keatsway	5,651
Lackner Woods	2,000
MacKenzie King	11,410
Manchester	11,948
NA MacEachern	4,413
Saginaw	1,257
Sandhills	6,782
Tait Street	19,913
Wellesley	2,000
Queensmount	1,527
Wilson	6,566

Table A.2 New Construction and Closed Sites, FY2012-13 through FY2017-18

New School Name	Floor Area (ft^2)		Closed School Name	Floor Area (ft^2)
Chicopee Hills	68,206		Dickson	16,275
Groh	68,677		Lincoln	46,500
Vista Hills	68,520		Rosemount	25,305
Riverside *	80,438		Three Bridges	12,984
Westmount *	52,952		Westmount *	23,478
			Riverside *†	12,310

* At these sites the original building was closed (eventually demolished) and replaced

† The old Riverside building is no longer operating as a school but has not been demolished and still consumes energy, therefore it is still included in the count of buildings and square footage

Appendix B. Cumulative Energy Intensity Goal Table from Ministry Template

This table is included to present that information included in Table 2.4 of this report in the format and with the calculation methodology recommended by the Ministry template. This is Table 6 in the ministry template. The table format was modified to present the data more clearly and concisely. The values are different because the methodology for calculating the Energy Intensity Target Change goals suggested by the Ministry for the 2019 report differs from the methodology suggested for the 2014 report. The values in Table 2.4 use the 2019 methodology to maintain consistency with the rest of this report, and as the new calculation makes more physical sense. All values here use the old methodology. To maintain comparability with other boards, the Ministry-recommended format and values are presented here for reference only.

Table B.1 Cumulative Energy Intensity Goals from FY2013-14 through FY2017-18

Cumulative Energy Intensity	(ekWh/ft2)	(ekWh/m2)	Variance
Forecasted Cumulative Energy Intensity Conservation Goal of FY 2013-2014 to FY 2017-18	6.65	71.57	
Forecasted Cumulative Energy Conservation Goal as a Percentage			6.10%
Actual Cumulative Energy Intensity Reduced /Increased from FY 2013-14 through FY 2017-18 – Weather Normalized	5.34	57.51	
Variance between 2014 Forecast Cumulative Conservation Goal and Actual Cumulative Energy Intensity– Weather Normalized	1.31	14.07	
% of Cumulative Energy Intensity Conservation Goal Achieved - Weather Normalized			80%

Appendix C. Energy Conservation Investment Details, FY2013-14 to FY2017-18

Table C.1 Design, Construction and Retrofit Investments, FY2013-14 to FY2017-18

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
High-efficiency Lighting Systems	$ 100,000	$ 150,000	$ 800,000	$ 200,000	$ 200,000
Daylight Sensors	$ -	$ -	$ -	$ -	$ -
Outdoor Lighting	$ 30,000	$ 50,000	$ 150,000	$ 50,000	$ 50,000
Occupancy Sensors	$ 7,500	$ 30,000	$ 120,000	$ 30,000	$ 100,000
Daylight Harvesting	$ -	$ -	$ -	$ -	$ -

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Efficient Boilers (near condensing)	$ 700,000	$ 800,000	$ 2,750,000	$ 650,000	$ 800,000
High-efficiency Boilers (condensing)	$ -	$ -	$ -	$ -	$ 60,000
High-efficiency Boiler Burners	$ -	$ -	$ -	$ -	$ -
Geothermal	$ -	$ -	$ -	$ -	$ -
Heat Recovery/Enthalpy Wheels	$ 150,000	$ 30,000	$ 450,000	$ -	$ 200,000
Economizers	$ -	$ -	$ -	$ -	$ -
Energy Efficient HVAC Systems	$ 600,000	$ 800,000	$ 1,500,000	$ 1,600,000	$ 1,000,000
Energy Efficient Rooftop Units	$ 100,000	$ 100,000	$ 300,000	$ -	$ 100,000
High-efficiency Domestic Hot Water	$ 6,000	$ 6,000	$ 6,000	$ 6,000	$ 6,000
Efficient Chillers and Controls	$ -	$ -	$ -	$ -	$ -
High-efficiency Motors	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
VFD	$ -	$ -	$ -	$ 260,000	$ -
Demand Ventilation	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Entrance Heater Controls	$ -	$ 15,000	$ 40,000	$ -	$ -

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Building Automation Systems - New	$ 500,000	$ 100,000	$ 1,250,000	$ 280,000	$ 400,000
Building Automation Systems - Upgrade	$ 110,000	$ 200,000	$ 150,000	$ 220,000	$ 220,000

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Glazing	$ -	$ -	$ -	$ -	$ -
Increased Wall Insulation	$ -	$ -	$ -		$ -
New Roof	$ 1,700,000	$ 1,500,000	$ 2,500,000	$ 6,000,000	$ 3,000,000
New Windows	$ 500,000	$ 1,200,000	$ 3,000,000	$ 4,000,000	$ 4,000,000
Treatments	$ -	$ -	$ -	$ -	$ -
Shading Devices	$ 30,000	$ 6,000	$ 40,000	$ 50,000	$ 20,000
Design, Construction and Retrofit Total	**$ 4,543,500**	**$ 4,997,000**	**$ 13,066,000**	**$ 13,356,000**	**$ 10,166,000**

Table C.2 Operations and Maintenance Investments, FY2013-14 to FY2017-18

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
New School Design/Construction Guidelines and Specifications	$ -	$ -	$ -	$ -	$ -
Day and Night Temperature Guidelines for all Schools	$ -	$ -	$ -	$ -	$ -
Nighttime Blackout of Sites - Interior	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Nighttime Blackout of Sites - Exterior	$ -	$ -	$ -	$ -	$ -
Procures Only Energy Star Certified Appliances	$ -	$ -	$ -	$ -	$ -
Daylight Harvesting (servicing)	$ -	$ -	$ -	$ -	$ -
Demand Ventilation (servicing)	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Walk Through Audit	$ -	$ -	$ -	$ -	$ -
Engineering Audit	$ -	$ -	$ -	$ -	$ -
Operations and Maintenance Total	**$ 3,000**	**$ 3,000**	**$ 3,000**	**$ 3,000**	**$ 3,000**

Table C.3 Occupant Behaviour Strategies, FY2013-14 to FY2017-18

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Building Operator Training	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
NRCan Benchmarking Program	$ -	$ -	$ -	$ -	$ -
Building Automation Training	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000
Ongoing Training and Awareness Programs	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Provide Detailed Information on Building Operational Costs	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Provide Detailed Information on Energy Consumption	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Participate in Environmental Programs	$ 7,500	$ 7,500	$ 7,500	$ 7,500	$ 7,500
Occupant Behaviour Strategies Total	$ 21,500	$ 21,500	$ 21,500	$ 21,500	$ 21,500

Table C.4 Summary of Energy Conservation Investments, FY2013-14 to FY2017-18

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2010-14 to 2017-18
Design, Construction and Retrofit	$ 4,543,500	$ 4,997,000	$ 13,066,000	$ 13,356,000	$ 10,166,000	$ 46,128,500
Operations and Maintenance	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 15,000
Occupant Behaviour	$ 21,500	$ 21,500	$ 21,500	$ 21,500	$ 21,500	$ 107,500
Total	$ 4,568,000	$ 5,021,500	$ 13,090,500	$ 13,380,500	$ 10,190,500	$ 46,251,000

Appendix D. Energy Conservation Investments Details, FY2018-19 to FY2022-23

Table D.1 Design, Construction and Retrofit Investments, FY2018-19 to FY2022-23

		2018-2019		2019-2020		2020-2021		2021-2022		2022-2023	
Lighting	**Lifetime (yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**
High Efficiency Lighting Systems	15	$ 200,000	163,265	$ 165,000	134,694	$ 125,000	102,041	$ 150,000	122,449	$ 150,000	122,449
Outdoor Lighting	15	$ 90,000	73,469	$ 100,000	81,633	$ 20,000	16,327	$ 50,000	40,816	$ 50,000	40,816
Occupancy Sensors	10	$ 160,000	182,857	$ 90,000	102,857	$ 90,000	102,857	$ 100,000	114,286	$ 100,000	114,286

		2018-2019		2019-2020		2020-2021		2021-2022		2022-2023	
H.V.A.C.	**Lifetime (yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**
Efficient Boilers (near condensing)	30	$ 250,000	347,536	$ 300,000	417,043	$ 730,000	1,014,805	$ 800,000	1,112,115	$ 1,150,000	1,598,665
High-efficiency Boilers (condensing)	15	$ 580,000	806,283	$ 530,000	736,776	$ 130,000	180,719	$ 120,000	166,817	$ 120,000	166,817
High-efficiency Boiler Burners	10	$ -	-	$ 10,000	55,606	$ 10,000	55,606	$ -	-	$ -	-
Geothermal	20	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-
Heat Recovery/Enthalpy Wheels	30	$ 150,000	258,978	$ 115,000	198,550	$ 120,000	207,182	$ 120,000	207,182	$ -	-
Economizers	15	$ 50,000	65,472	$ 25,000	32,736	$ 3,500	4,583	$ -	-	$ -	-
Energy Efficient HVAC systems	30	$ 1,455,000	190,523	$ 798,500	104,558	$ 1,350,000	176,774	$ 570,000	74,638	$ 225,000	29,462
Energy Efficient Rooftop Units	15	$ 195,000	63,835	$ 190,000	62,198	$ 130,000	42,557	$ 130,000	42,557	$ 75,000	24,552
High Efficiency Domestic Hot Water	15	$ 30,000	59,286	$ 15,000	29,643	$ 10,000	19,762	$ 5,000	9,881	$ 10,000	19,762
Efficient Chillers and Controls	25	$ 450,000	25,714	$ -	-	$ 150,000	8,571	$ -	-	$ 450,000	25,714
High-efficiency Motors	20	$ 5,000	2,857	$ 5,000	2,857	$ 5,000	2,857	$ 10,000	5,714	$ 5,000	2,857
VFD	15	$ 10,000	14,450	$ 10,000	14,450	$ 10,000	14,450	$ 10,000	14,450	$ -	-
Demand Ventilation	10	$ 60,000	117,849	$ 70,000	137,491	$ 45,000	88,387	$ 60,000	117,849	$ 45,000	88,387
Entrance Heater Controls	20	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-
Destratification Fans	10	$ 85,000	69,388	$ 85,000	69,388	$ -	-	$ -	-	$ -	-

		2018-2019		2019-2020		2020-2021		2021-2022		2022-2023	
Controls	**Lifetime (yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**
Building Automation Systems - New	10	$ 340,000	222,604	$ 335,000	219,331	$ 250,000	163,680	$ -	-	$ -	-
Building Automation Systems - Upgrade	10	$ 745,000	487,765	$ 650,000	425,567	$ 740,000	484,491	$ 500,000	327,359	$ 390,000	255,340
Real-time energy data for operators	10	$ 80,000	157,132	$ -	-	$ 5,000	9,821	$ 5,000	9,821	$ 5,000	9,821
Voltage Harmonizers	15	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-
Online web reporting tool		$ 9,000	31,414	$ 9,000	31,414	$ 9,000	31,414	$ 9,000	31,414	$ 9,000	31,414

		2018-2019		2019-2020		2020-2021		2021-2022		2022-2023	
Building Envelope	**Lifetime (yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**
Glazing	30	$ 430,000	74,240	$ 600,000	103,591	$ 860,000	148,481	$ 400,000	69,061	$ 400,000	69,061
Increased Wall Insulation	50	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-
New Roof	25	$ 3,100,000	178,407	$ 2,500,000	143,877	$ 3,200,000	184,162	$ 3,000,000	172,652	$ 3,000,000	172,652
New Windows	30	$ 1,720,000	296,961	$ 2,400,000	414,365	$ 3,440,000	593,923	$ 1,600,000	276,243	$ 1,600,000	276,243
Treatments	10	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-
Shading Devices	30	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-

Design, Construction & Retrofit Strategies Total		$ 10,194,000	3,890,286	$ 9,002,500	3,518,623	$ 11,432,500	3,653,447	$ 7,699,000	2,915,303	$ 7,784,000	3,048,298

Table D.2 Operations and Maintenance Investments, FY2018-19 to FY2022-23

		2018-2019		2019-2020		2020-2021		2021-2022		2022-2023	
Policy and Planning	**Lifetime (yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**
Design/Construction Guidelines/Specifications	5	$ 9,500	18,659	$ 9,500	18,659	$ 9,500	18,659	$ 9,500	18,659	$ 9,500	18,659
Day and Night Temperature Guidelines	10	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-
Nighttime Blackout of Sites - Interior	10	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-
Nighttime Blackout of Sites - Exterior	10	$ 18,000	14,694	$ 18,000	14,694	$ 18,000	14,694	$ 18,000	14,694	$ 18,000	14,694
Procures Only Energy Star Certified Appliances	5	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-
Demand Ventilation (servicing)	3	$ 1,800	3,535	$ 1,700	3,339	$ 1,500	2,946	$ -	-	$ -	-
HVAC Optimization	3	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-
Commissioning (retro and re)	10	$ 10,000	9,821	$ 10,000	9,821	$ 10,000	9,821	$ -	-	$ 10,000	9,821

		2018-2019		2019-2020		2020-2021		2021-2022		2022-2023	
Energy Audits	**Lifetime (yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**
Walk Through Audit	5	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-
Engineering Audit	5	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-
Operations and Maintenance Strategies Total		$ 39,300	46,710	$ 39,200	46,513	$ 39,000	46,120	$ 27,500	33,353	$ 37,500	43,174

Table D.3 Occupant Behaviour Investments, FY2018-19 to FY2022-2023

		2018-2019		2019-2020		2020-2021		2021-2022		2022-2023	
Training and Education	**Lifetime (yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**
Building Operator Training	3	$ 2,800	8,014	$ 2,500	7,156	$ 2,500	7,156	$ 2,500	7,156	$ 2,500	7,156
Energy Benchmarking Program	5	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-
Building Automation Training (site specific)	3	$ 7,300	62,682	$ 7,000	60,106	$ 7,000	60,106	$ 7,000	60,106	$ 7,000	60,106
Ongoing Training and Awareness Programs	5	$ -	-	$ 1,000	624	$ 1,000	624	$ 1,000	624	$ 1,000	624
Information on Building Operational Costs	1	$ 19,000	187	$ 9,000	88	$ 9,000	88	$ 9,000	88	$ 9,000	88
Information on Energy Consumption	1	$ -	-	$ 1,000	10	$ 1,000	10	$ 1,000	10	$ 1,000	10
Participate in Environmental Programs	1	$ -	-	$ 40,000	24,943	$ 40,000	24,943	$ 40,000	24,943	$ 40,000	24,943
Occupant Behaviour Strategies Total		$ 29,100	70,883	$ 60,500	92,927	$ 60,500	92,927	$ 60,500	92,927	$ 60,500	92,927

Table D.4 Summary of Investment and Conservation Goals, FY2018-19 to FY2022-23

	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023	
	Cost	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**	**Cost**	**Savings (ekWh/yr)**
Design, Construction and Retrofit Total	$ 10,194,000	3,890,286	$ 9,002,500	3,518,623	$ 11,432,500	3,653,447	$ 7,639,000	2,915,303	$ 7,784,000	3,048,298
Operations and Maintenance Total	$ 39,300	46,710	$ 39,200	46,513	$ 39,000	46,120	$ 27,500	33,353	$ 37,500	43,174
Occupant Behaviour Strategies Total	$ 29,100	70,883	$ 60,500	92,927	$ 60,500	92,927	$ 60,500	92,927	$ 60,500	92,927
TOTAL	$ 10,262,400	4,007,879	$ 9,102,200	3,658,063	$ 11,532,000	3,792,495	$ 7,727,000	3,041,584	$ 7,882,000	3,184,399
Percentage Change (%)		-2.68		-2.44		-2.53		-2.03		-2.13
Conservation Goal (ekWh/ft²)		-0.50		-0.46		-0.47		-0.38		-0.40