



Ontario EcoSchools Energy Performance Study 2017

Final Report

Prepared by Enerlife Consulting Inc.
for Ontario EcoSchools

November 2017

Acknowledgements

About this report

This report provides a third-party analysis of the energy performance of certified EcoSchools compared to non-certified schools in Ontario and is funded by the Ontario Ministry of Energy. Data analysis, interpretation, and report content were prepared by Enerlife Consulting Inc. Ontario EcoSchools contributed to the final design and layout. For more information, please contact info@ontarioecoschools.org

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EcoSchools Canada is a registered charity that aims to nurture environmental leadership, reduce the ecological impact of schools, and build environmentally responsible school communities. EcoSchools Canada administers the Ontario EcoSchools program.

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Glossary

Energy performance – the amount of energy consumed during standard use of the building, including heating, cooling, ventilation, lighting, hot water.

Energy use intensity (EUI) – total energy consumed by the building in one year (measured in equivalent kilowatt-hours) divided by the total gross floor area of the building (equivalent kilowatt-hours per square foot).

Energy use targets – expected amount of energy consumed by a building in one year divided by the total gross floor area of the building. In this report, all targets are adjusted for weather, portable classrooms, heating system type, and presence of swimming pools.

Energy savings potential – possible opportunity for reducing energy use in a building through achieving energy use targets. A less efficient building means more possibility for savings (i.e. higher energy savings potential). Calculated by using the difference between each facility's **energy use intensity (EUI)** and its **energy use target**, multiplied by its area.

Energy efficient – lowering the amount of energy required for operations. In this report, buildings with lower average percentage savings potential are considered more energy efficient.

GHG emissions savings potential – greenhouse gas (GHG) emissions (carbon dioxide equivalent) that could be avoided if a building reaches its energy use targets, presented in metric tonnes (MT).



Introduction

Ontario EcoSchools

Ontario EcoSchools is a long-running environmental education and certification program for K-12 schools in Ontario, with a mission to nurture environmental leaders, reduce the ecological impact of schools and build environmentally responsible school communities. The program encompasses six environmental impact sections: teamwork and leadership, energy conservation, waste minimization, school ground greening, curriculum and environmental stewardship. School facilities are large energy users, and energy conservation is a key action-oriented section of the program, which focuses on daily practices to reduce school energy consumption. Schools certify at one of the levels (Bronze, Silver, Gold and Platinum) by accumulating points in each of the sections.

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 Ontario EcoSchools Energy Performance Study.

Purpose

This Energy Performance Study evaluates whether certified EcoSchools are more energy efficient than non-certified Ontario schools. We used existing energy consumption data from all Ontario's school boards, for the year 2014-2015, and Ontario EcoSchools certification data from the same year, and compared the energy efficiency of non-certified schools with certified EcoSchools by looking at the relative energy savings potential of the two groups of schools.

This is an update of the study done by Enerlife Consulting for Ontario EcoSchools in 2016.

Summary of Findings

In 2014-2015, the overall energy performance of certified EcoSchools (elementary and secondary) was better than overall energy performance of non-certified schools. The dif-

ference in energy efficiency of the two groups of schools is statistically significant (see Appendix B for details on statistical significance). These results are consistent with those of the 2016 report.

In general, all schools, whether certified or not, are more efficient users of electricity compared to natural gas. High natural gas usage has a large impact on greenhouse gas emissions.

CONSIDERING TOTAL ENERGY USE, CERTIFIED ECOSCHOOLS ARE MORE ENERGY EFFICIENT THAN NON-CERTIFIED SCHOOLS.

Detailed Findings

Average percentage energy savings potential among the groups of schools was 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 and greenhouse gas emissions. We looked at elementary and secondary schools separately to compare schools with similar types of uses.

Comparing energy savings Potential: Total energy

Overall, when total energy (gas and electricity) savings potential is considered, certified EcoSchools (elementary and secondary) are more energy efficient than non-certified schools, as they have a lower energy savings potential than schools which do not participate in the program (Figure 1 and 2).



Figure 1 Total energy savings potential of elementary schools

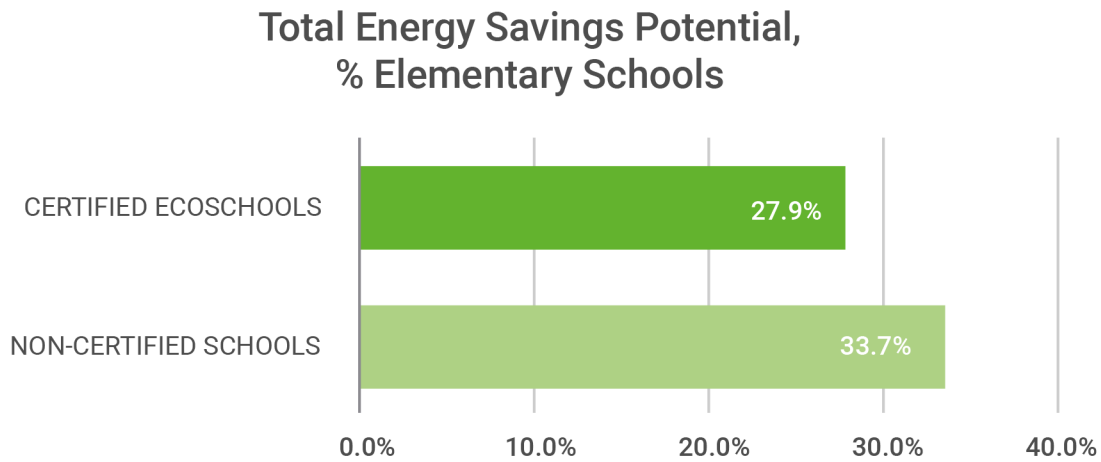
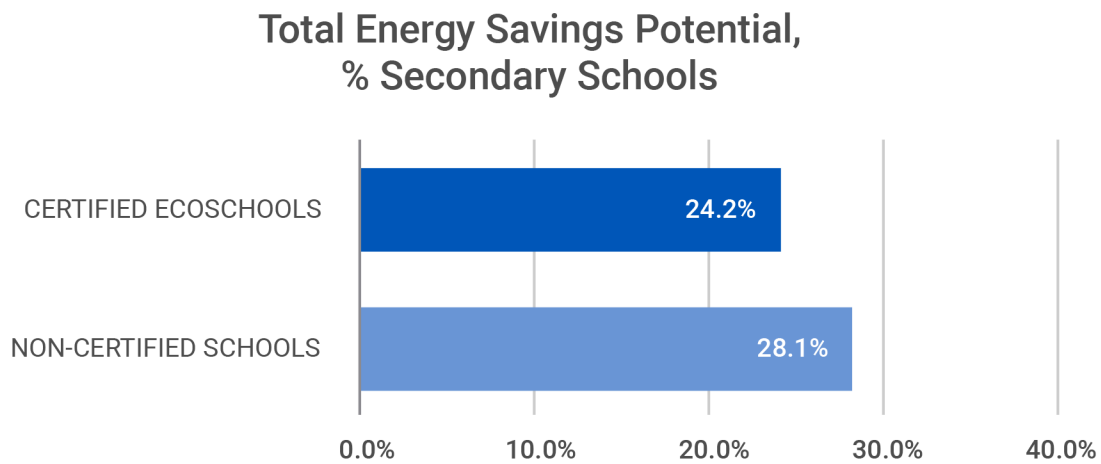


Figure 2 Total energy savings potential of secondary schools



Comparing energy savings potential: Gas and electricity

For elementary schools, certified EcoSchools are more efficient gas users (have lower gas savings potential) than non-certified elementary schools (Figure 3). They are almost as efficient as non-certified elementary schools when it comes to electricity use (Figure 5).

For secondary schools, certified EcoSchools are more efficient gas users (have lower gas savings potential) (Figure 4), but are less efficient electricity users (have higher electricity savings potential) than non-certified secondary schools (Figure 6).

Figure 3 Gas savings potential of elementary schools

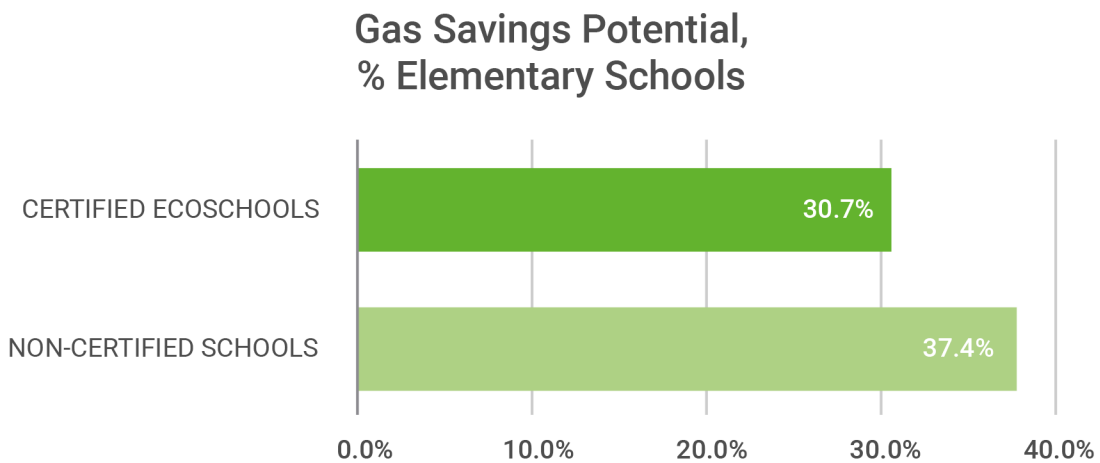


Figure 4 Gas savings potential of secondary schools

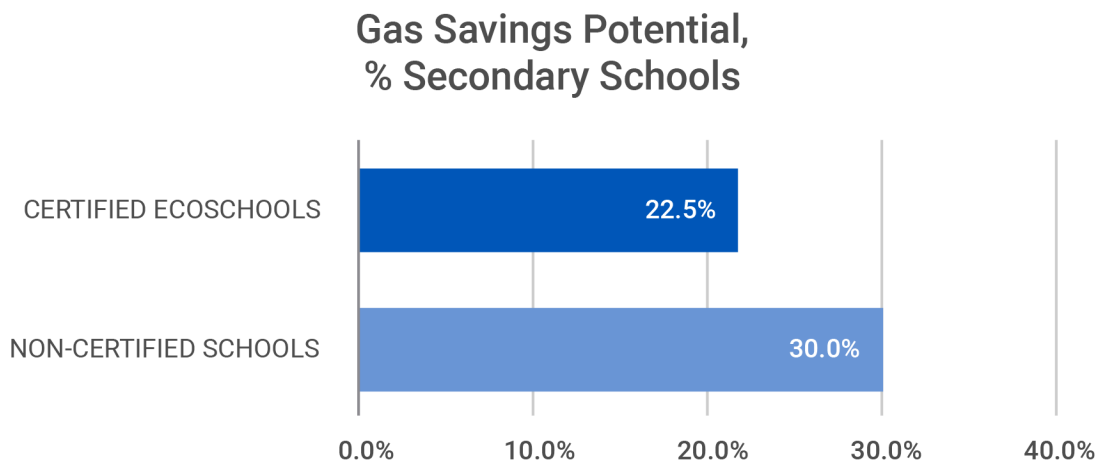


Figure 5 Electricity savings potential of elementary schools

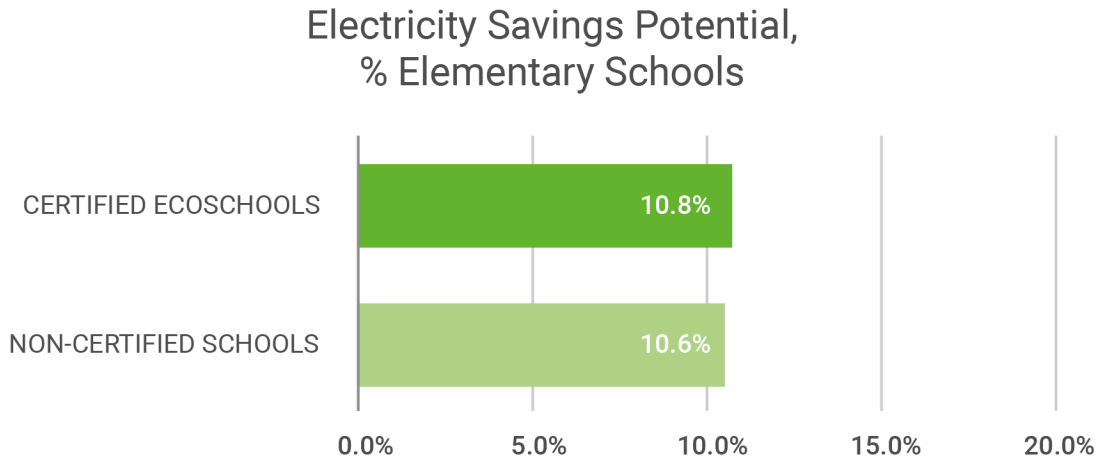
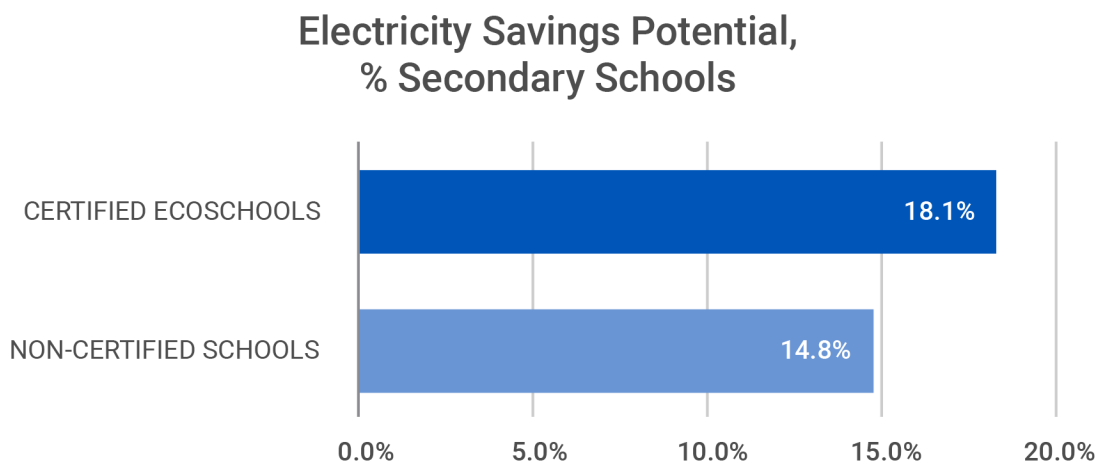


Figure 6 Electricity savings potential of secondary schools



Reducing greenhouse gas emissions

If non-certified schools performed as well as certified EcoSchools, they would use less energy and decrease their greenhouse gas emissions. On average, a non-certified elementary school could avoid 12 tonnes of greenhouse gas emissions if it performed as well as an elementary certified EcoSchool. Meanwhile, a non-certified secondary school could avoid over 52 tonnes of emissions per year if they performed as well as a secondary certified EcoSchool. The decrease would mostly come from more efficient gas use. If carbon footprint reduction is a priority, 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 settings in winter.

Table 1 Average GHG emissions (CO2e) savings potential comparison

	Average GHG Emission Savings Potential (tonnes CO2e), per school					
	Electricity		Natural Gas		Total Energy	
	Elementary	Secondary	Elementary	Secondary	Elementary	Secondary
Non-certified schools	4.5	11.3	45.1	138.3	49.6	149.7
Certified EcoSchools	5.1	14.4	32.6	83.1	37.6	97.5
Difference	-0.5	-3.1	12.5	55.2	12.0	52.1

On average, if a non-certified elementary school used energy as efficiently as a certified EcoSchool, it could reduce its greenhouse gas emissions by:

12 tonnes per year

That's equivalent to carbon sequestered by **311 tree seedlings grown for 10 years!**

On average, if a non-certified secondary school used energy as efficiently as a certified EcoSchool, it could reduce its greenhouse gas emissions by:

52.1 tonnes per year

That's equivalent to carbon sequestered by **1,350 tree seedlings grown for 10 years!**

If all non-certified schools performed as well as EcoSchools, overall greenhouse gas emissions would be reduced by an estimated **64,800 tonnes.**

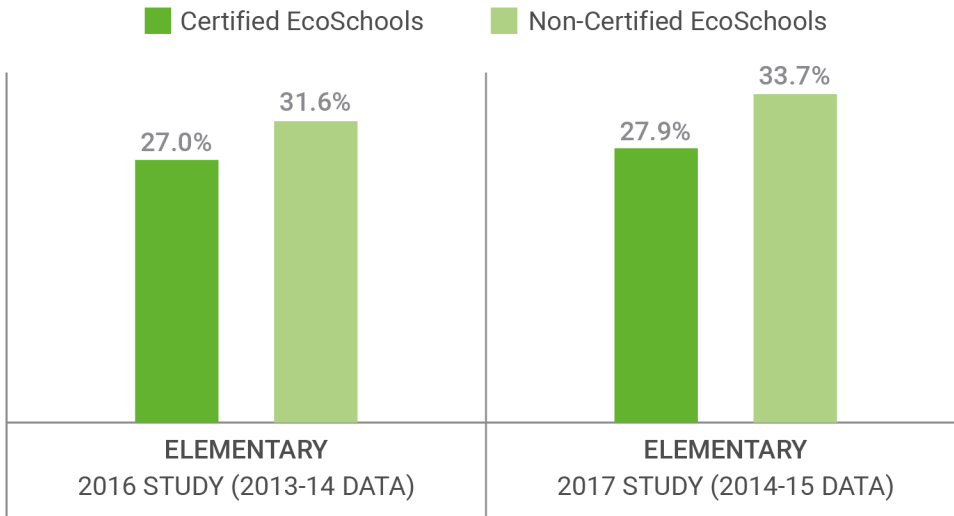
Current study results vs 2016 study results

Results from this Energy Performance Study are very consistent with those of the 2016 report prepared by Enerlife Consulting Inc. for Ontario EcoSchools. In both years, schools from the EcoSchools program proved to be most energy efficient and non-certified schools to be least energy efficient. These results indicate **the EcoSchools certification program has a consistent effect on the energy use of the school buildings certified under the program.**

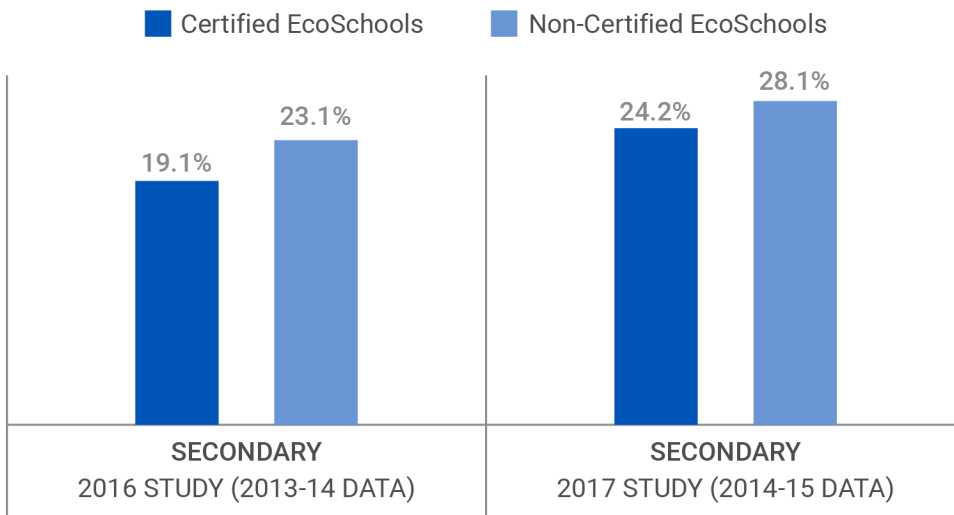
Table 2 Comparing energy % savings potential results from 2016 vs. 2017 study

Average Total Energy % Savings Potential				
	2016 study (2013-14 data)		2017 study (2014-15 data)	
	Elementary	Secondary	Elementary	Secondary
Certified EcoSchools	27.0%	19.1%	27.9%	24.2%
Non-certified schools	31.6%	23.1%	33.7%	28.1%
All schools	30.4%	22.1%	32.1%	27.2%

Total Energy Savings Potential, Elementary Schools, %



Total Energy Savings Potential, Secondary Schools, %



Distribution of energy savings potential by groups of schools

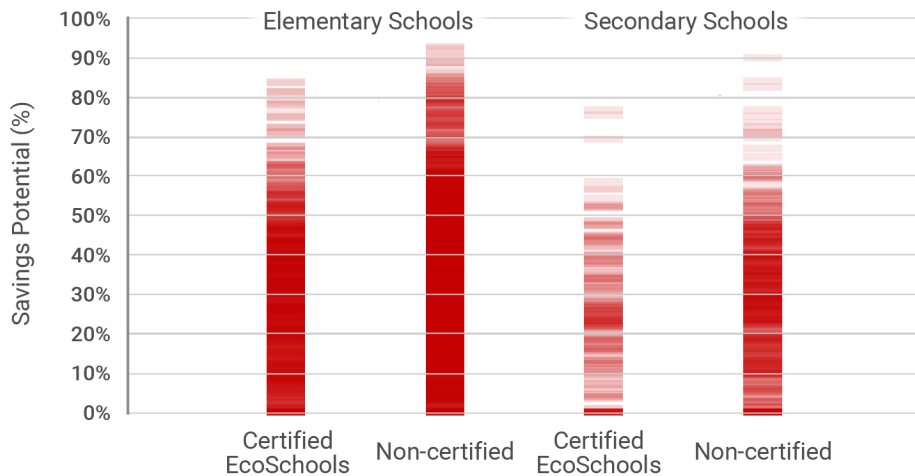
Both electricity and gas energy savings potential varies greatly from school to school, from 0% savings potential (a school is an efficient energy user operating at or under its energy use target) to as high as 70%-80% estimated energy savings potential (a school can potentially save most of its energy use if it achieves its customized target). We have found that non-certified schools are more likely to have outlier facilities with very high estimated energy savings potential. Meanwhile, certified EcoSchools have fewer outliers and fewer extremes of energy inefficiency.

certified EcoSchools with non-certified schools. The range of energy savings potential is wider for the non-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.

These findings are consistent with results from the 2016 Energy Performance Study, which was based on 2013-2014 energy use data.

Figures below illustrate the distribution of total energy % savings potential for each facility. For elementary and secondary schools separately, the graphs compare savings potential of

Distribution of Savings Potential (%) in Elementary and Secondary Schools: Certified EcoSchools vs Non-certified



Conclusions

On average, certified EcoSchools have lower total energy saving potential than non-certified schools (when considering electricity and gas together). We have found that within each group of schools, both electricity and gas energy savings potential varies considerably from school to school. Non-certified schools are more likely to have outlier facilities with very high estimated energy savings potential. Meanwhile, certified EcoSchools have fewer outliers and fewer extremes of energy inefficiency. This indicates a more consistent energy performance between schools, on average, in certified EcoSchools.

Both certified EcoSchools and non-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, such as temperature setpoints and hours of operation, avoiding simultaneous heating and cooling (during spring and fall months), and adopting lower temperature settings in winter. Finally, 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.



APPENDIX A: Methodology

Data sources

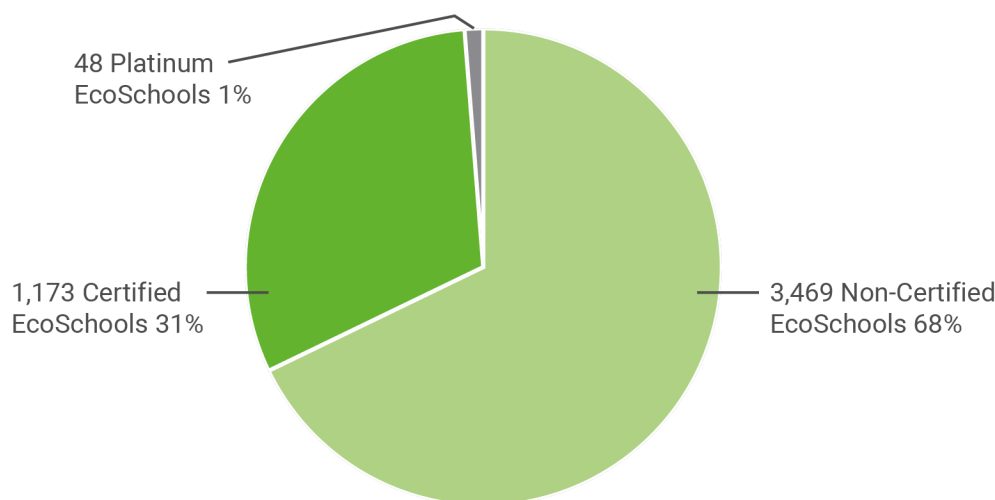
All public Ontario school boards are required to report energy use (electricity, gas and other thermal energy) for their facilities, on an annual basis. This data forms the basis of the Top Energy Performing School Boards analysis that Enerlife undertakes annually with the Toronto and Region Conservation Authority, as part of the Sustainable Schools program (the “Sustainable Schools dataset”). The Sustainable Schools dataset used in this study contains 2014-2015 energy use data submitted in the fall of 2016 by 71 Ontario school boards (5,000 facilities in total). After data matching and cleaning, we analysed the energy performance of a total 4,690 schools, of which 3,921 are elementary schools and 769 are secondary schools.

Of these schools, 1,221 are certified EcoSchools, with 48 Platinum certified EcoSchools. 2014-2015 certification data, provided by the Ontario EcoSchools program, was matched with the Sustainable Schools dataset of energy use.

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

Figure 7 Dataset overview

Sustainable Schools and Ontario EcoSchools Datasets



¹Private schools are not required to report their energy use to the Ministry of Energy, so they are not included in this study.

²Toronto District School Board schools were not included in the study since they don't report directly to Ontario EcoSchools.

Data processing

Energy use intensity (EUI) of each facility (ekWh/sf) is defined as a facility's total energy use over 12 months period (sum of electrical and gas/thermal energy use both converted to equivalent kilowatt-hours) divided by the facility's area (in square feet).

$$\begin{array}{rcccl}
 \text{Electricity} & & & & \\
 \text{(kilowatts-hours kWh,} & + & \text{Gas \& Other Thermal} & & \\
 \text{over 1 year)} & & \text{(equivalent kilowatts-hours} & & \\
 & & \text{ekWh, over 1 year)} & & \\
 \hline
 & & \text{Facility Area} & = & \text{Energy Use} \\
 \text{(Square feet, sf)} & & & & \text{Intensity (EUI)} \\
 & & & & \text{(ekWh/sf)}
 \end{array}$$

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 portable classrooms, heating system type, and presence of swimming pools.

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

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-certified facilities with energy savings potential of certified EcoSchools. **The smaller**

a facility's average energy savings potential (in percentage terms), the better its relative energy performance.

For more information on methodology used to estimate the energy savings potential for Ontario schools, please see the Methodology White Paper which accompanies the 2017 Top Energy Performing School Boards Report. This report was based on 2014-2015 school year data.

APPENDIX B: Statistical Analysis

t-Test: Two-Sample Assuming Unequal Variances
for EcoSchools-certified **elementary schools** vs.
non-certified elementary schools

	Variable 1	Variable 2
Mean	0.279126	0.33654
Variance	0.033876	0.037764
Observations	1030	2891
df	1902	
t Stat	-8.46961	
P(T<=t) two-tail	4.85E-17	

$P < 0.05$, therefore there is a significant difference in total energy saving potential between EcoSchools-certified elementary schools vs. non-certified elementary schools.

t-Test: Two-Sample Assuming Unequal Variances for
EcoSchools-certified **secondary schools** vs. non-certified
secondary schools

	Variable 1	Variable 2
Mean	0.240987336	0.28173563
Variance	0.026302664	0.029873025
Observations	192	577
df	346	
t Stat	2.965838442	
P(T<=t) two-tail	0.003228299	

$P < 0.05$, therefore there is a significant difference in total energy saving potential between EcoSchools-certified secondary schools vs. non-certified secondary schools.

References

Sustainable Schools. (2017). 2017 Top energy performing school boards report.
Retrieved from <http://sustainableschools.ca/wp-content/uploads/2017/06/2017-SUS-Top-Energy-Performing-Boards-report-1.pdf>

Sustainable Schools. (2017). Sustainable schools top boards report: Methodology white paper.
Retrieved from http://sustainableschools.ca/wp-content/uploads/2013/07/Top-Boards-Report-White-Paper-June-2017_final.pdf

