
EcoSchools
Energy
Performance
Study

Final Report

Enerlife Consulting
June 29, 2016

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Table of Contents

1. Overview	2
1.1 Ontario EcoSchools	2
1.2 Sustainable Schools.....	2
1.3 Energy Performance Study	2
2. Summary of findings	3
3. Background	4
3.1 EcoSchools dataset	4
3.2 Sustainable Schools dataset.....	5
4. Detailed findings	6
4.1 Average energy savings potential by groups of schools	6
4.2 Average energy savings potential of EcoSchools-certified facilities, by certification level	8
4.3 Distribution of energy savings potential by groups of schools.....	9
4.4 Relationship between energy savings potential and points in Section II Energy Conservation	12
5. Conclusions	15
APPENDIX A: Methodology	16
1. Energy use data collection	16
2. Energy data analysis.....	16
2.1 Data cleaning.....	16
2.2 Data processing.....	17
2.3 Weather-normalization and target-setting.....	17
2.4 Establishing savings potential	20
Appendix B: EcoSchools certification program	21
References	23

1. Overview

1.1 Ontario EcoSchools

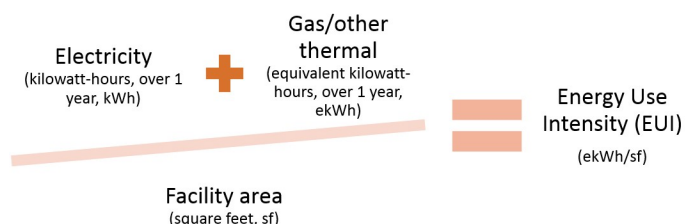
[Ontario EcoSchools](#) is a long-running environmental education and certification program for K-12 schools in Ontario. The program encompasses several environmental impact areas: school ground greening, teamwork and leadership, environmental stewardship, curriculum, waste minimization and energy conservation. Energy conservation is an “action-oriented section” which “focuses on daily practices to reduce school energy consumption.” Schools certify to one of the levels (Bronze, Silver, Gold and Platinum) by accumulating points in each of the sections.

1.2 Sustainable Schools

Under the [Living City initiative](#), Toronto and Region Conservation Authority and Enerlife Consulting (the author of this report) have worked to establish and lead energy performance benchmarking and engagement programs in the municipal, hospital and K-12 school sectors. [Sustainable Schools](#) program analysed the energy performance of all Ontario schools by establishing their energy savings potential. This work, which utilized energy use data from Ontario school boards submitted to the Ministry of Energy in accordance with Ontario Regulation 397/11, forms the basis for this EcoSchools Energy Performance Study.

1.3 Energy Performance Study

This Energy Performance Study looks at relative energy efficiency of Ontario elementary and secondary schools. We compare non-EcoSchools-certified facilities with EcoSchools-certified facilities by looking at their energy savings potential, which is the difference between a school's actual energy use and target energy use.



All Ontario school boards are required to report energy use (electricity, gas and other thermal energy) for each of their facilities, on an annual basis. **Energy use intensity** of each facility is defined as a facility's total energy use for 12 months (adding up electrical and thermal energy use converted to equivalent kilowatt-hours) divided by the facility's area (ekWh/sf). The Sustainable Schools analysis establishes **energy use targets** (separately for electricity and gas use) for each facility, also measured in ekWh/sf. These targets incorporate adjustments for weather, portable classrooms, heating system type, and presence of swimming pools.

A facility's **energy savings potential**, then, is the difference between each facility's energy use intensity and its energy use target, multiplied by its area. The savings potential is determined for electricity and gas/other thermal energy separately. To remain consistent with the work done as part the Sustainable Schools analysis, we use this energy savings potential as a proxy for energy performance, and compare energy savings potential of non-EcoSchools-certified facilities with energy savings potential of Eco-

Schools-certified facilities. The smaller a facility's energy savings potential (in percentage terms), the better its relative energy performance.

$$\left(\begin{array}{c} \text{Actual} \\ \text{Electricity Use} \\ \text{Intensity} \\ \text{(kWh/sf)} \end{array} - \begin{array}{c} \text{Target} \\ \text{Electricity Use} \\ \text{Intensity} \\ \text{(kWh/sf)} \end{array} \right) \times \begin{array}{c} \text{Facility} \\ \text{area} \\ \text{(square} \\ \text{feet, sf)} \end{array} = \begin{array}{c} \text{Estimated} \\ \text{Electricity} \\ \text{Savings} \\ \text{Potential} \\ \text{(kWh)} \end{array}$$

The results are similar to those achieved by comparing weather-normalized, adjusted for variables energy use intensities of schools. The Sustainable Schools analysis already had weather-normalization and variable adjustments built into energy use targets, and therefore into savings potential estimates, so the savings potential metric is a measure of energy performance. In addition, using energy savings potential as the energy performance metric eliminated the need to create an additional metric (normalized and adjusted energy use intensity) for each facility.

2. Summary of findings

On average, EcoSchools-certified elementary and secondary schools have a slightly lower total energy saving potential than non-EcoSchools (total energy combines electricity and gas use). As well, gas savings potential of EcoSchools-certified facilities is slightly lower than that of non-certified facilities. Energy conservation is one of six areas where schools can obtain points in the EcoSchools certification program. Nevertheless, and despite the fact that behavioural actions have a limited effect on energy use, EcoSchools-certified facilities are slightly better energy performers than non-certified facilities.

EcoSchools-certified facilities are slightly better energy performers than non-certified facilities

Within each group of schools, both electricity and gas energy savings potential varies greatly from school to school, from no savings potential (a school is an efficient energy user operating at or under its energy use target) to as high as 70%-80% estimated energy savings potential (a school can potentially save most of its energy use if it achieves its customized target). We have found that the group of non-EcoSchools-certified schools is more likely to have outlier facilities with very high estimated energy savings potential. Meanwhile, the schools that are EcoSchools-certified have fewer outliers and fewer extremes of energy inefficiency. This means that the least energy efficient schools are found in the group of schools that do not participate in the EcoSchools program. This indicates a slightly better energy performance, on average, in EcoSchools-certified facilities.

The least energy efficient schools are found in the group of schools that do not participate in the EcoSchools program

In addition to comparing the two groups of schools, we have separated out a subset of EcoSchools-certified facilities which have accumulated a relatively high number of points in the Energy Conservation section of EcoSchools certification program. We have found that a higher number of points in that section

is not correlated with lower savings potential (better energy performance) for a school. The subset of schools with high scores in the energy-efficiency section has a similar energy savings potential (that is, is as energy-efficient) than those schools with fewer points in that section.

We have found that all groups of schools, including EcoSchools-certified facilities, have higher gas savings potential in percentage terms and in terms of greenhouse gas emissions that could be avoided. If reducing carbon footprint is a priority, then as part of their EcoSchools certification, schools could focus on such gas-saving measures as temperature setpoints and hours of operation, in collaboration with principals/administrators, avoiding simultaneous heating and cooling (during spring and fall months), and adopting lower temperature setting in winter.

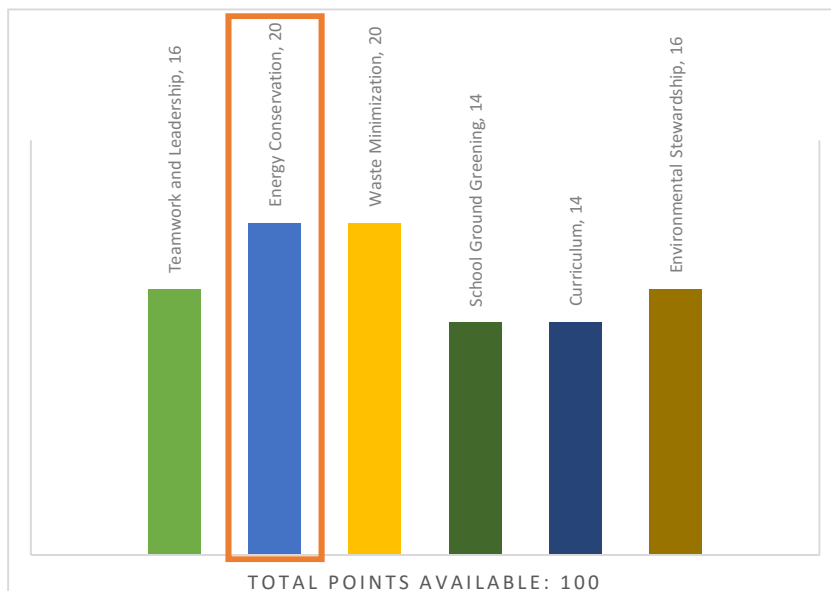
To assess impact of energy conservation actions by students, we recommend tracking changes in energy use over time (as measured by energy use intensity and energy savings potential).

3. Background

3.1 EcoSchools dataset

EcoSchools certification program consists of 6 sections: teamwork and leadership, energy conservation, waste minimization, school ground greening, curriculum, and environmental stewardship. The figure below indicates the number of points available in each section. Section II, Energy Conservation, has 20 points available out of the total of 100 points.

Figure 1 EcoSchools certification program: points by section



There are four certification levels that schools can achieve under the EcoSchools program, as per the table below. For more details on program sections and questions, please see Appendix B.

Level	Bronze	Silver	Gold	Platinum
Total Points	50-65	66-74	75-100	Gold certification <u>plus</u> 20 out of 25 Platinum Section points

Please note: a minimum of 50 points must be claimed to be eligible for certification

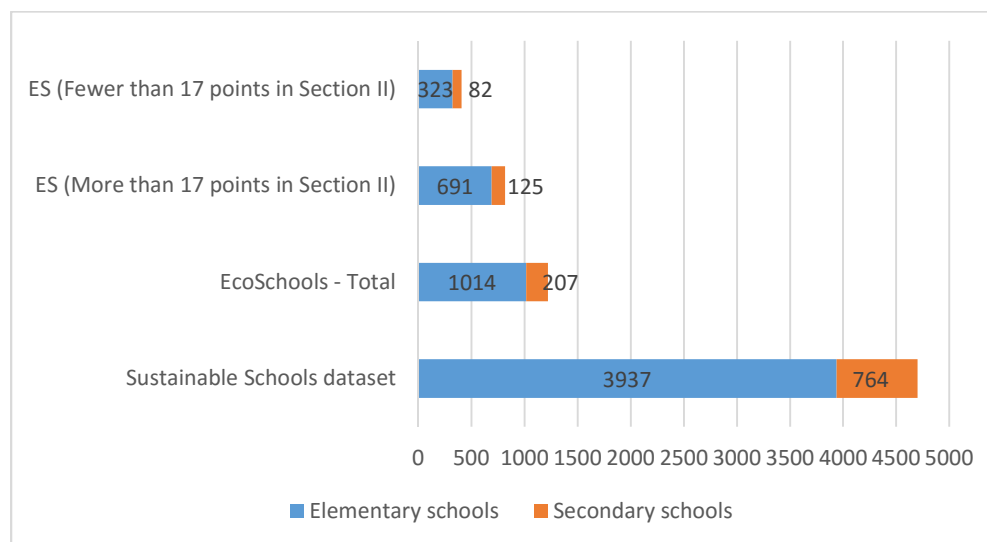
Source: <http://www.ontarioecoschools.org/get-certified/certify-now/levels-certification/>

3.2 Sustainable Schools dataset

The current Energy Performance Study started with the Sustainable Schools dataset of Ontario elementary and secondary schools. This dataset contains 2013-2014 energy use data submitted in the fall of 2015 by 71 Ontario school boards for the Sustainable Schools analysis that Enerlife undertook with the Toronto and Region Conservation Authority. Of these schools, over 1,200 are certified EcoSchools. We separate EcoSchools-certified facilities into two subsets: those with more than 17 points in Section II Energy Conservation, and those with fewer than 17 points. A relatively high number of points in Section II is a potential indicator of more effective energy conservation in that facility.

Overall, we analyse the energy performance of 3,937 elementary schools and 764 secondary schools, of which 1,014 and 207 are EcoSchools-certified facilities, respectively. There are 681 EcoSchools-certified elementary schools and 125 certified secondary schools which have achieved 17 or more points in Section II Energy Conservation.

Figure 2 Dataset overview



4. Detailed findings

As part of the Sustainable Schools analysis, for each school, we establish its energy use intensity (for electricity and gas), energy use target (for electricity and gas; adjusted for weather and other variables), and estimated its energy savings potential (for more details, please see Appendix A: Methodology). This dataset is combined with the EcoSchools database of certification indicators.

Average percentage energy savings potential among the groups of schools is compared to see which groups show lower energy savings potential. Lower energy savings potential indicates better energy efficiency, adjusted for weather and other variables. Higher energy savings potential indicates greater opportunity for reducing energy use. When translated into dollars, it shows how much schools would be able to save on energy costs if they reduced their energy use to meet their customized energy use targets.

4.1 Average energy savings potential by groups of schools

Each group of schools shows similar levels of energy savings potential. For elementary schools, electricity savings potential ranges from 10.4% (non-EcoSchools certified) to 12.0% (EcoSchools-certified with fewer than 17 points in Section II Energy Conservation). EcoSchools-certified elementary schools are relatively more energy efficient when it comes to gas use: their average gas savings potential, at 30.3%, is lower than that of non-EcoSchools certified elementary schools – 36.2%.

Overall, when total energy (gas and electricity) savings potential is considered, both elementary and secondary schools that are EcoSchools-certified have somewhat lower energy savings potential (27.0% and 19.1%, respectively) than schools that do not participate in the program (31.6% and 23.1%). This indicates slightly better energy performance in schools that are part of the program.

Figure 3 Electricity savings potential

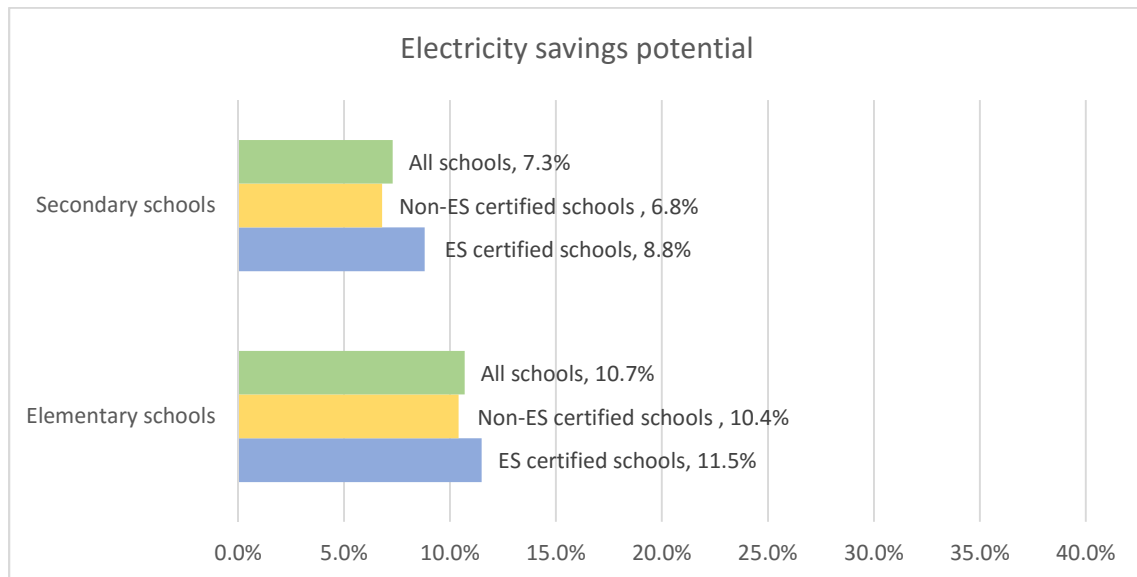


Figure 4 Gas savings potential

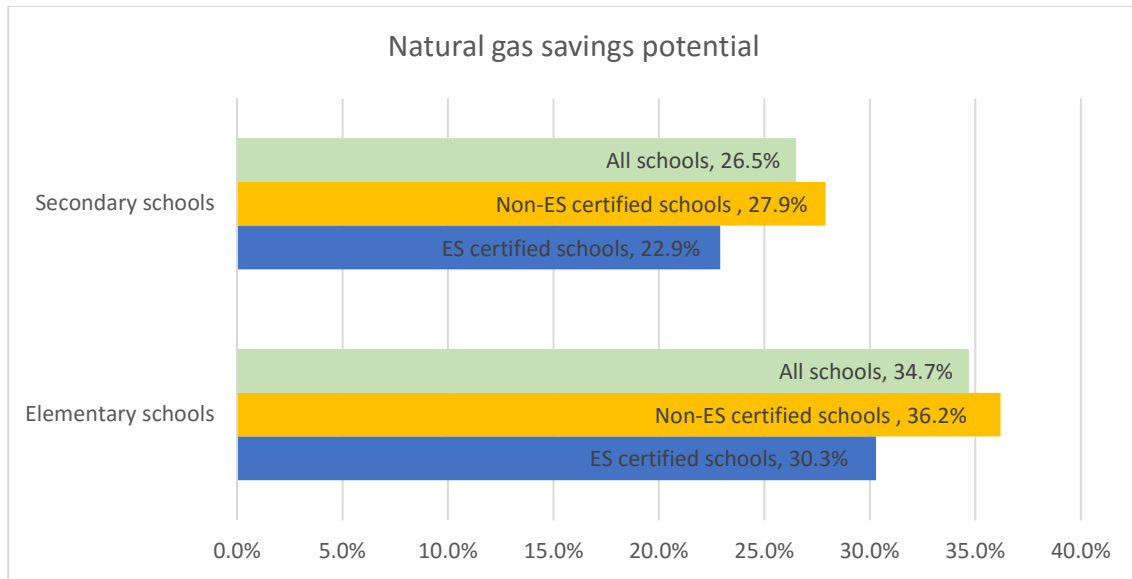
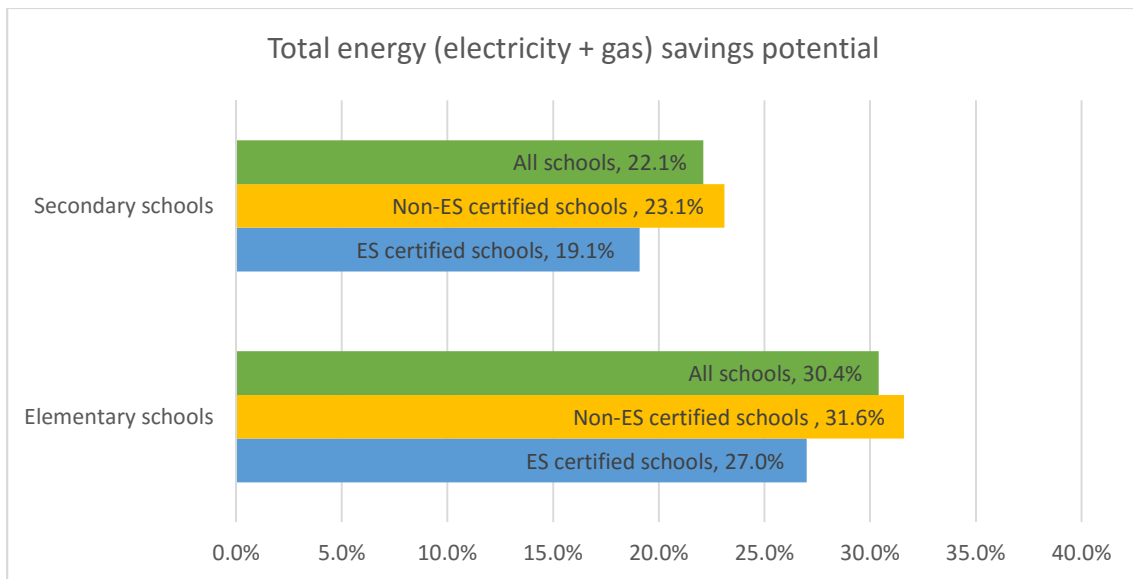


Figure 5 Total energy savings potential



For an average EcoSchools-certified elementary school, its estimated 30.3% gas savings translates into \$3,799 per year, if its gas use target was achieved. This would avoid 35.9 tonnes of greenhouse gas emissions. Compare that to an average non-EcoSchools certified elementary school, with 36.2% gas savings potential: if it achieves its gas use target, it would save \$4,889 per year and would avoid 46.1 tonnes of greenhouse gas emissions. The \$1,090 difference in savings potential between the two average schools is equivalent to taking 2.2 cars off the road for one year, or to carbon sequestered by 264 tree seedlings grown for 10 years. Same is true for gas savings potential of secondary schools – EcoSchools-

certified facilities have lower dollar savings potential and lower greenhouse gas emissions savings potential, indicating better gas performance, on average, for this group.

For electricity, both elementary and secondary EcoSchools-certified facilities have larger estimated savings potential: \$6,883 and \$20,190 per year, respectively, compared with \$5,559 and \$13,118 per year for non-EcoSchools certified ones. The larger average savings potential indicates worse energy performance.

Table 1 Dollar savings potential comparison between subsets of schools

	Average \$ savings potential, per school					
	Electricity		Natural Gas		Total Energy (Electricity + Gas)	
	Elementary	Secondary	Elementary	Secondary	Elementary	Secondary
All schools	\$ 5,938	\$ 15,154	\$ 4,557	\$ 12,629	\$ 10,495	\$ 27,784
Non-ES certified schools	\$ 5,559	\$ 13,118	\$ 4,889	\$ 13,656	\$ 10,448	\$ 26,774
ES certified schools	\$ 6,883	\$ 20,190	\$ 3,799	\$ 10,177	\$ 10,682	\$ 30,367
17 points and above in Section II	\$ 6,522	\$ 23,049	\$ 3,739	\$ 10,634	\$ 10,260	\$ 33,682
Below 17 points in Section II	\$ 7,655	\$ 15,832	\$ 3,927	\$ 9,481	\$ 11,582	\$ 25,313

Table 2 Greenhouse gas emissions savings potential comparison between subsets of schools

	Average Greenhouse Gas Emissions Savings Potential (tonnes CO ₂ e), per school					
	Electricity		Natural Gas		Total Energy (Electricity + Gas)	
	Elementary	Secondary	Elementary	Secondary	Elementary	Secondary
All schools	5.0	12.8	43.0	119.2	48.0	132.0
Non-ES certified schools	4.7	11.1	46.1	128.9	50.9	140.0
ES certified schools	5.8	17.1	35.9	96.1	41.7	113.2
17 points and above in Section II	5.5	19.5	35.3	100.4	40.8	119.9
Below 17 points in Section II	6.5	13.4	37.1	89.5	43.6	102.9

4.2 Average energy savings potential of EcoSchools-certified facilities, by certification level

As expected, the total energy savings potential does not vary greatly between different certification levels of ES-certified schools. A higher level of ES certification does not necessarily mean that the school is more energy efficient, as the additional points to achieve a higher certification level could have come from other sections which do not have a direct effect on energy consumption in schools, such as school grounds greening.

Figure 6 EcoSchools-certified facilities, by certification level

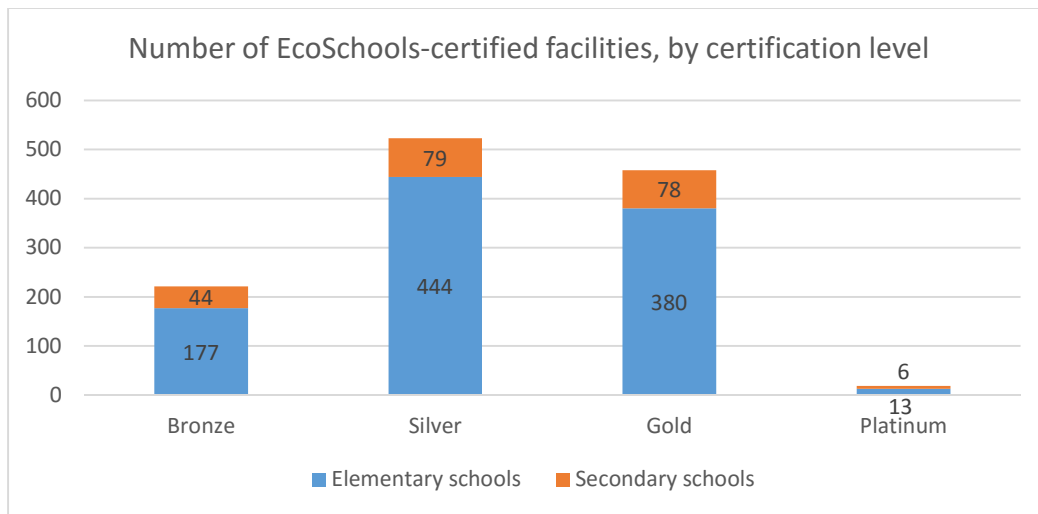
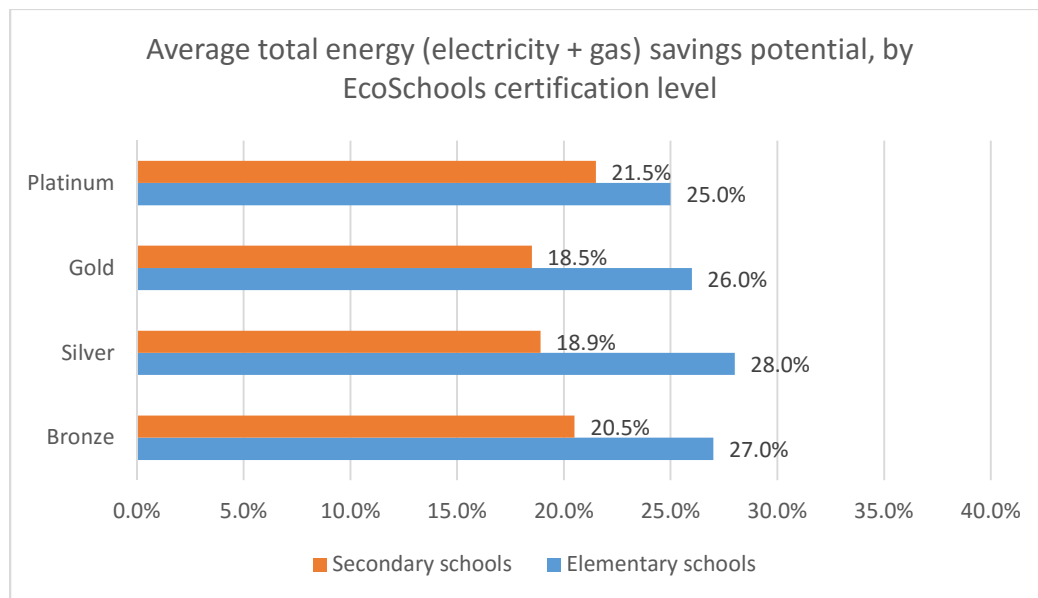


Figure 7 Total energy savings potential comparison between different certification levels of ES-certified schools



4.3 Distribution of energy savings potential by groups of schools

Figures 1-4 below illustrate the distribution of electricity and gas % savings potential for each facility. For elementary and secondary schools separately, the graphs compare savings potential of schools with 17 or more points in Section II Energy Conservation with non-ES-certified schools, and savings potential of certified ones with non-ES-certified. For both energy types as well as total energy, the range of energy savings potential is wider for the non-ES-certified group (for both elementary and secondary schools). This means that the least energy efficient schools are found in the group of schools that do not participate in the EcoSchools program.

Figure 8 Savings potential comparison, elementary schools, scoring 17+ points in Section II vs non-ES-certified

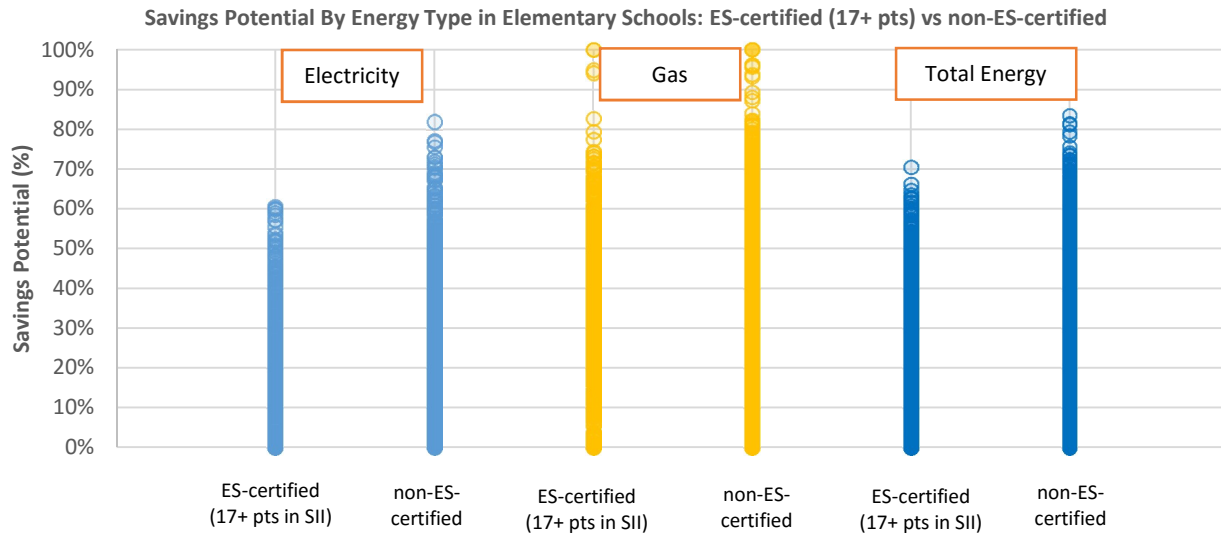


Figure 9 Savings potential comparison, elementary schools, all ES-certified vs non-ES-certified

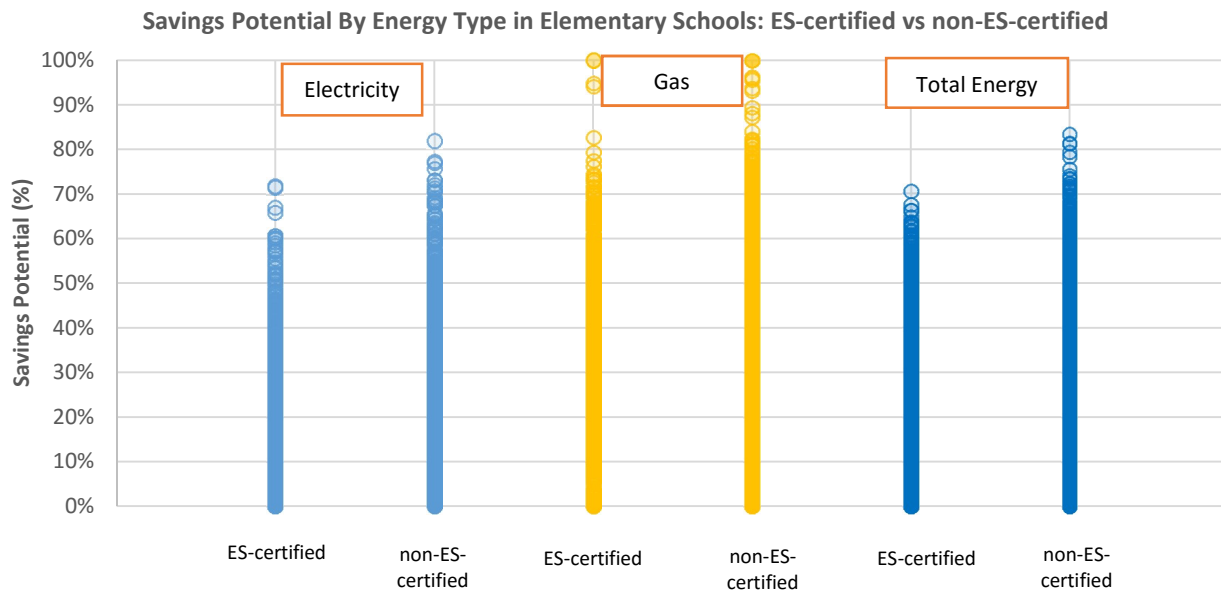


Figure 10 Savings potential comparison, secondary schools, scoring 17+ points in Section II vs non-ES-certified

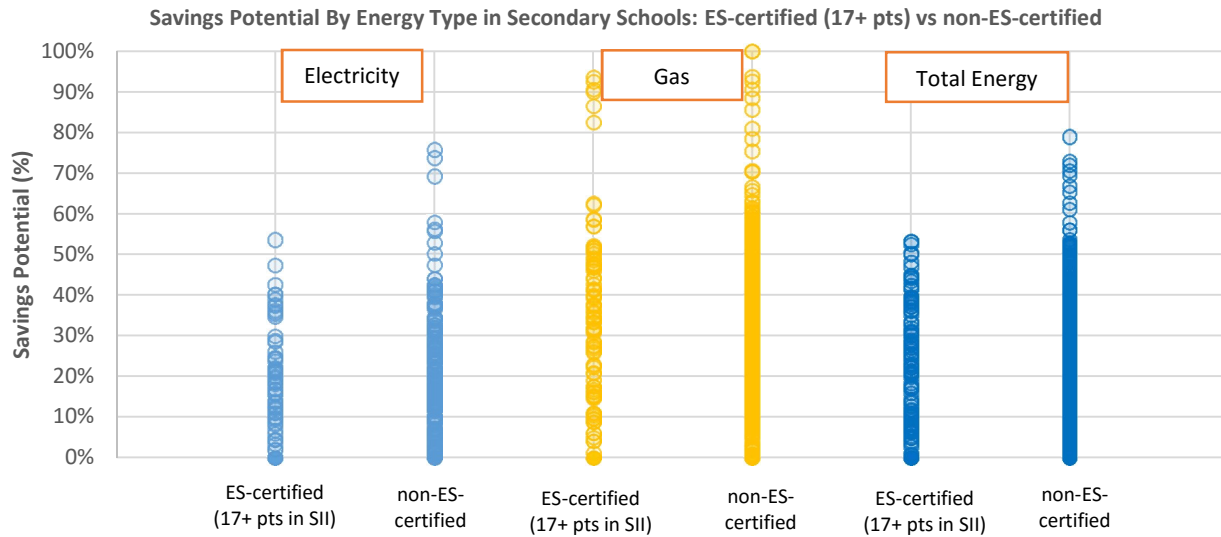
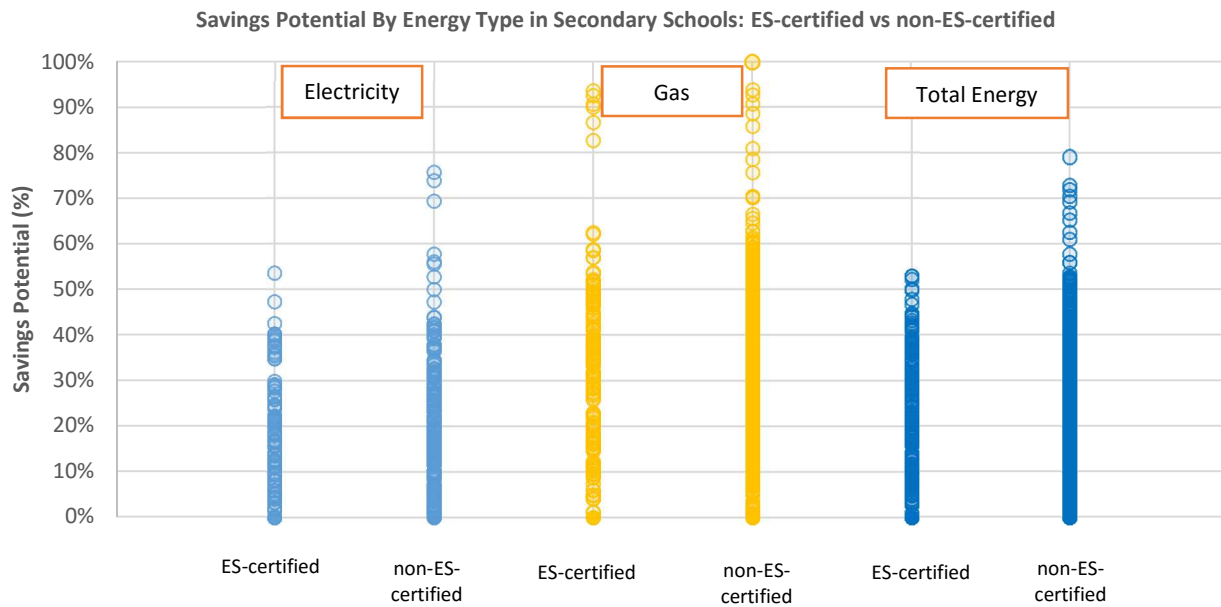


Figure 11 Savings potential comparison, secondary schools, all ES-certified vs non-ES-certified



4.4 Relationship between energy savings potential and points in Section II Energy Conservation

Figures 5-8 below illustrate the relationship between energy savings potential and the number of points achieved by schools in Section II Energy Conservation. We have not found a correlation between Section II scores and energy savings potential.

However, we cannot definitively say that the actions being taken by the students in certified Eco-Schools do *not* have an effect on energy performance (lower energy savings potential and lower energy use intensities). Year-to-year changes in energy savings potential must be considered to assess the impact of energy conservation initiatives. Tracking performance of Eco-School-certified facilities over multiple years will provide greater insight into the impact of energy conservation initiatives.

Figure 12 Electricity savings potential in elementary schools

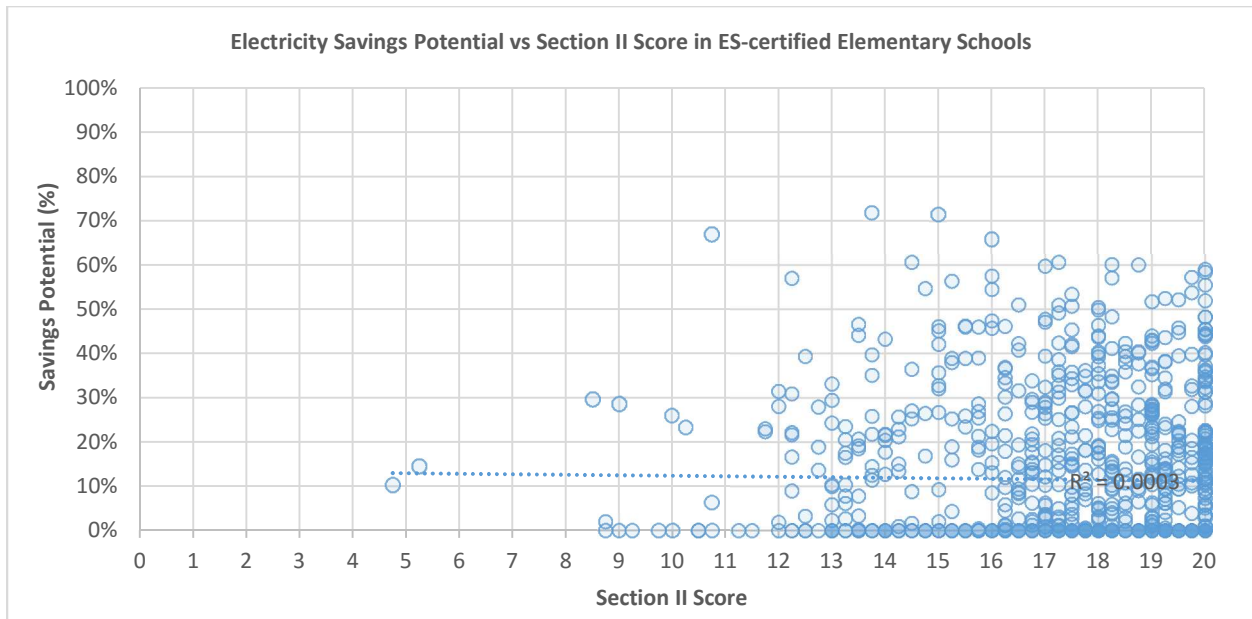


Figure 13 Gas savings potential in elementary schools

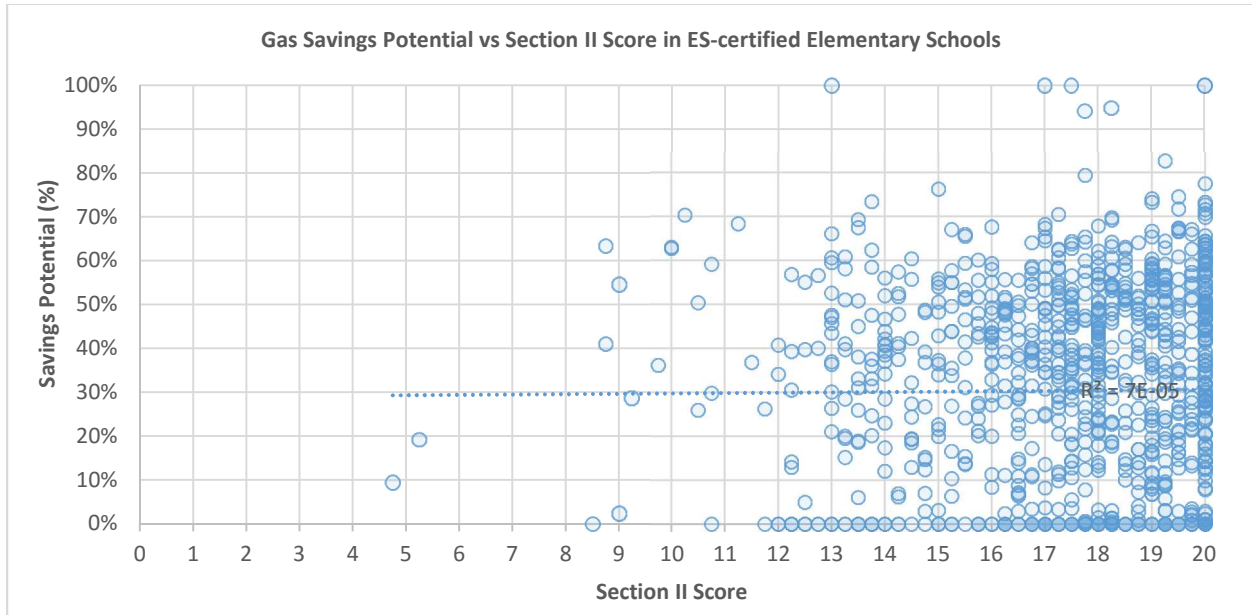


Figure 14 Electricity savings potential in secondary schools

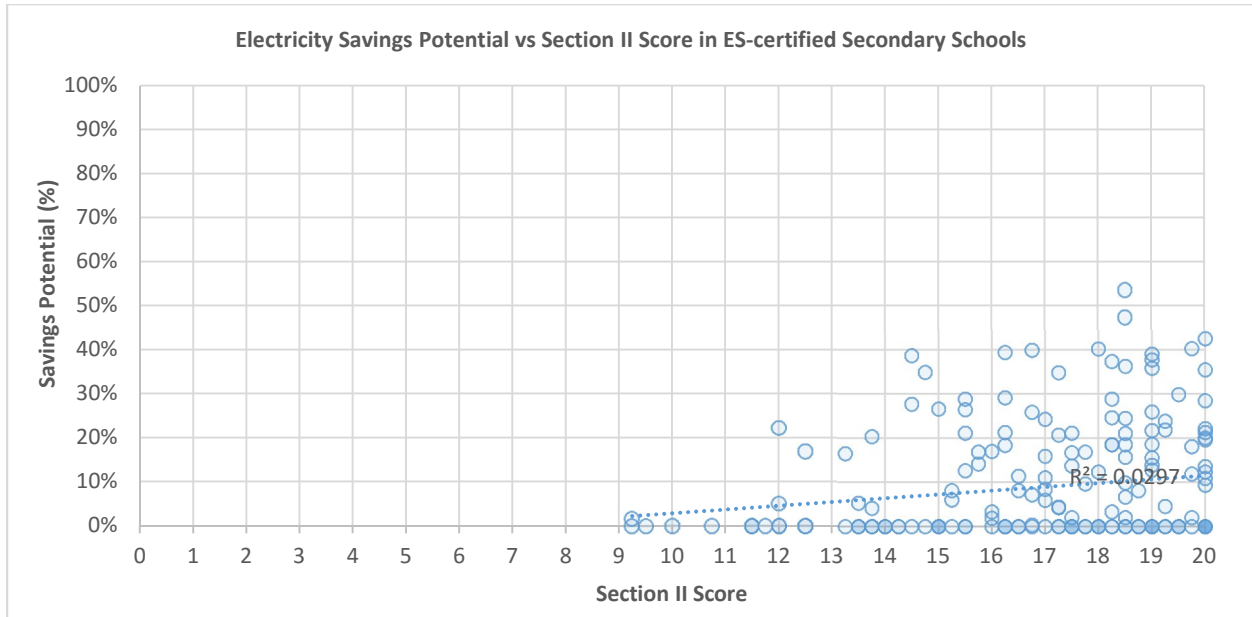
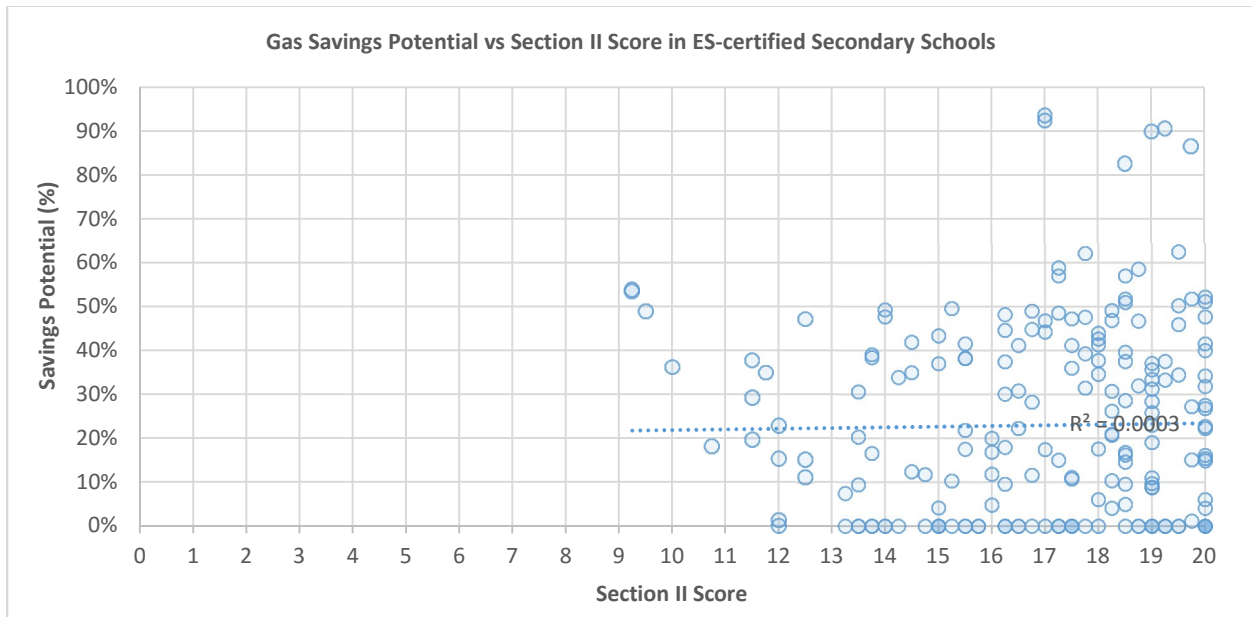


Figure 15 Gas savings potential in secondary schools



5. Conclusions

On average, EcoSchools-certified facilities have a somewhat lower total energy saving potential than non-EcoSchools (when considering electricity and gas together). Looking at each energy type separately, EcoSchools-certified facilities have lower gas savings potential (are more efficient gas users) but somewhat higher electricity savings potential (are less efficient electricity users) than facilities that are not certified. The differences are sufficiently small and this is an expected finding, given that energy conservation is just one of six areas where schools can obtain points in the EcoSchools certification program and that students have a limited ability to influence energy use throughout the whole school. However, the slightly better energy performance of EcoSchools-certified facilities indicates that these limited behavioural actions have some effect.

We have found that within each group of schools, both electricity and gas energy savings potential varies considerably from school to school. The group of non-EcoSchools-certified schools is more likely to have outlier facilities with very high estimated energy savings potential. Meanwhile, the schools that are EcoSchools-certified have fewer outliers and fewer extremes of energy inefficiency. This indicates a slightly better energy performance, on average, in EcoSchools-certified facilities.

Within the group of EcoSchools-certified schools, we analysed the energy savings potential by certification level and found that a higher certification level is not related to lower energy savings potential, that is, a school with a higher certification level is not more energy efficient than a school with a basic certification level. We have also looked at possible correlation between the number of points achieved in Section II Energy Conservation and energy savings potential. We have found that more points being achieved in that section does not correlate with a lower savings potential, and so does not mean that the school is more energy efficient.

Issues

The energy use data was self-reported by school boards and is not third-party verified. We have attempted to remove obvious anomalies from energy use data, but there are likely to be data gaps and other issues within the dataset. The boards were required to report annual energy use data, not monthly data, which makes data gaps harder to detect.

Recommendations

We suggest tracking changes in energy use (as measured by energy use intensity and energy savings potential) over time to assess impact of energy conservation actions by students. It should be noted that even then, it will be hard to disaggregate the effect of student and staff actions from other changes impacting the facility energy use.

All groups of schools, including EcoSchools-certified facilities, have higher gas savings potential in percentage terms and in terms of greenhouse gas emissions that could be avoided. If greenhouse gas emissions reduction is a priority, then as part of their EcoSchools certification, schools could focus on gas-saving measures, if possible. This could include temperature setpoints and hours of operation, in collaboration with principals/administrators, avoiding simultaneous heating and cooling (during spring and fall months), and adopting lower temperature setting in winter.

APPENDIX A: Methodology

1. Energy use data collection

Enerlife Consulting proposed to use Ministry of Energy's Broader Public Sector data set of energy use. However, at the time of the analysis, the 2013-2014 school year energy use data was not yet available on the Ministry of Energy's website. 2013-2014 energy use data was submitted in the fall of 2015 by 71 Ontario school boards for the Sustainable Schools analysis that Enerlife undertook with the Toronto and Region Conservation Authority. This data has been provided to the Ministry of Energy, but has not yet been published on the Ministry of Energy's website. As a result, we used the 2013-2014 data set obtained for the Sustainable Schools analysis for this study. An additional benefit to using this data set is the enhancement of additional information submitted by the Boards for this analysis, such as heating system types and swimming pool sizes.

The Sustainable Schools dataset contains data that each Ontario school board reported on all facilities currently in use by the board, including leased buildings. The data include general information about the facilities (building name, address, operation type, total floor area, average hours of use per week, swimming pools and numbers of portables) and energy use information (consumption of electricity, natural gas, oil, propane, coal, wood, district heating, and district cooling, in appropriate units). All facilities included by a board in the reporting template were analyzed, whether leased or owned.

Ontario EcoSchools has provided a master data book of EcoSchools certification indicators. Each section has several questions with a certain number of points that can be achieved in each question (see Appendix B for list of questions). Schools that wish to certify report their own performance. This data was combined with the Sustainable Schools dataset of energy use. It should be noted that there were significant differences between school and board names in the two datasets and a lot of effort went into matching schools' energy savings potential data with their own EcoSchools certification data.

2. Energy data analysis

2.1 Data cleaning

Currently, the template used by school boards to submit their energy data to the Ministry of Energy indicates only two operation types for each building: a) school; and b) administrative offices and related facilities. As part of our work on the 2016 Sustainable Schools Top Energy Performing Boards report, we added "Elementary" or "Secondary" designations for school buildings.

A number of facilities were excluded from the analysis as follows:

- From Sustainable Schools dataset:
 - o Administrative facilities
 - o Schools with total energy intensity of less than 5 equivalent kilowatt-hours per square foot (kWh/sf)
 - o Substantial anomalies likely due to energy data or building area issues
 - o Closed/demolished/sold/unoccupied/vacant
 - o Multiple buildings at one address and energy use split not clear
- From EcoSchools dataset:
 - o Schools without a final certification level, or those not certified (from EcoSchools dataset)

- Private schools (not required to submit energy use data to Ministry of Energy, so absent from Sustainable Schools dataset)

Energy use data verification was **not** conducted with individual school boards, apart from excluding anomalies as listed above.

2.2 Data processing

Within the Sustainable Schools dataset, oil, propane and district heating were converted into natural gas equivalents, and district cooling into electricity equivalents, using the following conversion factors:

Conversion factors	
Litre of oil	= 1.023 m3 of gas
Litre of propane	= 0.6818 m3 of gas
District heating to gas (m3)	26.8384326
District cooling to kWh	79.0177774 *0.75

2.3 Weather-normalization and target-setting

The 2016 Sustainable Schools analysis involved weather-normalizing energy use targets, adjusting them for specific variables, and then comparing those with actual energy use intensities to arrive at savings potential estimates. For this study, it was decided to use energy savings potential percentages for comparison with OE certification indicators, for practical reasons, rather than weather-normalizing and adjusting the actual energy use intensities.

Within the Sustainable Schools dataset, one of the weather stations listed below was assigned to each facility. Weather stations were chosen based on data completeness and reliability. Assignment of each weather station was done based on geographical proximity. Daily mean temperature data for each weather station for September 2013 – August 2014 period was obtained from the federal Climate Data Online website at <http://climate.weather.gc.ca/>

HAMILTON A
 KENORA A
 KINGSTON CLIMATE
 KITCHENER/WATERLOO
 LONDON A
 MOOSONEE
 OTTAWA INTL A
 PETERBOROUGH
 RAVENSCLIFFE
 SAULT STE MARIE A
 SHANTY BAY
 SUDBURY CLIMATE
 THUNDER BAY
 TIMMINS A
 TORONTO INTL A
 WELLAND-PELHAM

WIARTON A
WINDSOR A

For the Sustainable Schools analysis, balance temperatures of 15 and 10 degrees Celsius were used to calculate heating and cooling degree-days respectively. The following standard targets (based on 2012-2013 Toronto International Airport weather) are used for buildings with conventional heating systems, before adjustment for weather and site-specific characteristics (portables, water- and ground-source heat pumps, and swimming pools):

Building type	Targets		
	Electricity	Natural Gas	Total Energy
Elementary	5.5 kWh/ft ²	6.5 ekWh/ft ²	12 ekWh/ft ²
Secondary	7.5 kWh/ft ²	7.5 ekWh/ft ²	15 ekWh/ft ²

These standard targets for schools and administrative buildings are based on good practice benchmarked energy use intensities from the Sustainable Schools database, are considered readily attainable, and are already being met or surpassed by a growing number of buildings.

Standard targets were weather-normalized to the 2013-2014 school year and the assigned weather station of each individual building using the weather-sensitive proportions below for different building types (elementary and secondary):

Building type	Proportion of energy target that is weather-sensitive	
	Electricity	Natural Gas
Elementary	0%	91.5%
Secondary	0%	92.5%

Proportions of gas use target in school buildings that are considered non-weather-sensitive were derived from top quartile benchmarking of conventionally-heated schools (without heat pumps) from the Sustainable Schools database, and determined separately for elementary and secondary schools.

In the Ontario climate cooling electricity consumption accounts for 5% or less of total electricity consumption of a well-performing school. Many schools are not air-conditioned and those with air conditioning are generally closed during July and August, when most cooling-degree days are recorded. Therefore no adjustment was made for cooling-degree-days for school buildings.

Weather-sensitive portions of energy use targets were normalized based on degree-day ratios between 2012-13 weather conditions at Toronto Lester B. Pearson International Airport and current reporting year (2013-2014) conditions at the weather station assigned to each facility.

Adjustment for portables

Adjustments for portables were calculated as the number of portables multiplied by weather-normalized standard annual electricity consumption required for one portable and divided by Total Floor Area of the associated building. The adjustment was then added to the standard target for Total Electricity.

The standard adjustment applied is 9,000 kWh/year, including a non-weather-sensitive portion of 3,000 kWh (to account for lighting, HVAC and computers) and a weather-sensitive portion of 6,000 kWh (heating based on Toronto International Airport 2012-13 weather data). This allowance has been increased from the 2015 analysis based on updated data from individually metered portables.

No allowance was made for air conditioning. The weather-sensitive portion of the target is normalized based on degree-day ratios between 2012-13 weather conditions at Toronto Lester B. Pearson International Airport and current reporting year (2013-2014) conditions at the weather station assigned to each facility.

Adjustment for swimming pools

The 2016 analysis incorporates new information from boards on the size of their swimming pools. The standard developed by TRCA's Mayors' Megawatt Challenge for operation of a swimming pool is 50 kWh of electricity and 280 ekWh of natural gas per year per square foot of water surface area. The adjustment to gas and electricity targets is applied to each facility based on the size of its swimming pool. If a board has reported the number of pools but not the water surface area, a default pool size of 2,723 sf was used (23m by 11m, 6 lanes).

Adjustment for all-electric buildings and heat pumps

The 2016 Sustainable Schools analysis incorporates information from boards on the heating systems in their facilities. The adjustments to energy use targets were introduced as follows:

1. All-electric: The standard gas use target is then multiplied by 75% as a deemed gas-firing efficiency and added to the electricity target.
2. Ground-source or water-source heat pump:
 - a. Electricity targets increased by

Heat pump	Elementary	Secondary
GSHP	1.1 kWh/sf	1.3 kWh/sf
WSHP	1.2 kWh/sf	1.4 kWh/sf

- b. Gas targets reduced by

Heat pump	Elementary	Secondary
GSHP	6.0 ekWh/sf	6.9 ekWh/sf
WSHP	1.6 ekWh/sf	1.9 ekWh/sf

The assumptions behind these adjustments are tabulated below.

Deemed boiler plant efficiency (conventionally heated school)	75%
% of heat required that is extracted from the ground (GSHP)	90%
% of electrical energy required to produce the same amount of heat	25%
Coefficient of Performance for the heat pump	4.0
Domestic hot water heated by heat pump	100%

As in case of targets for a conventional gas-fired system, the targets for electric heat and heat pumps were weather-normalized to current year and local weather station.

Hours of operation

Based on our earlier work with the schools data set, we did not find hours of operation to be a reliable indicator of actual school operations, as this variable can be interpreted differently by different school boards. We therefore did not normalize for hours of operation for this study.

2.4 Establishing savings potential







The energy savings potential for each individual school was calculated as the difference between actual energy use intensity and adjusted, weather-normalized target energy use. The savings potential was calculated separately for electricity and for gas, and is presented in %, energy units, emissions and dollars. The dollar savings potential is based on the following prices per unit of energy:

Electricity: \$0.13/kWh

Gas: \$0.20/m³

The higher a school's energy efficiency, the lower is its total % energy savings potential, that is, its overall energy use intensity is closest to its target energy use intensity.

Appendix B: EcoSchools certification program

 <p>Teamwork & Leadership In this section, schools build strong EcoTeams and develop effective school-wide communications.</p> <ul style="list-style-type: none"> • EcoTeams should include student and adult representation to ensure all voices are heard and for ease of organizing. • Strong school-wide communications via regular meetings, displays, and assemblies. • Build student leadership through planning and implementing actions and campaigns. 	 <p>Energy Conservation This action-oriented section focuses on daily practices to reduce school energy consumption.</p> <ul style="list-style-type: none"> • Turn off lights and equipment in classrooms and throughout the school when not in use. • Conserve heating and air conditioning through simple practices such as closing the blinds. • Monitor daily practices and share results with the whole school. 	 <p>Waste Minimization This section encourages schools to reduce waste, while tracking and reporting on progress to the whole school.</p> <ul style="list-style-type: none"> • Reduce through initiatives such as Waste-Free lunches, composting, and online communications. • Reuse through systems like Good On One Side (GOOS) paper trays, swap shops, and upcycling. • Recycle paper and containers school-wide.
 <p>School Ground Greening This section engages students in creating vibrant, rich environments for learning on school grounds.</p> <ul style="list-style-type: none"> • Students plan, implement, or maintain a greening project such as an outdoor classroom or school garden. • Increase biodiversity through planting native species and trees to create a healthy ecosystem and habitat. • Outdoor learning for students that regularly uses the greening project to enrich their education. 	 <p>Curriculum Integrates environmental learning in and outside of the classroom.</p> <ul style="list-style-type: none"> • “In, About, For the Environment” develops a sense of place, instructs how nature works, and encourages environmental advocacy. • Classroom lessons with environmental learning outcomes • Off-site field trips that deepen valuable learning opportunities. 	 <p>Environmental Stewardship A section that fosters whole school campaigns on specific environmental issues.</p> <ul style="list-style-type: none"> • Fosters environmental learning that has clear and well-communicated connections to an environmental issue. • Connects this learning to an action that involves the whole school community. • Goes 'above and beyond' other sections of the program and does not replicate campaigns from other sections.

Source: <http://www.ontarioecoschools.org/get-certified/program-sections/>

Standard Questionnaire			
Section	Question	Short Question	Total Points
I. Teamwork and Leadership	1.1	EcoTeam meets regularly	2
I. Teamwork and Leadership	1.2	EcoTeam reflects all parts of the adult school community	2
I. Teamwork and Leadership	1.3	EcoTeam includes diverse student representation	2
I. Teamwork and Leadership	1.4	EcoSchools a part admin/principal decision	2
I. Teamwork and Leadership	1.5	EcoTeam nurtures student leadership and/or team building	2
I. Teamwork and Leadership	1.6	Environmental program evident/visible throughout the school	1
I. Teamwork and Leadership	1.7	EcoTeam communicates regularly with whole school	1
I. Teamwork and Leadership	1.8a	Enviro focused PD/stud. leader/mentoring submission #1	2
I. Teamwork and Leadership	1.8b	Enviro focused PD/mentoring submission #2	2
II. Energy Conservation	2.1	Lights off when not required	3
II. Energy Conservation	2.2	Monitors off when not required	3
II. Energy Conservation	2.3	Printers/ photocopiers turned off at end of day	1
II. Energy Conservation	2.4	Equipment consolidation/ networking printers	1
II. Energy Conservation	2.5	Windows/curtains closed	1
II. Energy Conservation	2.6	Vents/windowsills kept clear	1
II. Energy Conservation	2.7	Doors closed to the outside	1
II. Energy Conservation	2.8	Board standard temperatures and HVAC/BAS	1
II. Energy Conservation	2.9	Equipment checked regularly	2
II. Energy Conservation	2.10a	Students monitor energy cons. practices	2
II. Energy Conservation	2.10b	Students continue monitor energy cons. practices	2
II. Energy Conservation	2.10c	Students communicate results	2
III. Waste Minimization	3.1	Photocopy/print on both sides of paper	1
III. Waste Minimization	3.2	Comm. via electronic methods/sibling list	1
III. Waste Minimization	3.3	Reduce food-related waste, boomerang/composting	3
III. Waste Minimization	3.4	Re-use it/GOOS paper box system	1
III. Waste Minimization	3.5	Reusable dishes for events and meetings	1
III. Waste Minimization	3.6	Reuse/recycle computers and surplus goods	1
III. Waste Minimization	3.7	School-wide paper recycling system	2
III. Waste Minimization	3.8	School-wide container recycling system	2
III. Waste Minimization	3.9	Toner and printer cartridge recycling	1
III. Waste Minimization	3.10a	Contamination tracking in garbage/recycling	2
III. Waste Minimization	3.10b	Students communicate waste monitoring results	2
III. Waste Minimization	3.11	Communicate waste audit details	3
IV. School Ground Greening	4.1	Students involved in greening project	4
IV. School Ground Greening	4.2	Consult wider school community	2
IV. School Ground Greening	4.3	Improve biodiversity/ ecological sustainability	2
IV. School Ground Greening	4.4	Useful shade for students/building	3
IV. School Ground Greening	4.5	Students/teachers regularly use greening	3
V. Curriculum	5.1	Curriculum #1	2

Standard Questionnaire			
Section	Question	Short Question	Total Points
V. Curriculum	5.2	Curriculum #2	2
V. Curriculum	5.3	Curriculum #3	2
V. Curriculum	5.4	Curriculum #4	2
V. Curriculum	5.5	Curriculum #5	2
V. Curriculum	5.6	Curriculum #6	2
V. Curriculum	5.7	Curriculum #7	2
VI. Environmental Stewardship	6.1	Enviro stewardship submission #1	4
VI. Environmental Stewardship	6.2	Enviro stewardship submission #2	4
VI. Environmental Stewardship	6.3	Enviro stewardship submission #3	4
VI. Environmental Stewardship	6.4	Environmental stewardship submission #4	4
Platinum Questionnaire			
Section	Question	Short Question	Total Points
Platinum Extension Questions	1.9	Organizational structure within EcoTeam	1
Platinum Extension Questions	1.10	Visibility beyond school walls	1
Platinum Extension Questions	1.11	EcoTeam mentoring	2
Platinum Extension Questions	2.11	Energy Action Plan	2
Platinum Extension Questions	2.12	Analysis of energy data	2
Platinum Extension Questions	2.13	Exploring energy use through assessment/audit	1
Platinum Extension Questions	3.12	Waste Action Plan	2
Platinum Extension Questions	3.13	Analysis of waste data	2
Platinum Extension Questions	3.14	Effective Waste Minimization practices	1
Platinum Extension Questions	4.6	School Ground Greening Survey Choice	3
Platinum Extension Questions	5.8	Curriculum Diversity	1
Platinum Extension Questions	5.9	Enhanced environmental learning	3
Platinum Extension Questions	6.5	ES Campaign Analysis	1
Platinum Extension Questions	6.6	Campaign Reflection	3

References

Sustainable Schools 2016 Top Energy Performing School Boards report http://sustainableschools.ca/wp-content/uploads/2013/07/2016-Top-Energy-Performing-School-Boards-Report-April-2016_revMay62016.pdf

Sustainable Schools Top Boards Report – methodology white paper <http://sustainableschools.ca/wp-content/uploads/2016/05/Top-Boards-Report-White-Paper-May-2016-final.pdf>

Weather data <http://climate.weather.gc.ca/>

US EPA Greenhouse gas equivalencies calculator <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>