



# Energy Conservation & Demand Management Plan

2019 - 2023



1001 Fanshawe College Blvd  
London Ontario

[www.fanshawec.ca](http://www.fanshawec.ca)



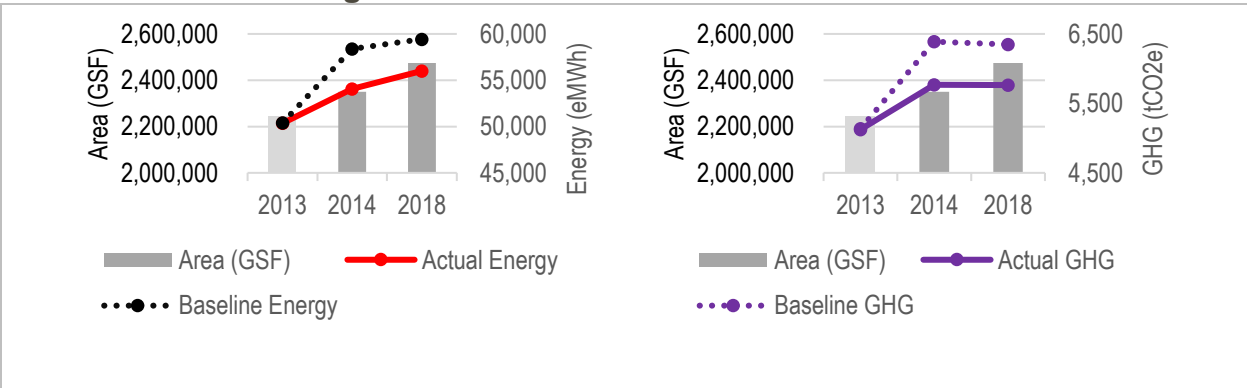
# Executive Summary

This Energy Conservation and Demand Management (ECDM) Plan (the “Plan” or ECDM-2019) is written in accordance with sections 4, 5, and 6 of O. Reg. 507/18, of the recently amended Electricity Act, 1998.

The first iteration of the Plan (ECDM-2014) projected avoidances of 10% in total energy consumption and Greenhouse Gas (GHG) emissions and 7% in peak electrical, over ECDM-2014’s baseline. During the five years of the ECDM-2014 (2014-2018), the College invested \$5.5 million (\$7.5 million before incentives) in energy & GHG conservation measures. **The impact of these measures represent a near doubling of these targets, with avoidances of 19.5% in total energy consumption, 18.7% in GHG emissions, and 12.8% in peak electrical demand, over ECDM-2014 baseline!** Refer to page 16 for details.

In 2018, overall avoidances of 5.8% in energy consumption and 9.2% in GHG emissions were achieved based on comparison of Baseline (ECDM-2014 baseline corrected to 2018 variables) with measured Actuals for 2018. This analysis looks at the performance of the College as a whole, independent of EMOs implemented, and provides an indication of whether other factors have affected performance. See Figure 1 below for details.

**Figure 1: Avoidance ECDM-2014 Baseline**



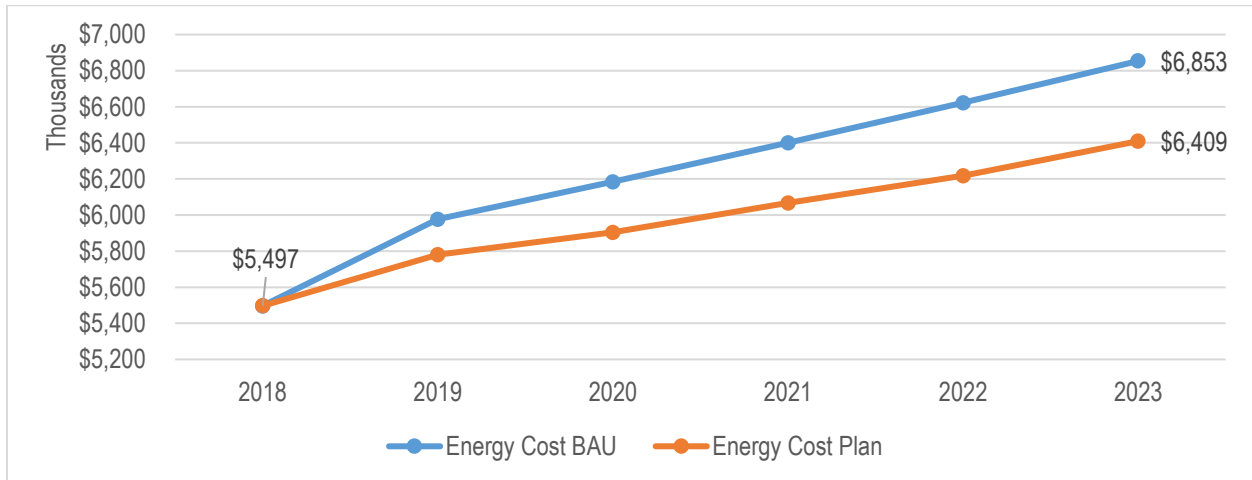
To further these energy conservation initiatives, the College has recently completed an ASHRAE Level 1 Energy Audit (EA-2018), as part of its Greenhouse Gas Reduction Roadmap (G-RRAP) and GHG Inventory of Scope 1, 2 & 3 GHG emissions. The results of this energy audit have formed the basis and details of Energy Management Opportunities (EMOs) identified in this Plan, along with EMOs from prior comprehensive Energy Audit completed in 2013 (EA-2013).

ECDM-2019 projects a 10% avoidance in energy consumption and 14% avoidance in GHG emissions in the final year of the Plan (2023), over ECDM-2019 Baseline (2023 Projected). Initiatives implemented to meet these objectives require an investment of \$10.21 million, which will be offset by \$5.89 million in provincial GHG grant funding and incentives of \$467,000, for a total “out of pocket” expense to the College of \$3.85 million. With a total cost avoidance of

\$4.38 million over 10 years, the initiatives will pay for themselves in just over 8 years. In addition to energy and GHG avoidances, \$1.39 million in deferred maintenance will be addressed within the measures identified.

Business as usual (BAU) projections indicate that the College's annual energy costs will rise from \$5.5 million in 2019 to \$6.85 million in 2023. This increase is due to projected College growth, and increase in electrical costs over general inflation. It is estimated that implementation of the Plan will decrease additional budget required by \$444,000, to \$6.4 million in 2023 due to decrease in purchased electricity and natural gas. See Figure 2 for details.

**Figure 2: Energy Cost BAU vs Plan**



This Plan is a living document. Periodic review and updates will take place to confirm approved budgets are adequate to meet expenditures required. Funding opportunities will be pursued to augment implementation of initiatives, as may be required to meet objectives.

This Plan fulfills the College's regulatory requirements under the Electricity Act, 1998, provides a roadmap for stabilizing and reducing overall operational costs as energy prices increase, and promotes a high-performing and sustainable college.

# Contents

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- I. **Executive Summary** ..... 2
  - Figure 1: Avoidance ECDM-2014 Baseline..... 2
  - Figure 2: Energy Cost BAU vs Plan ..... 3
- II. **Contents**..... 4
- III. **Plan Information** ..... 7
  - Regulatory Requirements & Updates..... 7
  - Plan Details & Scope ..... 7
  - Time Period..... 8
  - Development Team..... 8
  - Plan Access ..... 8
- IV. **Background Energy Information** ..... 9
  - Fanshawe College..... 9
  - Table 1: Facility Area..... 9
  - Energy Information 2005 - 2017 ..... 10
  - Figure 3: Energy Cost Avoidance over 2005 Baseline..... 10
  - Figure 4: GHG Avoidance over 2005 Baseline..... 10
  - Figure 5: Energy Trend 2005-2017 ..... 12
  - Figure 6: GHG Trend 2005-2017..... 12
  - Figure 7: Energy Cost Trend 2005-2017 ..... 12
  - Figure 8: Energy, GHG & Cost Intensity Trend 2005-2017..... 13
  - Energy Information 2018 ..... 13
  - Figure 9: 2018 Energy Use by Campus ..... 14
  - Figure 10: 2018 Campus Energy Use by Source ..... 14
  - Figure 11: 2018 Campus GHG Emissions by Source ..... 14
  - Figure 12: 2018 Campus Cost by Source Summary..... 15
  - Figure 13: 2018 Energy Consumption by Source ..... 15
  - ECDM Plan 2014-2018 Results..... 16
  - Figure 14: ECDM-2014 Top 10 Energy Initiatives..... 17
  - Figure 15: ECDM-2014 Top 10 GHG Initiatives ..... 17
  - Figure 16: ECDM-2014 Results - Net Energy ..... 18
  - Figure 17: ECDM-2014 Results - Net GHG Emissions..... 18
  - Energy Baseline ECDM-2019..... 19
  - Table 2: Energy & GHG Baseline..... 19

|      |   |           |
|------|---|-----------|
|      | Figure 18: 2016-2018 Fanshawe Trend .....                         | 20        |
|      | Figure 19: 2016-2018 Campus Group Trend .....                     | 20        |
| V.   | <b>Energy Objectives and Targets .....</b>                        | <b>21</b> |
|      | Vision, Mission, Values & Goals .....                             | 21        |
|      | Energy and GHG Targets.....                                       | 22        |
|      | Table 3: Plan Projections Summary .....                           | 22        |
|      | Figure 20: Energy Avoidance by Category and Approval Status ..... | 23        |
|      | Figure 21: GHG Avoidance by Category and Approval Status.....     | 23        |
|      | Figure 22: Cost Avoidance by Category and Approval Status.....    | 23        |
| VI.  | <b>Plan of Action.....</b>  | <b>24</b> |
|      | Business as Usual.....  | 24        |
|      | Figure 23: Energy Cost BAU vs Plan.....                           | 24        |
|      | Approved Initiatives (2019 – 2020).....                           | 24        |
|      | Table 4: Approved Initiatives (2019 - 2020) .....                 | 25        |
|      | Pending Approval Initiatives (2021 – 2023) .....                  | 25        |
|      | Table 5: Pending Approval Initiatives (2021 – 2023) .....         | 25        |
|      | Initiative Priority and Category .....                            | 26        |
|      | Table 6: Initiative Prioritization and Categories.....            | 26        |
|      | Year 1 (2019) .....   | 27        |
|      | Table 7: Year 1 Initiatives (2019).....                           | 27        |
|      | Year 2 (2020) .....   | 27        |
|      | Table 8: Year 2 Initiatives (2020).....                           | 28        |
|      | Years 3-5 (2021-2023) .....                                       | 28        |
|      | Table 9: Years 3-5 Initiatives (2021-2023) .....                  | 29        |
|      | Capital Projects (Conservation and Renewable Energy): .....       | 29        |
|      | Table 10: Capital Projects.....                                   | 30        |
|      | Retro-Commissioning (RCx) & Controls: .....                       | 30        |
|      | Table 11: RCx Projects.....                                       | 31        |
|      | Energy Management Information System (EMIS): .....                | 31        |
|      | Energy Auditing & Cost Control:.....                              | 31        |
|      | College Community Awareness & Training: .....                     | 31        |
|      | Energy Team:.....   | 32        |
| VII. | <b>Implementation Budget &amp; Plan Life Cycle Analysis.....</b>  | <b>33</b> |
|      | Table 12: Annual Implementation Budget (\$ x 1,000) .....         | 33        |

|       |  |           |
|-------|--|-----------|
|       | Table 13: Annual Energy and GHG Avoidance .....              | 34        |
|       | Figure 24: Plan Life Cycle Costing.....                      | 35        |
| VIII. | <b>Keys to Success &amp; Verification .....</b>              | <b>36</b> |
| IX.   | <b>Conclusion .....</b>                                      | <b>37</b> |
| X.    | <b>Appendix-A: Facility Information.....</b>                 | <b>38</b> |
|       | Table A-1: Facility Info .....                               | 38        |
|       | Table A-2: Activity Code.....                                | 39        |
| XI.   | <b>Appendix-B: Energy Usage.....</b>                         | <b>40</b> |
|       | Table B-1: 2017 Usage Data.....                              | 40        |
|       | Table B-2: 2018 Usage Data.....                              | 41        |
| XII.  | <b>Appendix-C: Renewable Energy Generation .....</b>         | <b>42</b> |
|       | Existing Renewable Energy .....                              | 42        |
|       | Table C-1: Renewable Energy (Existing).....                  | 42        |
|       | Renewable Energy Capital Projects: .....                     | 43        |
|       | Table C-2: Renewable Energy (Future) .....                   | 43        |
|       | Renewable Energy Research and Education:.....                | 44        |
| XIII. | <b>Appendix-D: Glossary of Terms &amp; Conversions .....</b> | <b>45</b> |

# Plan Information

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## Regulatory Requirements & Updates

On January 1, 2012, Ontario Regulation 397/11 made under the Green Energy Act, 2009 came into effect. This regulation required all public agencies to report on annual energy use and GHG emissions beginning in July of 2013 (for calendar year 2011), and required development of five-year energy conservation and demand management plans starting in July 2014.

In December of 2018, the Ontario Government passed Bill 34 (Green Energy Repeal Act, 2018). This bill repealed the Green Energy Act, and associated regulations, including O. Reg. 397/11. On January 1, 2019, O.Reg. 397/11 was officially repealed.

On December 14, 2018, Ontario Regulation 507/18 (Broader public sector: energy reporting and Conservation and Demand Management Plans) (the “Regulation”) was filed under the Electricity Act, 1998. This regulation replaces O. Reg. 397/11.

This Energy Conservation and Demand Management (ECDM) Plan (the “Plan”) is written in accordance with sections 4, 5, and 6 of O. Reg. 507/18.

## Plan Details & Scope

The Regulation requires the following elements to be included in the Plan<sup>1</sup>:

- i. information on the public agency’s annual energy consumption during the last year for which complete information is available for a full year (2018 for the purposes of this Plan),
- ii. the public agency’s goals and objectives for conserving and otherwise reducing energy consumption and managing its demand for energy,
- iii. the public agency’s proposed measures under its energy conservation and demand management plan,
- iv. cost and saving estimates for its proposed measures,
- v. a description of any renewable energy generation facility operated by the public agency and the amount of energy produced on an annual basis by the facility,
- vi. a description of,
  - a. the ground source energy harnessed, if any, by ground source heat pump technology operated by the public agency,
  - b. the solar energy harnessed, if any, by thermal air technology or thermal water technology operated by the public agency, and
  - c. the proposed plan, if any, to operate heat pump technology, thermal air technology or thermal water technology in the future,
- vii. the estimated length of time the public agency’s energy conservation and demand management measures will be in place, and

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<sup>1</sup> O. Reg. 507/18, Section 6 (1) (c).



- viii. confirmation that the energy conservation and demand management plan has been approved by the public agency's senior management.

## **Time Period**

- Publication: July 1, 2019
- Term: January 1, 2019 – December 31, 2023 (5 years)
- Plan Life Cycle: January 1, 2019 – December 31, 2028 (10 years). The Plan Life Cycle is the 10-year period starting at commencement of the Term. Plan Life Cycle is used to calculate total energy avoidances and net investment value at the end of the 10-year period.
- EMO Life Cycle: Unless noted otherwise, Energy Management Opportunity (EMO) initiatives identified in this Plan are anticipated to be in place for a minimum of 10 years.

## **Development Team**

- Executive Sponsor: Peter Gilbert – Chief Infrastructure Officer, Facilities and IT Services
- Author: Nathan Gerber, ASCT, CEM, CMVP – Energy Coordinator, Campus Planning & Capital Development
- Contributors: Shawn Harrington – Director, Campus Planning & Capital Development  
Ivan Walker – Senior Manager, Facilities Operations & Sustainability  
Michelle Cong – Sustainability Coordinator, Facilities Operations & Sustainability
- Approval: Jenny Ruz – Vice President, Finance and Administration

## **Plan Access**

As required under the Regulation, the Plan is required to be publically available. This Plan is on the College's website at <https://www.fanshawec.ca/ecdm-plan>.

## Background Energy Information

### Fanshawe College

The Fanshawe College of Applied Arts and Technology (the “College” or “Fanshawe”) operates out of 34 buildings, at 16 sites in the counties of Middlesex, Oxford, Elgin, Norfolk and Huron, totaling over 2.5 million square feet of gross floor area. The London Campus, 1001 Fanshawe College Blvd site accounts for approximately 71% of this total. Table 1 provides a summary of College owned and leased facilities as of January 1, 2019. The College is in process of establishing a London South Campus (leased facility) at 1060 Wellington Rd S., London as well as new leased facility at 45 Metcalfe St., Woodstock, which are anticipated to come online by fall of 2019. Other facilities that the College currently leases but do not directly purchase utilities for are not included in the scope of this Plan. Refer to Appendix-A for further details.

**Table 1: Facility Area<sup>2</sup>**

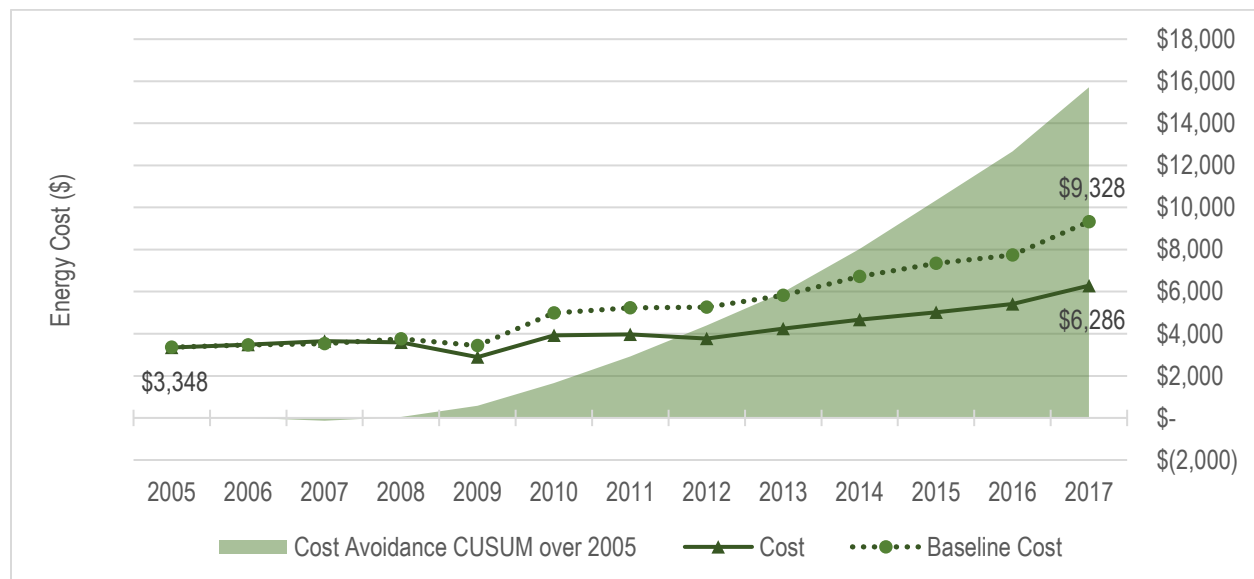
| Owned / Leased     | Site Address                       | Area % of Total | Area GSF         | Buildings per Site |
|--------------------|------------------------------------|-----------------|------------------|--------------------|
| <b>OWN</b>         | 1001 Fanshawe College Blvd, London | 71.1%           | 1,815,296        | 19                 |
|                    | 1764 Oxford St, London             | 5.9%            | 149,866          | 1                  |
|                    | 900 Fanshawe College BLVD, London  | 5.3%            | 134,625          | 1                  |
|                    | 130 Dundas St., London             | 4.5%            | 116,000          | 1                  |
|                    | 1001 Air Ontario Blvd, London      | 3.2%            | 81,400           | 1                  |
|                    | 137 Dundas St, London              | 2.3%            | 58,598           | 1                  |
|                    | 2 Cuddy Crt, London                | 1.8%            | 45,456           | 1                  |
|                    | 120 Bill Martyn Pkwy, St. Thomas   | 1.8%            | 45,132           | 1                  |
|                    | 2555 Bonder Rd, London             | 1.5%            | 37,039           | 1                  |
|                    | 634 Ireland Rd, Simcoe             | 1.2%            | 31,774           | 1                  |
|                    | 28443 Centre Rd, Strathroy         | 0.3%            | 6,501            | 1                  |
| <b>OWN Total</b>   |                                    | <b>98.7%</b>    | <b>2,521,687</b> | <b>29</b>          |
| <b>LEASE</b>       | 369 Finkle St, Woodstock           | 0.7%            | 17,674           | 1                  |
|                    | 431 Richmond St., London           | 0.3%            | 7,632            | 1                  |
|                    | 417 Wellington St., St. Thomas     | 0.1%            | 2,807            | 1                  |
|                    | 155 Clarke Rd., London             | 0.1%            | 2,535            | 1                  |
|                    | 33 St. David St., Goderich         | 0.1%            | 1,500            | 1                  |
| <b>LEASE Total</b> |                                    | <b>1.3%</b>     | <b>32,148</b>    | <b>5</b>           |
| <b>Grand Total</b> |                                    | <b>100.0%</b>   | <b>2,553,835</b> | <b>34</b>          |

2 Current as of commencement of Plan Publication (July 1, 2019)

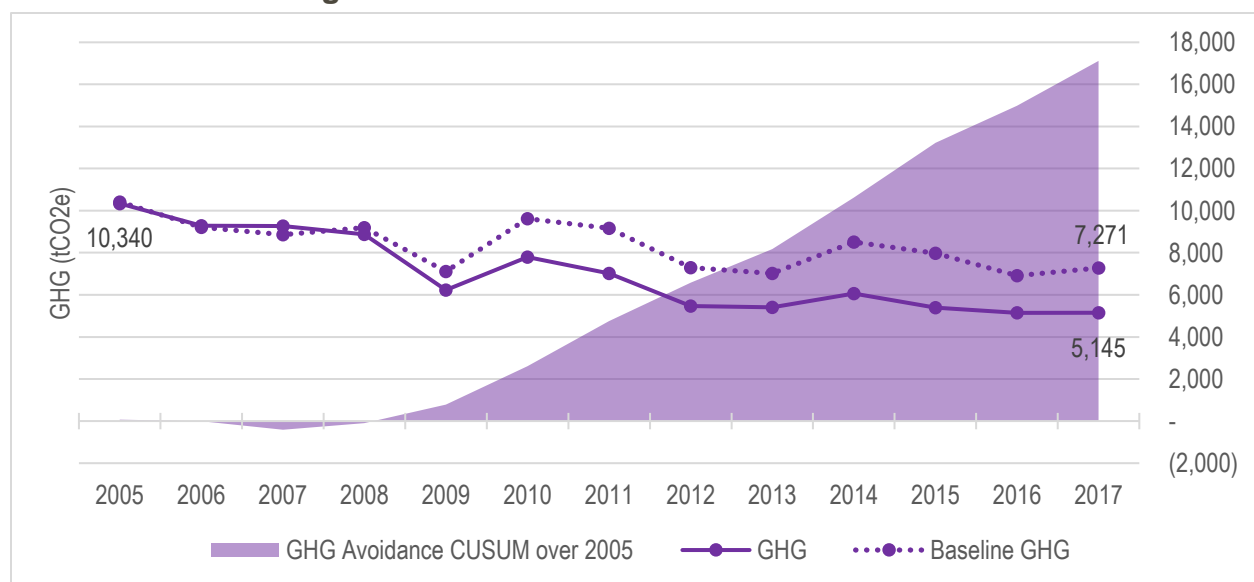
## Energy Information 2005 - 2017

Energy conservation has been a focus of Fanshawe for more than three decades. Between 2005-2017, the period for which data is available, the College has invested in energy conservation and demand management initiatives, as well as onsite renewable energy generation. During this timeframe, these initiatives have resulted in avoidances of approximately \$15 million in energy cost and of GHG emissions by 17,000 tCO<sub>2</sub>e, the equivalent to removing 3,200 cars or light trucks from use for one year. This represents an avoided energy cost of \$3 million and GHG emissions of 2,100 tCO<sub>2</sub>e in 2017 over 2005 baseline levels. Refer to Figure 3 and 4 for details.

**Figure 3: Energy Cost Avoidance over 2005 Baseline**



**Figure 4: GHG Avoidance over 2005 Baseline**



In 2005, the College consumed 53,599 equivalent MWh (eMWh) of energy, comprised of 30,845 MWh and 2,198,469 m<sup>3</sup> of electricity and natural gas respectively. GHG emissions were 10,340 tCO<sub>2</sub>e. The total average area during that timeframe was approximately 1.7 million gross square feet (GSF) for an Energy Use Intensity (EUI) of 0.030 eMWh/GSF. Total energy costs were \$3.35 million for an Energy Cost Intensity (ECI) of around \$1.92/GSF.

In 2017, the College consumed 50,260 eMWh of energy, comprised of 28,234 MWh and 2,123,869 m<sup>3</sup> of electricity and natural gas respectively, and estimated 44 eMWh in on-site Solar and Thermal renewable energy. GHG emissions were 5,145 tCO<sub>2</sub>e. The total average area during that timeframe was approximately 2.4 million GSF, for an EUI of 0.0208 eMWh/GSF. Total energy costs were \$6.29 million for an Energy Cost Intensity (ECI) of around \$2.62/GSF.

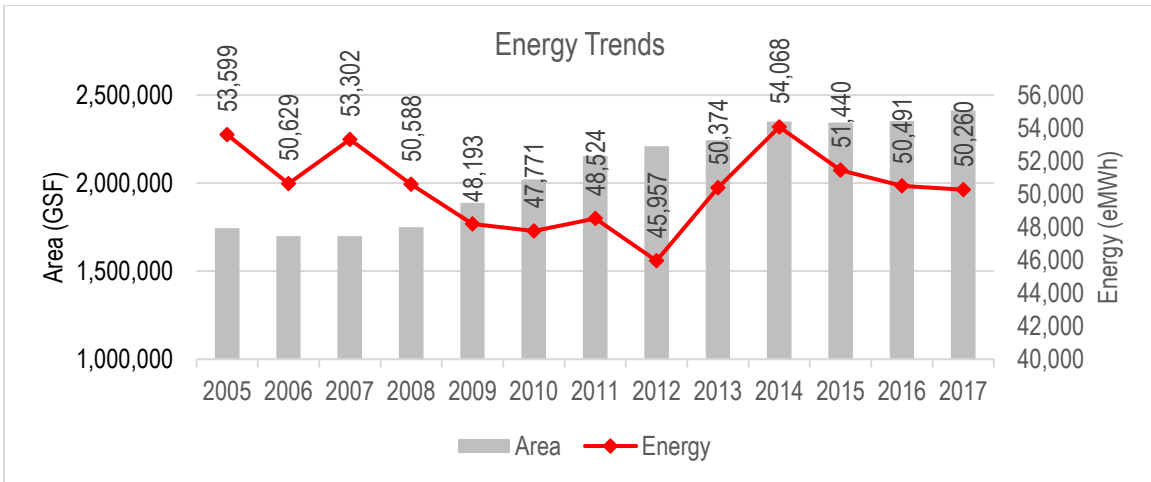
This represents a 31% EUI reduction; however, due to increase in unit cost per unit of energy the total net Energy Cost Intensity (ECI) increased by around 36% for 2017 compared with 2005. In spite of College growth in GSF of 41%, overall energy usage was reduced by 6.2%.

The College has participated in the Independent Electricity System Operator (IESO) Embedded Energy Manager program since July 2012, and is completing its seventh term ending December 31, 2019. This program, currently provided under the Conservation First Framework (CFF), is in place until December 31, 2020. Fanshawe will continue to pursue this program in 2020 and beyond if extended.

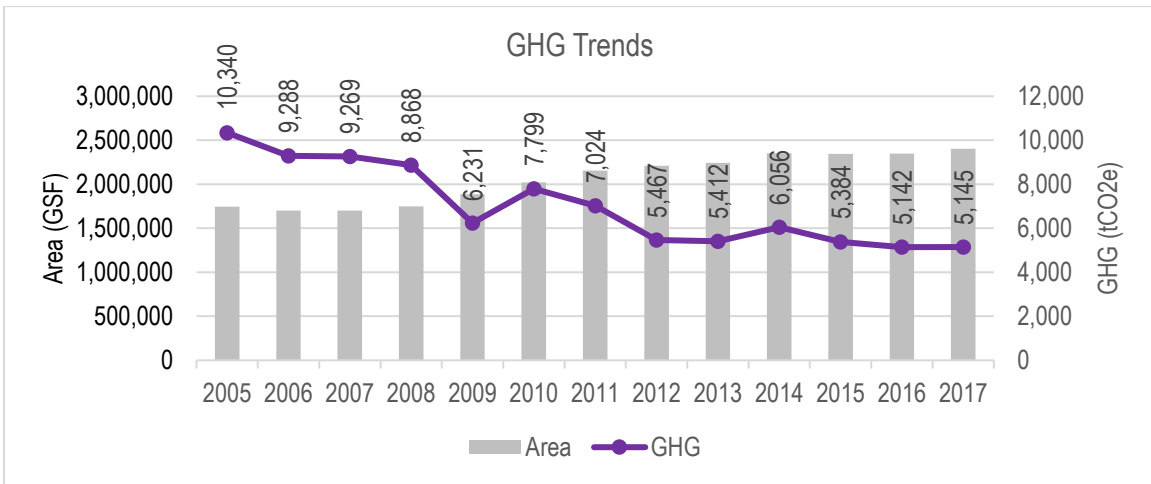
To further these energy conservation initiatives, the College has recently completed an ASHRAE Level 1 Energy Audit (EA-2018), as part of its Greenhouse Gas Reduction Roadmap (G-RRAP) and GHG Inventory of Scope 1, 2 & 3 GHG emissions. This audit assessed just over 2.3 million square feet, at 28 buildings located in London, St. Thomas, Simcoe and Woodstock. The results of this energy audit have formed the basis and details of Energy Management Opportunities (EMOs) identified in this Plan, along with EMOs from prior comprehensive Energy Audit completed in 2013 (EA-2013).

Figures 5, 6, 7 & 8 show energy, GHG, cost and intensity trends from 2005 through 2017.

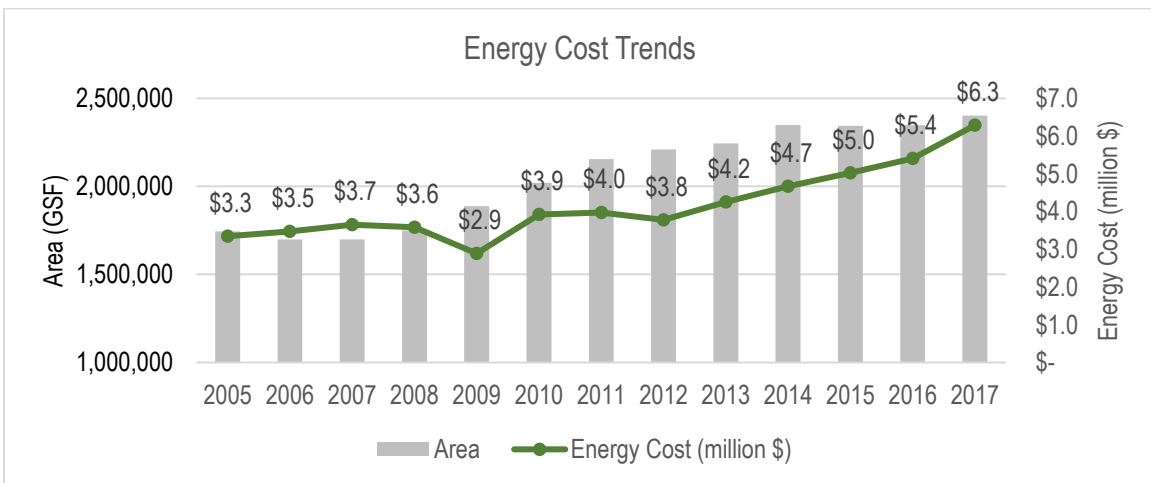
**Figure 5: Energy Trend 2005-2017**



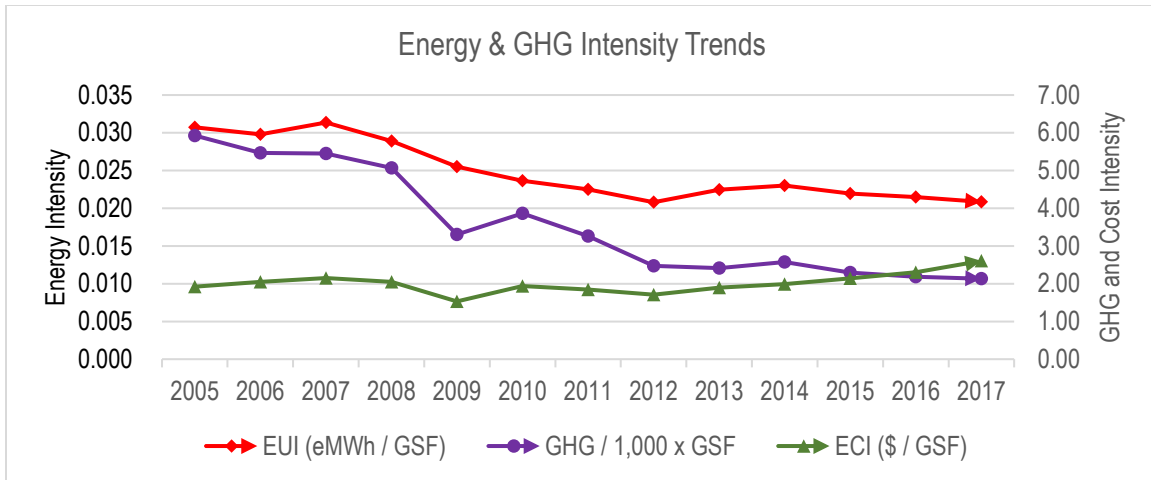
**Figure 6: GHG Trend 2005-2017**



**Figure 7: Energy Cost Trend 2005-2017**



**Figure 8: Energy, GHG & Cost Intensity Trend 2005-2017**



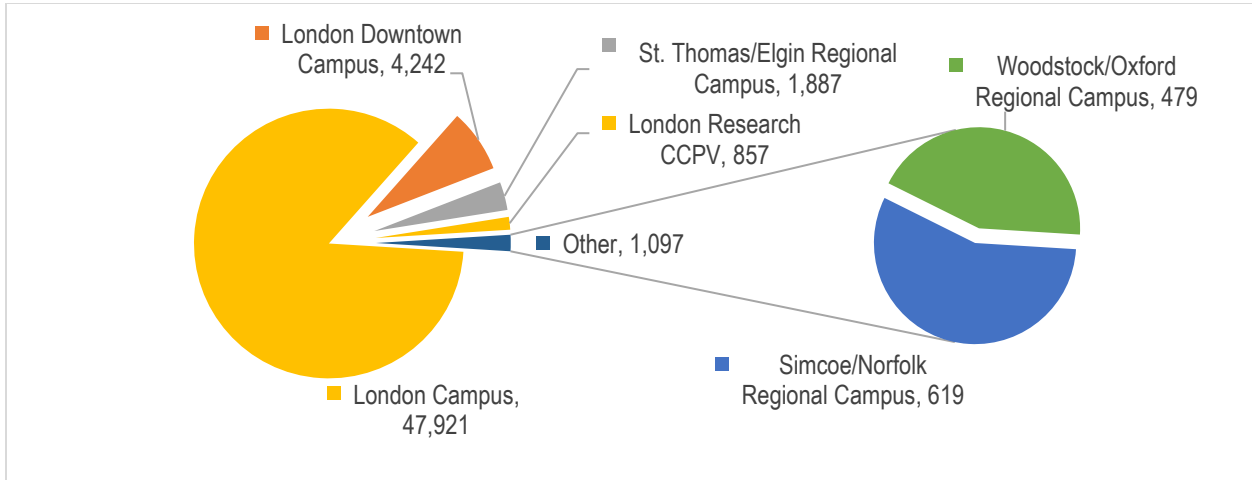
### Energy Information 2018

In 2018, the College consumed 56,005 eMWh of energy, comprised of 31,138 MWh purchased electricity, 100 MWh from onsite renewable Solar PV, 24,744 eMWh in natural gas plus an estimated 23 eMWh in Solar thermal. GHG emissions were 5,765 tCO<sub>2</sub>e. The College’s total average building area that year was 2.47 million GSF for an EUI of 0.0226 eMWh/GSF. During this period, the College offset roughly 123 eMWh of non-renewable energy with onsite renewable energy generation. This included 100 MWh (electrical) in Solar Photo Voltaic (PV) made up of 18 MWh at the St. Thomas/Elgin Campus and , 81 MWh (electrical) on H Building Solar PV (2018 partial data) as well as 23 eMWh (natural gas avoidance) in Solar Hot Water (HW) at “Z” and “J” Building in London. Renewable energy generation accounted for approximately 11 tCO<sub>2</sub>e in GHG emissions avoided annually due to offsets in electrical and natural gas consumption. Refer to Appendix-B & Appendix-C for details.

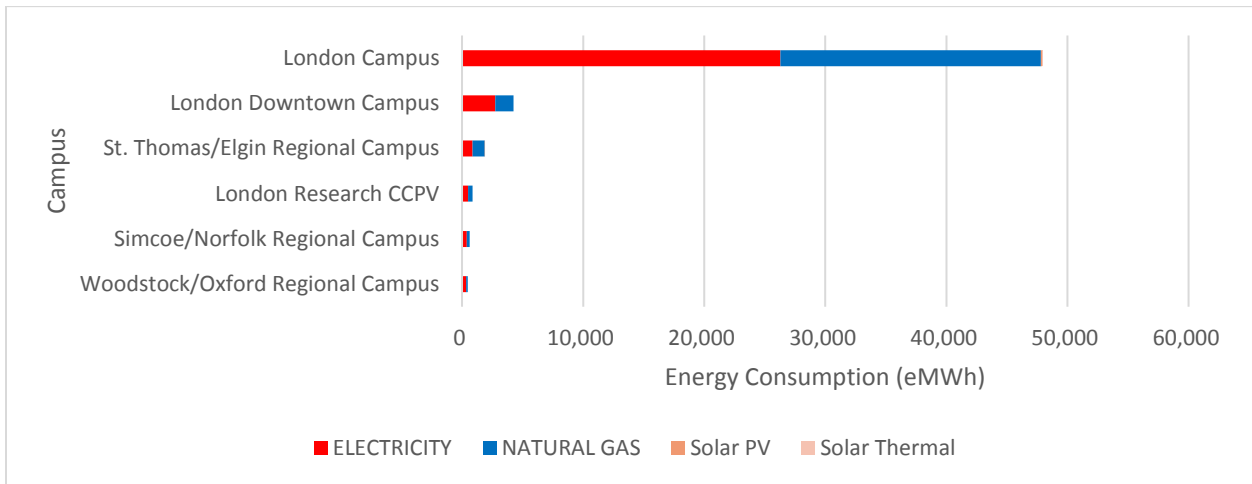
Total energy costs in 2018 were \$5.5 million, comprised of \$4.8 million and \$673,000 in electrical and natural gas respectively, for an ECI of \$2.23/GSF. Cost per unit, for the College, during this timeframe averaged \$133/MWh (\$155/MWh mixed average) electrical and \$0.243/ m<sup>3</sup> (\$0.282/m<sup>3</sup> mixed average) for natural gas.

Figure 9 shows total energy use by campus. Figures 10, 11 & 12 show energy usage, GHG emissions and cost breakdown by energy source at each campus. Figure 13 shows energy consumption by source.

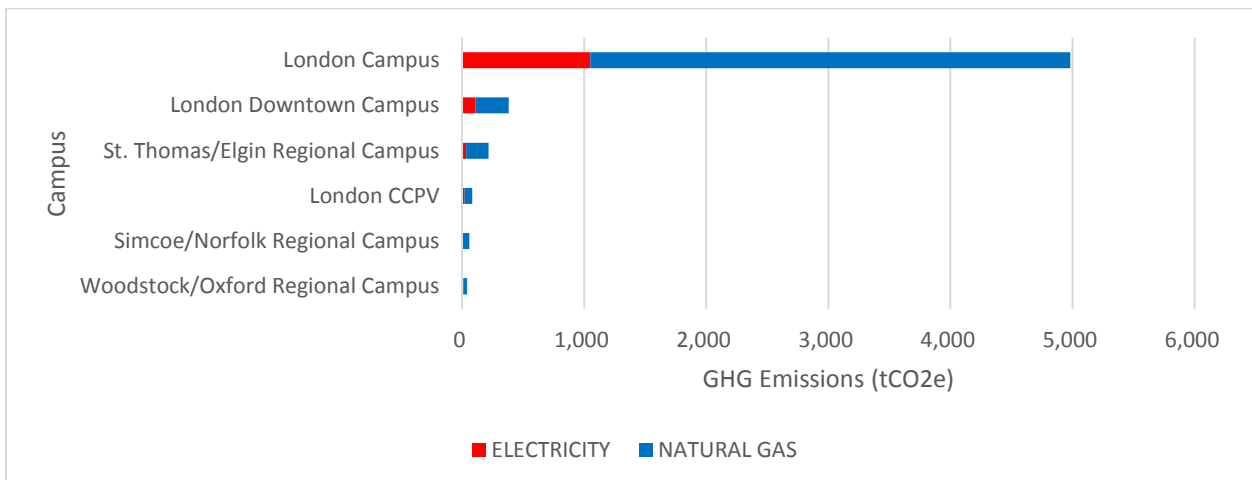
**Figure 9: 2018 Energy Use by Campus**



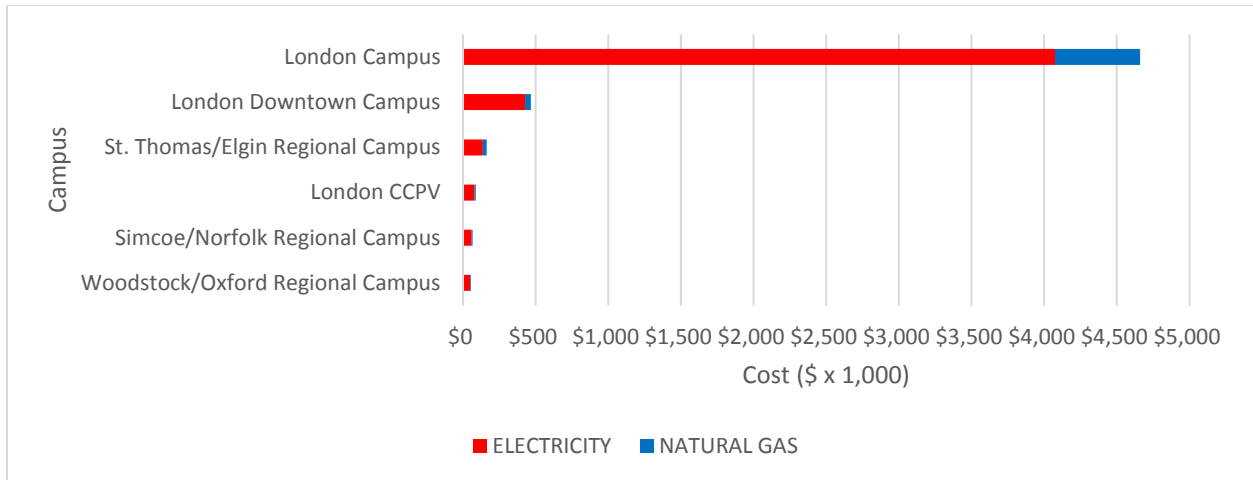
**Figure 10: 2018 Campus Energy Use by Source**



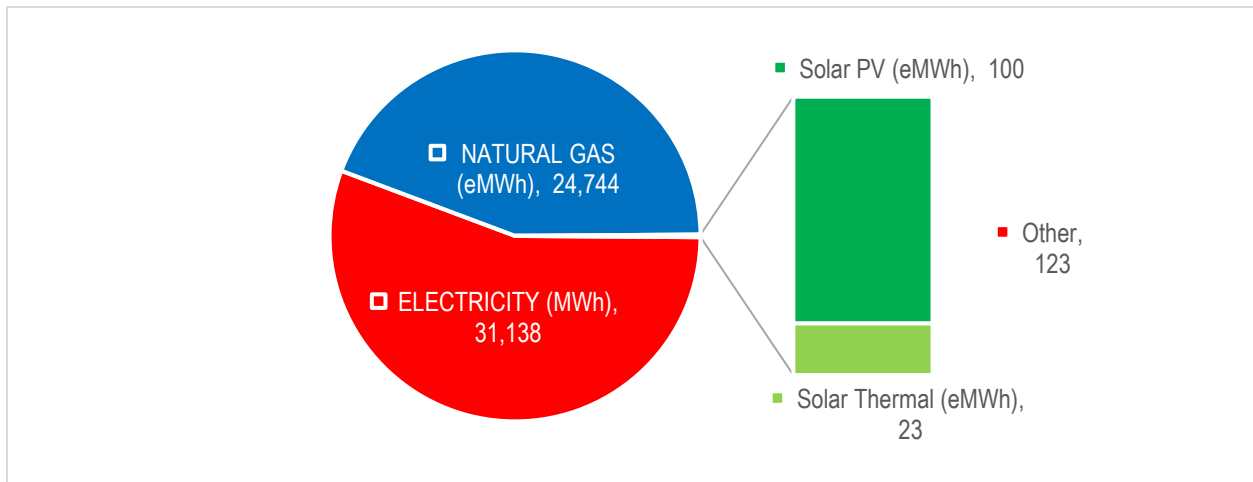
**Figure 11: 2018 Campus GHG Emissions by Source**



**Figure 12: 2018 Campus Cost by Source Summary**



**Figure 13: 2018 Energy Consumption by Source**





## ECDM Plan 2014-2018 Results

In July of 2014, the College published the first iteration of its Plan (ECDM-2014). The term of this plan was from April 2014 through to March 31, 2019. The ECDM-2014 projected a 10% avoidance in total energy and GHG emissions and 7% avoidance in peak electrical, of 5,317 eMWh, 652 tCO<sub>2</sub>e, and 459 kW respectively, over ECDM-2014's baseline.

Based on the results period - the five full calendar years (2014-2018) – the EMOs implemented have contributed to an incremental avoidance of 19.5% energy, 18.7% GHG emissions and 12.8% in demand, of 10,287 eMWh, 1,242 tCO<sub>2</sub>e, and 803 kW respectively over ECDM-2014 baseline. These reductions consist of annual Net electrical and natural gas usage avoidances of 4,469 MWh & 562,134 m<sup>3</sup> respectively, of which 170 eMWh per year is due to offsets related to renewable energy generation. This is equivalent to the energy 346 average households consume, or the amount of GHG emissions 284 cars or light trucks emit, every year.

At a total incremental capital expenditure of \$5.5 million (\$7.5 million before incentives and GHG grant funding), these investments are projected to result in total normalized energy cost avoidances of just under \$1 million per year in the final year. This represents an overall simple payback of just over 5.5 years (7.6 years without incentives).

Initiatives completed include:

- Existing Building Commissioning (EBCx) buildings B, D, H, M and Z.
- Energy upgrades for new building expansions J-Wellness and LD-B (130 Dundas), which improved building performance over baseline minimum code requirements.
- Demand ventilation control in the Centre for Advanced Research and Innovation in Biotechnology (CARIB)
- HVAC Upgrades
- Lighting upgrades
- Heating / cooling plant optimization

In addition to EMO implementation, the Energy Team was established, and meets three times per year aligned with the College's academic semesters (fall, winter, summer). Refer to page 32 for details.

In 2018, overall avoidances of 5.8% in energy consumption and 9.2% in GHG emissions, of 3,429 eMWh and 584 tCO<sub>2</sub>e respectively were achieved. These results are determined by comparing the Baseline<sup>3</sup> with measured Actuals for 2018. The Baseline for 2018 was 59,434 eMWh in energy consumption and 6,349 tCO<sub>2</sub>e in GHG emissions. The Actuals for 2018 were 56,005 eMWh in energy consumption and 5,765 tCO<sub>2</sub>e in GHG emissions. This analysis looks at the performance of the College as a whole, independent of EMOs implemented, and provides indication of whether other factors have affected performance. These results indicate that other variables affected total energy and GHG avoidances than the EMOs implemented. These variables may include new buildings and processes with higher EUI than baseline, controls and

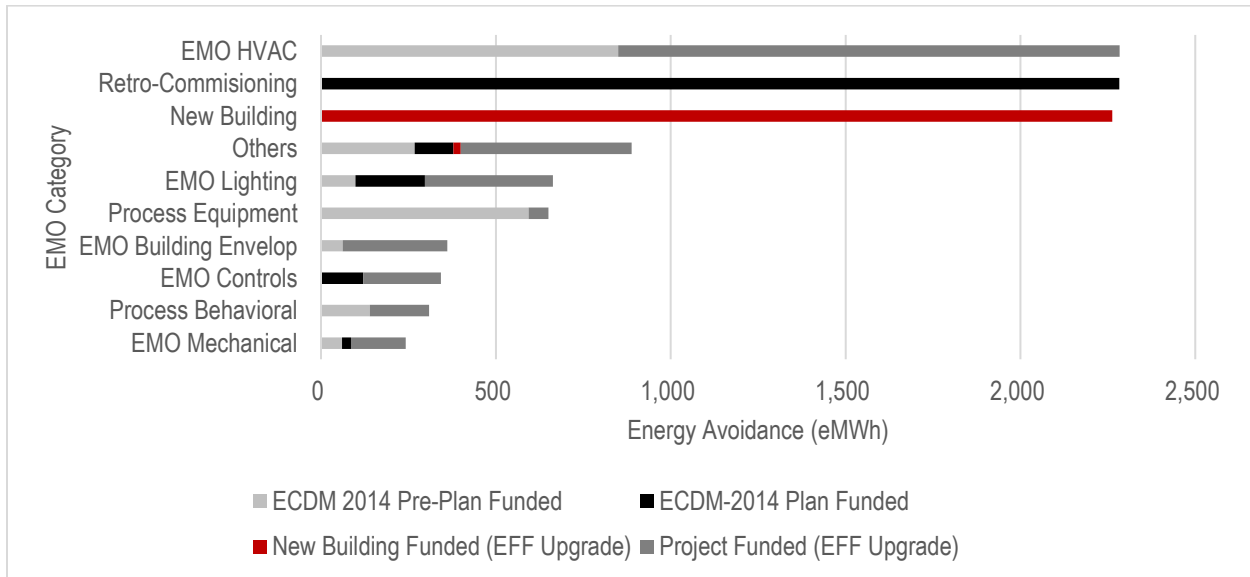
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3 The ECDM-2014 baseline adjusted with 2018 reference year variables such as area (GSF) and weather (cooling and heating degree-days)

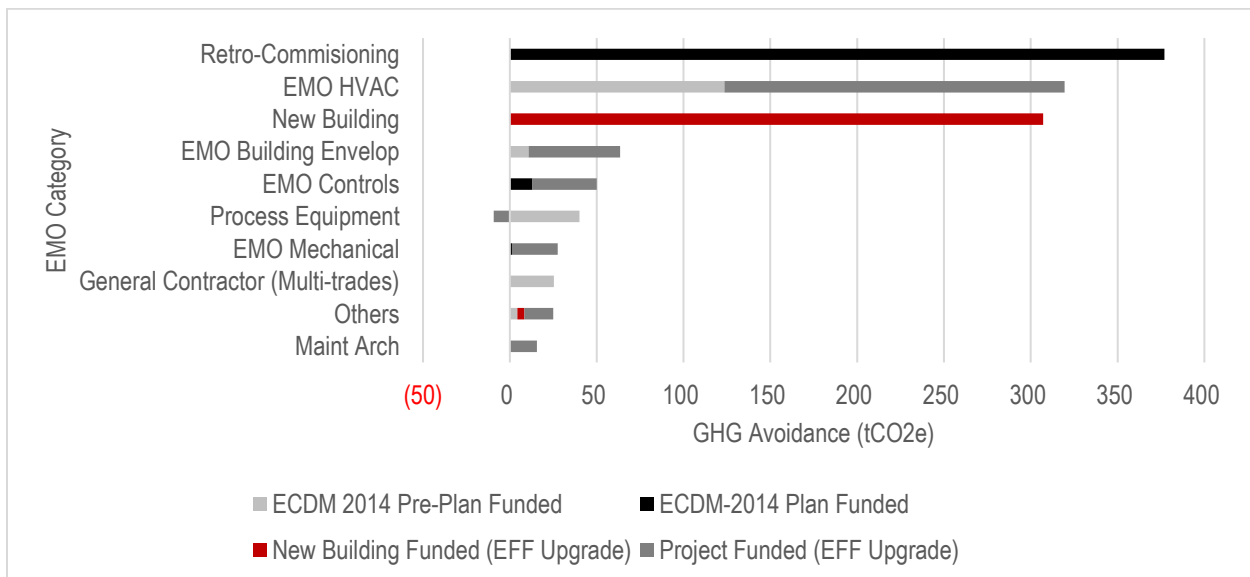
schedule changes, and increase in student enrollment of 31% from 30,277 in 2013 to estimated 39,498 in 2018<sup>4</sup>.

Figures 14 & 15 show details of the top ten Energy and GHG EMO categories, by funding phase, completed during the results period identified as part of ECDM-2014. Phases include ECDM-2014 Pre-Plan Funded, ECDM-2014 Funded, and incremental energy efficiency (EFF) Upgrades in new buildings and other College projects. Figures 16 & 17 show verified results of energy and GHG results of ECDM-2014.

**Figure 14: ECDM-2014 Top 10 Energy Initiatives**

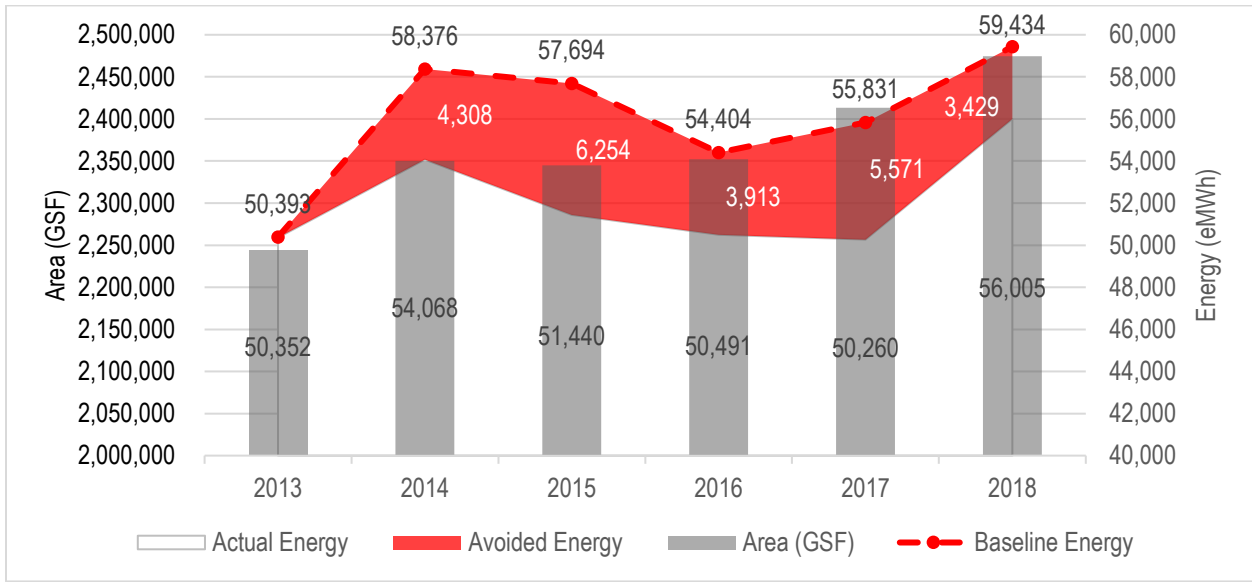


**Figure 15: ECDM-2014 Top 10 GHG Initiatives**

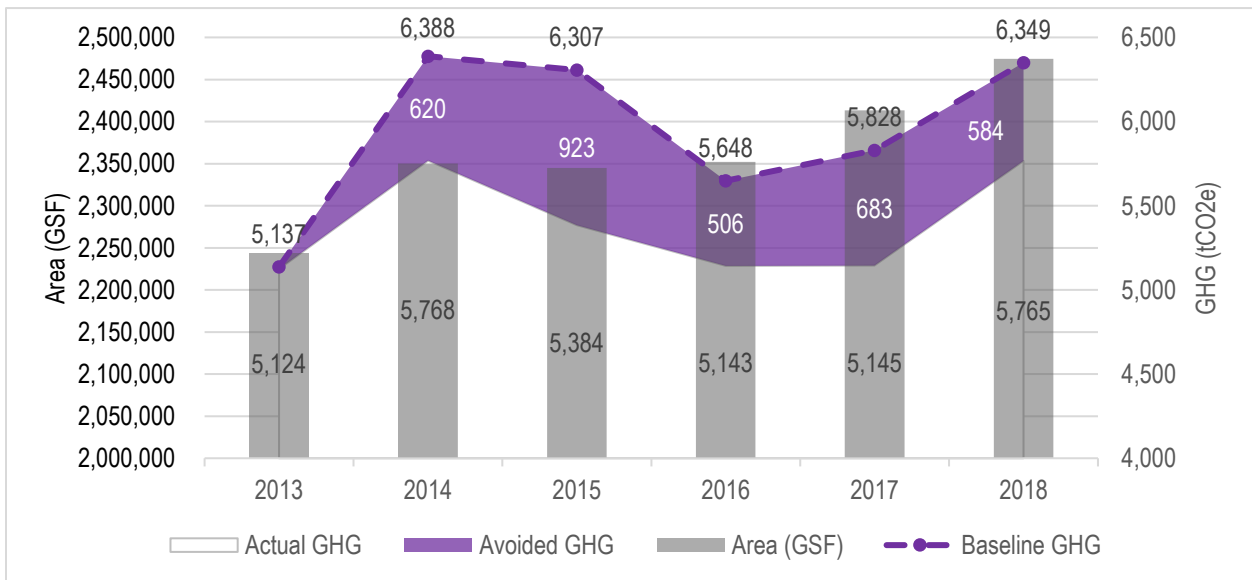


4 Estimates based on "Combined Domestic & International 5 Year FTPS Target Projection" found on page 32 of "The integrated Master Academic Priorities Plan (iMAPP) 2018-2021".

**Figure 16: ECDM-2014 Results - Net Energy**



**Figure 17: ECDM-2014 Results - Net GHG Emissions**



## Energy Baseline ECDM-2019

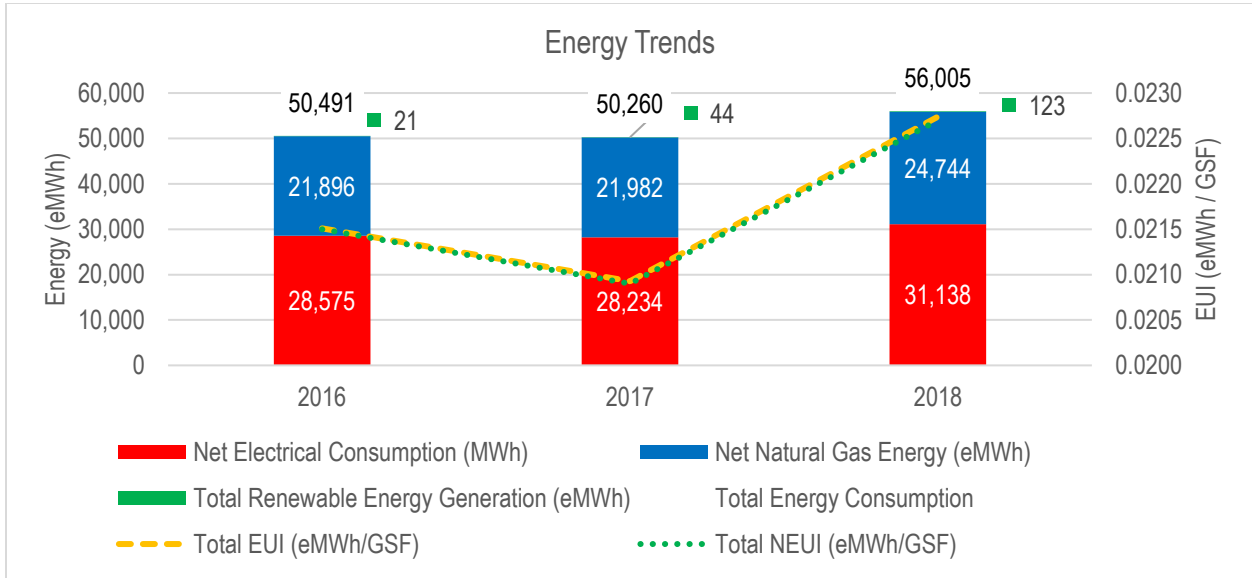
The energy analysis provided in the EA-2018, along with the College's utilities database derived from utilities bills for 2017 and 2018 have been used to determine the Baseline year's energy usage. This Baseline will be used for comparing reporting period data to verify EMO performance. The Baseline is calculated using regression analysis of overall EUI (net energy + onsite energy produced) compared to heating and cooling degree days (HDD and CDD respectively) and then extrapolated to a normalized set of variables (GSF, HDD, and CDD). This normalized predicted Baseline represents the energy usage during normal operating conditions. These variables (GSF, HDD, and CDD) will be updated to match the reporting period in order to verify performance and to calculate avoidances in the reporting period. Peak electrical kW data is estimated based on 50% load factor (typical for all references to peak kW). Table 2 provides details for the years 2016 through to 2018, as well as the Baseline year<sup>5</sup>. Figure 18 and 19 provide details on the College's net energy usage for 2016, 2017 and 2018.

**Table 2: Energy & GHG Baseline**

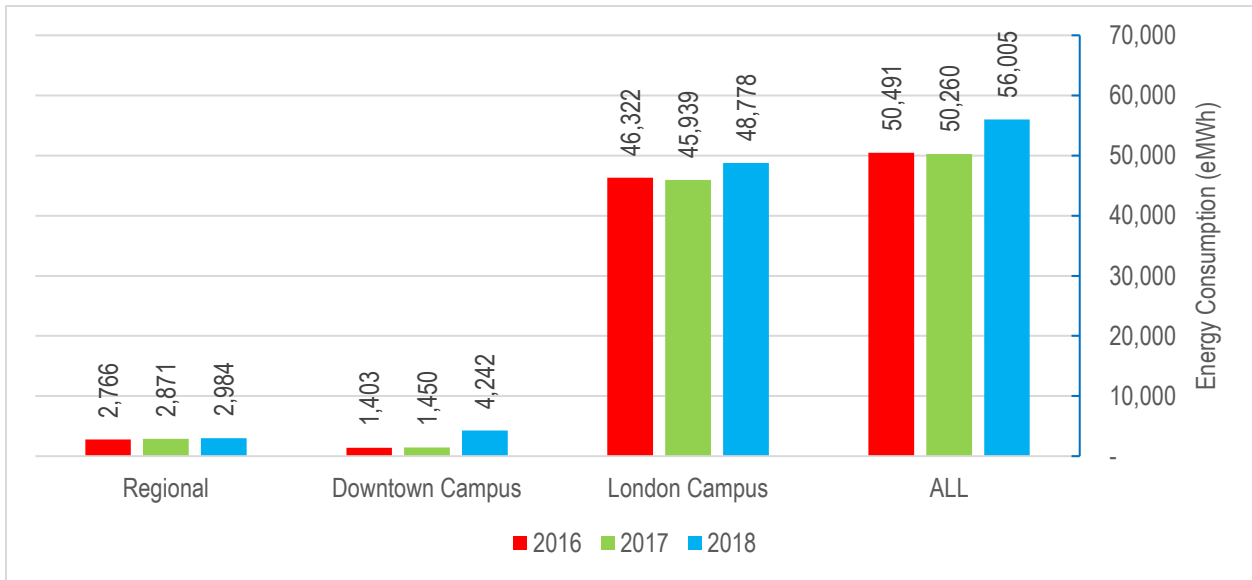
|   | 2016          | 2017          | 2018          | Baseline<br>(2023<br>Projected) |
|---|---------------|---------------|---------------|---------------------------------|
| Average Area GSF                            | 2,352,277     | 2,413,331     | 2,474,594     | 2,819,640                       |
| Enrollment                                  | 34,560        | 37,790        | 39,498        | 45,901                          |
| CDD   | 711           | 468           | 669           | 623                             |
| HDD   | 3,642         | 3,679         | 3,993         | 3,712                           |
| Net Electrical Peak (kW) - estimated        | 6,524         | 6,446         | 7,109         | 8,208                           |
| Net Electrical Consumption (MWh)            | 28,575        | 28,234        | 31,138        | 35,949                          |
| Net Electrical EUI (MWh/GSF)                | 0.0121        | 0.0117        | 0.0126        | 0.0127                          |
| Net Natural Gas Consumption (M3)            | 2,115,488     | 2,123,869     | 2,390,658     | 2,868,043                       |
| Net Natural Gas Energy (eMWh)               | 21,896        | 21,982        | 24,744        | 29,685                          |
| Net Natural Gas EUI (eMWh/GSF)              | 0.0093        | 0.0091        | 0.0100        | 0.0105                          |
| Total Net Energy Consumption                | 50,470        | 50,216        | 55,882        | 65,634                          |
| Total Renewable Energy Generation<br>(eMWh) | 21            | 44            | 123           | 153                             |
| <b>Total Energy Consumption</b>             | <b>50,491</b> | <b>50,260</b> | <b>56,005</b> | <b>65,787</b>                   |
| GHG (tCO <sub>2</sub> e) Emissions          | 5,143         | 5,145         | 5,765         | 6,860                           |
| Total EUI (eMWh/GSF)                        | 0.0215        | 0.0208        | 0.0226        | 0.0233                          |
| Total NEUI (eMWh/GSF)                       | 0.0215        | 0.0208        | 0.0226        | 0.0233                          |
| Total NEUI per Student (eMWh/Student)       | 1.460         | 1.329         | 1.415         | 1.430                           |

<sup>5</sup> Normalized to reporting period variables (HDD & CDD values projected as average of prior 5 years & projected GSF). Assumes 2% YOY GSF Increase over Jan 1 2019 (See Table 1).

**Figure 18: 2016-2018 Fanshawe Trend**



**Figure 19: 2016-2018 Campus Group Trend**



# Energy Objectives and Targets

## Vision, Mission, Values & Goals

In April 2017, “following a year of extensive research, consultation and planning, inclusive of a series of engaging, robust planning sessions, a set of bold and relevant new strategic goals have emerged to provide the necessary focus for us to respond together to new and emerging challenges and opportunities”<sup>6</sup>.

This Plan aligns with the new strategic framework and provides a means towards achievement, specifically with respect to involving our communities, optimizing and utilizing resources wisely, as well as enhancing innovative practices for exceptional student learning.

|  |   |
|--|---|
| <b>Vision</b>                                  | <b>Unlocking Potential</b>  |
| <b>Mission</b>                                 | <b>Provide pathways to success, an exceptional learning experience, and a global outlook to meet student and employer needs</b>   |
| <b>Values<br/>(How we will meet the goals)</b> | <ul style="list-style-type: none"> <li>• Focus on Students</li> <li>• Engage Each Other</li> <li>• Utilize Resources Wisely</li> <li>• Embrace Change</li> <li>• Involve our Communities</li> </ul>   |
| <b>Strategic Goals</b>                         | <ol style="list-style-type: none"> <li>1. Enhance innovative practices for exceptional student learning.</li> <li>2. Manage enrolment growth.</li> <li>3. Optimize use of resources.</li> <li>4. Build sustainable sources of alternative revenue.</li> </ol> |

<sup>6</sup> [https://www.fanshawec.ca/sites/default/files/uploads/strategicplan/strategic\\_goals.pdf](https://www.fanshawec.ca/sites/default/files/uploads/strategicplan/strategic_goals.pdf)

## Energy and GHG Targets

This Plan outlines an annual implementation of EMOs, consisting of capital initiatives, retro-commissioning, renewable energy generation and harvesting, and further enhancements to the Energy Management Information System (EMIS) over the Term of the Plan, commencing in 2019 with the target year being year ending 2023 for verification of performance. The proposed EMOs are projected to avoid overall net electrical and natural gas usage by 5% and 16% respectively over the Baseline (2023 Projected). The overall net energy avoidance is projected to be 10%, which is made up of 8% avoidance in energy usage plus 2% from renewable energy generation offsets<sup>7</sup>.

Table 3 provides a summary of the energy management projections of this Plan based on full implementation of all measures (approved and budgeted pending approval)<sup>8</sup>. Figures 20, 21 & 22 show breakdown of energy, GHG and cost avoidances by category of approved and budgeted pending approval EMOs.

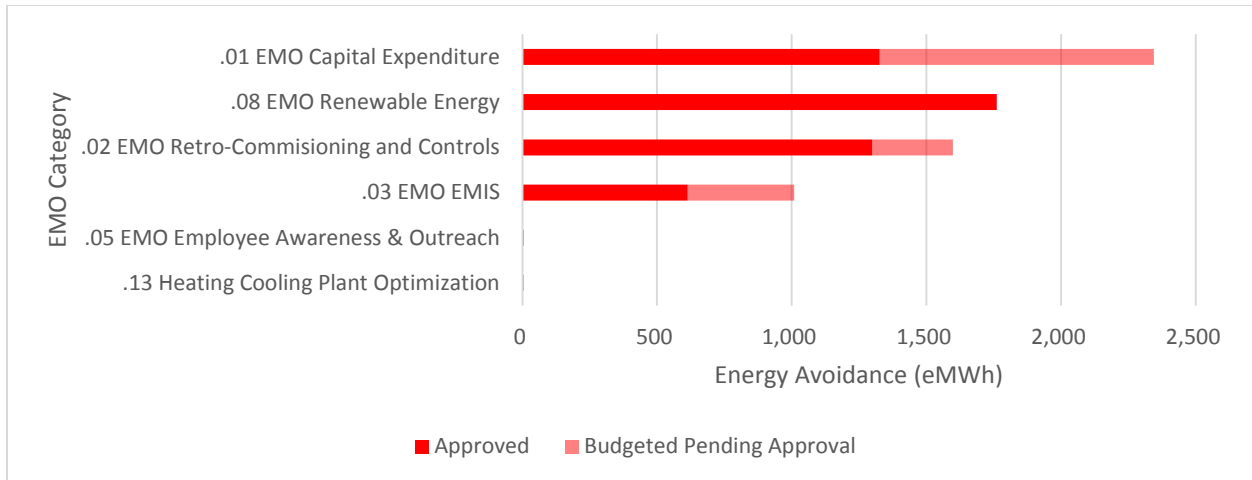
**Table 3: Plan Projections Summary**

|   | 2018          | Baseline<br>(2023<br>Projected) | Proposed<br>(2023) | Reduction<br>(Baseline –<br>Proposed) | Percent<br>Reduction |
|---|---------------|---------------------------------|--------------------|---------------------------------------|----------------------|
| Average Area GSF                            | 2,474,594     | 2,819,640                       | 2,819,640          | N/A                                   | N/A                  |
| Enrollment                                  | 39,498        | 45,901                          | 45,901             | N/A                                   | N/A                  |
| CDD   | 669           | 623                             | 623                | N/A                                   | N/A                  |
| HDD   | 3,993         | 3,712                           | 3,712              | N/A                                   | N/A                  |
| Net Electrical Peak (kW) - estimated        | 7,109         | 8,208                           | 8,031              | 176                                   | 2%                   |
| Net Electrical Consumption (MWh)            | 31,138        | 35,949                          | 34,098             | 1,851                                 | 5%                   |
| Net Electrical EUI (MWh/GSF)                | 0.0126        | 0.0127                          | 0.0121             | 0.0006                                | 5%                   |
| Net Natural Gas Consumption (M3)            | 2,390,658     | 2,868,043                       | 2,397,232          | 470,811                               | 16%                  |
| Net Natural Gas Energy (eMWh)               | 24,744        | 29,685                          | 24,812             | 4,873                                 | 16%                  |
| Net Natural Gas EUI (eMWh/GSF)              | 0.0100        | 0.0105                          | 0.0088             | 0.0017                                | 16%                  |
| Total Net Energy Consumption                | 55,882        | 65,634                          | 58,910             | 6,724                                 | 10%                  |
| Total Renewable Energy Generation<br>(eMWh) | 123           | 153                             | 1,598              | -1,445                                | -944%                |
| <b>Total Energy Consumption</b>             | <b>56,005</b> | <b>65,787</b>                   | <b>60,508</b>      | <b>5,279</b>                          | <b>8%</b>            |
| GHG (tCO2e) Emissions                       | 5,765         | 6,860                           | 5,896              | 964                                   | 14%                  |
| Total EUI (eMWh/GSF)                        | 0.0226        | 0.0233                          | 0.0215             | 0.0019                                | 8%                   |
| Total NEUI (eMWh/GSF)                       | 0.0226        | 0.0233                          | 0.0209             | 0.0024                                | 10%                  |
| Total NEUI per Student (eMWh/Student)       | 1.415         | 1.430                           | 1.283              | 0.146                                 | 10%                  |
|   |               |                                 |                    | CapEx Total (\$ x 1,000):             | \$10,210             |
|   |               |                                 |                    | College Cost (\$ x 1,000):            | \$3,853              |

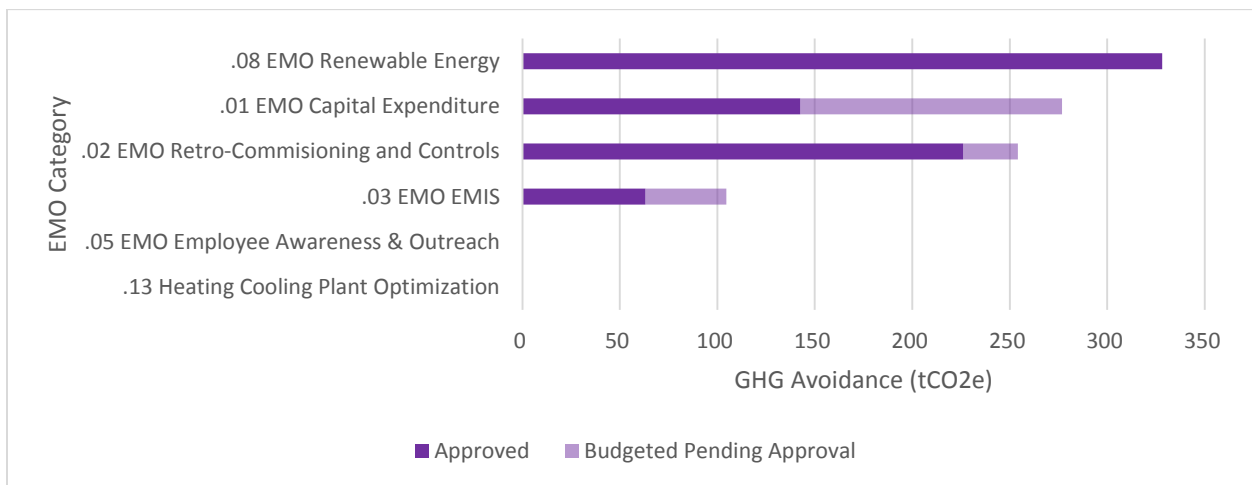
7 Renewable energy generation in Reduction (Baseline – Proposed) field shows as negative to indicate increased usage (reliance) of renewable energy to offset non-renewable energy sources.

8 Due to uncertainty in levels of funding this Plan will need to be reviewed and adjusted annually to reflect the level of achievement relative to funding availability. Advocacy for funding to support this Plan will continue with all levels of government.

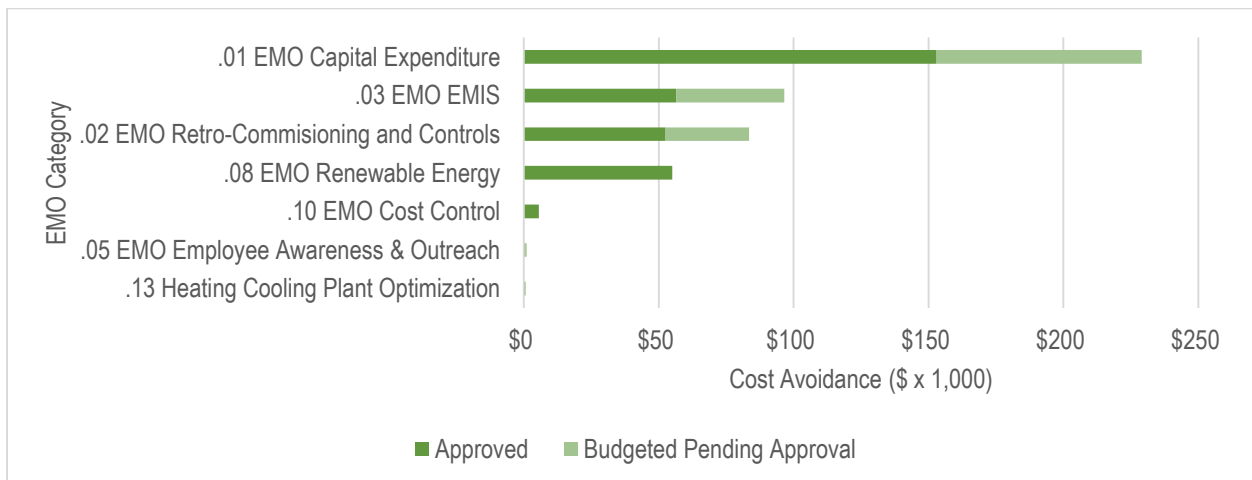
**Figure 20: Energy Avoidance by Category and Approval Status**



**Figure 21: GHG Avoidance by Category and Approval Status**



**Figure 22: Cost Avoidance by Category and Approval Status**



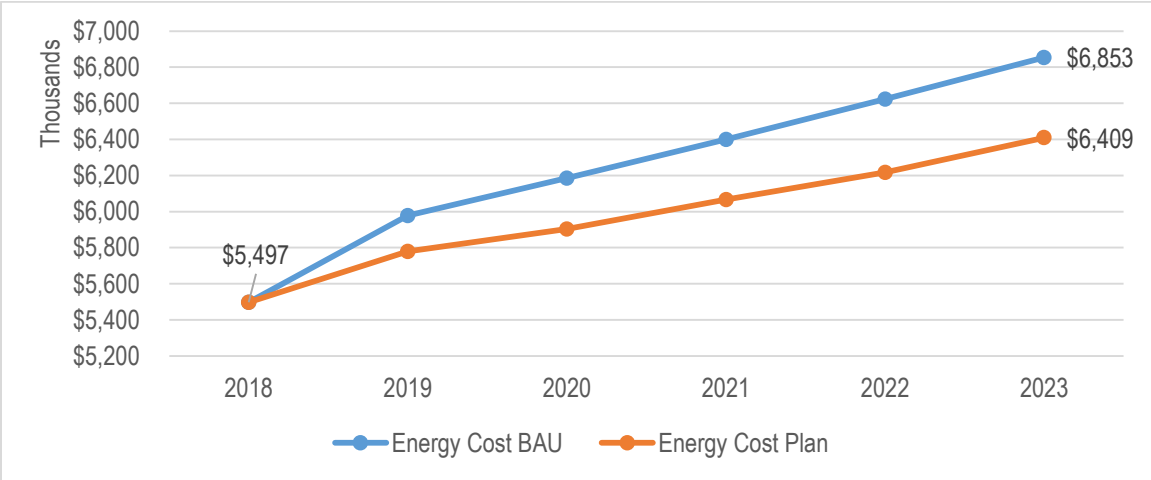


# Plan of Action

## Business as Usual

Business as usual (BAU) projections indicate that the College’s annual energy costs will rise from \$5.5 million in 2019 to \$6.85 million in 2023. This increase is due to projected College growth, and increase in electrical costs over general inflation. It is estimated that implementation of the Plan will decrease additional budget required by \$444,000, to \$6.4 million in 2023 due to decrease in purchased electricity and natural gas. See Figure 23 for details.

**Figure 23: Energy Cost BAU vs Plan**



## Approved Initiatives (2019 – 2020)

Currently the Plan has funding approval for EMOs scheduled for completion in 2019 and 2020.

These EMOs are anticipated to reduce peak electrical demand by 82 kW and provide net annual electrical and natural gas usage avoidances of 1,086 MWh & 379,090 m3 respectively. This equates to a total net energy consumption avoidance of 5,009 eMWh per year, of which 1,445 eMWh per year is due to offsets related to renewable energy generation, and represents an annual GHG avoidance of 760 tCO2e.

The EMOs represent approximately \$8.9 million in capital expenditures, which are offset by provincial GGRP Grant funding and incentives of \$5.89 million and \$356,000 respectively, for total cost to the College of \$2.7 million. These EMOs are anticipated to provide an energy cost avoidance of \$324,000 annually (present value). Table 4 provides summary details.

**Table 4: Approved Initiatives (2019 - 2020)**

| Phase / Year                 | CapEx (x \$1,000) | CapEx - Incentives (x \$1,000) | Cost Avoidance (x \$1,000) | Elec Avoidance (MWh) | Elec Peak Avoidance (kW) | Natural Gas Avoidance (M3) | Total Energy (eMWh) | GHG Avoidance (tCO2e) | Renewable Energy Generation (eMWh) |
|------------------------------|-------------------|--------------------------------|----------------------------|----------------------|--------------------------|----------------------------|---------------------|-----------------------|------------------------------------|
| <b>0. Current Allocation</b> | \$8,386           | \$2,199                        | \$239                      | 669                  | 49                       | 329,573                    | 4,080               | 650                   | 1,262                              |
| <b>2019</b>                  | \$8,386           | \$2,199                        | \$239                      | 669                  | 49                       | 329,573                    | 4,080               | 650                   | 1,262                              |
| <b>1. FMCS Capital Plan</b>  | \$590             | \$532                          | \$85                       | 417                  | 32                       | 49,518                     | 930                 | 110                   | 183                                |
| <b>2020</b>                  | \$590             | \$532                          | \$85                       | 417                  | 32                       | 49,518                     | 930                 | 110                   | 183                                |
| <b>Grand Total</b>           | <b>\$8,976</b>    | <b>\$2,730</b>                 | <b>\$324</b>               | <b>1,086</b>         | <b>82</b>                | <b>379,090</b>             | <b>5,009</b>        | <b>760</b>            | <b>1,445</b>                       |

### Pending Approval Initiatives (2021 – 2023)

In order to meet the targets identified in this Plan, further approvals will be required to complete initiatives identified for completion in 2021, 2022 & 2023.

These EMOs are anticipated to reduce peak electrical demand by 95 kW and provide net annual electrical and natural gas usage avoidances of 765 MWh & 91,721 m3 respectively. This equates to a total net energy consumption avoidance of 1,715 eMWh per year, and represents an annual GHG avoidance of 204 tCO2e.

They represent approximately \$1.24 million in capital expenditures, which are offset by incentives of \$111,000, for total cost to the College of \$1.13 million. These EMOs are identified in the College's multi-year capital plan pending annual budget approval. These EMOs are anticipated to provide an energy cost avoidance of \$148,000 annually (present value) in the final year. Table 5 provides summary details.

**Table 5: Pending Approval Initiatives (2021 – 2023)**

| Phase / Year                | CapEx (x \$1,000) | CapEx - Incentives (x \$1,000) | Cost Avoidance (x \$1,000) | Elec Avoidance (MWh) | Elec Peak Avoidance (kW) | Natural Gas Avoidance (M3) | Total Energy (eMWh) | GHG Avoidance (tCO2e) | Renewable Energy Generation (eMWh) |
|-----------------------------|-------------------|--------------------------------|----------------------------|----------------------|--------------------------|----------------------------|---------------------|-----------------------|------------------------------------|
| <b>2. FMCS Capital Plan</b> | \$1,234           | \$1,123                        | \$148                      | 765                  | 95                       | 91,721                     | 1,715               | 204                   | 0                                  |
| <b>2021</b>                 | \$506             | \$467                          | \$49                       | 263                  | 38                       | 22,763                     | 499                 | 54                    | 0                                  |
| <b>2022</b>                 | \$445             | \$390                          | \$63                       | 391                  | 54                       | 13,937                     | 535                 | 42                    | 0                                  |
| <b>2023</b>                 | \$283             | \$266                          | \$36                       | 111                  | 3                        | 55,021                     | 681                 | 108                   | 0                                  |
| <b>Grand Total</b>          | <b>\$1,234</b>    | <b>\$1,123</b>                 | <b>\$148</b>               | <b>765</b>           | <b>95</b>                | <b>91,721</b>              | <b>1,715</b>        | <b>204</b>            | <b>0</b>                           |

## Initiative Priority and Category

This Plan distinguishes initiatives by Priority, CDM Plan Category, and EMO Category. The Priority level groups initiatives in order of impact on a particular building or process. The CDM Plan category groups initiatives by type for basis of budgeting and for method of procurement and implementation. The EMO Category further defines initiatives by type of measure, supplier or subject matter expert grouping. Table 6 shows priority structure of initiatives:

**Table 6: Initiative Prioritization and Categories**

| Priority                    | CDM Plan Category                                | EMO Category                      |
|-----------------------------|--|-----------------------------------|
| <b>0. Study</b>             | <b>.04 EMO Energy Audit</b>                      | Energy Audit                      |
| <b>1. Match Load</b>        | <b>.02 EMO Retro-Commissioning and Controls</b>  | EMO Controls                      |
|                             |  | Retro-Commissioning               |
|                             | <b>.03 EMO EMIS</b>                              | M&T                               |
|                             | <b>.05 EMO Employee Awareness &amp; Outreach</b> | Process Behavioral                |
|                             |  | Process Equipment                 |
|                             | <b>.16 Water Conservation</b>                    | WCO Plumbing                      |
| <b>2. Reduce Load</b>       | <b>.01 EMO Capital Expenditure</b>               | EMO Building Envelop              |
|                             |  | EMO ELEC                          |
|                             |  | EMO HVAC                          |
|                             |  | EMO Lighting                      |
|                             |  | EMO Mechanical                    |
|                             |  | General Contractor (Multi-trades) |
|                             |  | Maint Arch                        |
| Maint Mech                  |  |                                   |
| <b>.07 EMO New Building</b> | New Building                                     |                                   |
| <b>3. Energy Transfer</b>   | <b>.08 EMO Renewable Energy</b>                  | Renewable Energy                  |
|                             | <b>.13 Heating Cooling Plant Optimization</b>    | EMO Plant Chiller                 |
| <b>4. Cost Control</b>      | <b>.10 EMO Cost Control</b>                      | EMO Cost Control                  |

## Year 1 (2019)

The EMOs scheduled for completion in 2019, target electrical peak reduction of 49 kW annual net electrical and natural gas usage avoidances of 669 MWh & 329,573 m<sup>3</sup> respectively. This equates to a total net energy consumption avoidance of 4,080 eMWh per year, of which 1,262 eMWh per year is due to offsets related to renewable energy generation, and represents an annual GHG avoidance of 650 tCO<sub>2</sub>e. These EMOs represent approximately \$8.3 million in capital expenditures, and offset energy costs by \$239,000 annually (present value). These initiatives are fully approved, with capital cost of \$8.4 million. Table 7 provides details of initiatives scheduled for completion in 2019 by Priority and EMO Category.

**Table 7: Year 1 Initiatives (2019)**

| Priority and EMO Category                | CapEx (x \$1,000) | CapEx - Incentives (x \$1,000) | Cost Avoidance (x \$1,000) | Elec Avoidance (MWh) | Elec Peak Avoidance (kW) | Natural Gas Avoidance (M <sup>3</sup> ) | Total Energy (eMWh) | GHG Avoidance (tCO <sub>2</sub> e) | Renewable Energy Generation (eMWh) |
|--|-------------------|--------------------------------|----------------------------|----------------------|--------------------------|---|---------------------|------------------------------------|------------------------------------|
| <b>0. Current Allocation</b>             | <b>\$8,386</b>    | <b>\$2,199</b>                 | <b>\$239</b>               | <b>669</b>           | <b>49</b>                | <b>329,573</b>                          | <b>4,080</b>        | <b>650</b>                         | <b>1,262</b>                       |
| <b>1. Match Load</b>                     | <b>\$276</b>      | <b>\$214</b>                   | <b>\$105</b>               | <b>415</b>           | <b>27</b>                | <b>134,196</b>                          | <b>1,804</b>        | <b>270</b>                         | <b>0</b>                           |
| .02 EMO Retro-Commissioning and Controls | \$71              | \$52                           | \$48                       | 72                   | 8                        | 108,093                                 | 1,191               | 207                                | 0                                  |
| .03 EMO EMIS                             | \$205             | \$162                          | \$57                       | 343                  | 19                       | 26,103                                  | 613                 | 63                                 | 0                                  |
| <b>2. Reduce Load</b>                    | <b>\$5,208</b>    | <b>\$1,481</b>                 | <b>\$87</b>                | <b>294</b>           | <b>25</b>                | <b>43,012</b>                           | <b>739</b>          | <b>93</b>                          | <b>0</b>                           |
| .01 EMO Capital Expenditure              | \$5,208           | \$1,481                        | \$87                       | 294                  | 25                       | 43,012                                  | 739                 | 93                                 | 0                                  |
| <b>3. Energy Transfer</b>                | <b>\$2,902</b>    | <b>\$505</b>                   | <b>\$48</b>                | <b>-40</b>           | <b>-2</b>                | <b>152,365</b>                          | <b>1,537</b>        | <b>286</b>                         | <b>1,262</b>                       |
| .08 EMO Renewable Energy                 | \$2,866           | \$469                          | \$47                       | -45                  | -2                       | 152,365                                 | 1,532               | 286                                | 1,262                              |
| .13 Heating Cooling Plant Optimization   | \$36              | \$36                           | \$1                        | 4                    | 0                        | 0                                       | 4                   | 0                                  | 0                                  |
| <b>Grand Total</b>                       | <b>\$8,386</b>    | <b>\$2,199</b>                 | <b>\$239</b>               | <b>669</b>           | <b>49</b>                | <b>329,573</b>                          | <b>4,080</b>        | <b>650</b>                         | <b>1,262</b>                       |

## Year 2 (2020)

The EMOs scheduled for completion in 2020 target electrical peak reduction of 32 kW and annual net electrical and natural gas usage avoidances of 417 MWh & 49,518 m<sup>3</sup> respectively. This equates to a total net energy consumption avoidance of 930 eMWh per year, of which 183 eMWh per year is due to offset related to renewable energy generation, and represents an annual GHG avoidance of 110 tCO<sub>2</sub>e. These EMOs represent approximately \$590,000 in capital expenditures, and offset energy costs by \$85,000 annually (present value). Including

potential incentives of \$59,000, these initiatives provide a simple payback in under 7 years. Table 8 provides details regarding initiatives, which have approved funding for 2020 by Priority and EMO Category.

**Table 8: Year 2 Initiatives (2020)**

| Priority and EMO Category                | CapEx (x \$1,000) | CapEx - Incentives (x \$1,000) | Cost Avoidance (x \$1,000) | Elec Avoidance (MWh) | Elec Peak Avoidance (kW) | Natural Gas Avoidance (M3) | Total Energy (eMWh) | GHG Avoidance (tCO2e) | Renewable Energy Generation (eMWh) |
|--|-------------------|--------------------------------|----------------------------|----------------------|--------------------------|----------------------------|---------------------|-----------------------|------------------------------------|
| <b>1. FMCS Capital Plan</b>              | <b>\$590</b>      | <b>\$532</b>                   | <b>\$85</b>                | <b>417</b>           | <b>32</b>                | <b>49,518</b>              | <b>930</b>          | <b>110</b>            | <b>183</b>                         |
| <b>1. Match Load</b>                     | <b>\$15</b>       | <b>\$13</b>                    | <b>\$5</b>                 | <b>11</b>            | <b>0</b>                 | <b>9,822</b>               | <b>113</b>          | <b>19</b>             | <b>0</b>                           |
| .02 EMO Retro-Commissioning and Controls | \$13              | \$11                           | \$5                        | 8                    | 0                        | 9,822                      | 109                 | 19                    | 0                                  |
| .05 EMO Employee Awareness & Outreach    | \$2               | \$2                            | \$1                        | 4                    | 0                        | 0                          | 4                   | 0                     | 0                                  |
| <b>2. Reduce Load</b>                    | <b>\$496</b>      | <b>\$442</b>                   | <b>\$66</b>                | <b>406</b>           | <b>33</b>                | <b>17,546</b>              | <b>588</b>          | <b>49</b>             | <b>0</b>                           |
| .01 EMO Capital Expenditure              | \$496             | \$442                          | \$66                       | 406                  | 33                       | 17,546                     | 588                 | 49                    | 0                                  |
| <b>3. Energy Transfer</b>                | <b>\$69</b>       | <b>\$67</b>                    | <b>\$8</b>                 | <b>0</b>             | <b>-1</b>                | <b>22,149</b>              | <b>229</b>          | <b>42</b>             | <b>183</b>                         |
| .08 EMO Renewable Energy                 | \$69              | \$67                           | \$8                        | 0                    | -1                       | 22,149                     | 229                 | 42                    | 183                                |
| <b>4. Cost Control</b>                   | <b>\$10</b>       | <b>\$10</b>                    | <b>\$6</b>                 | <b>0</b>             | <b>0</b>                 | <b>0</b>                   | <b>0</b>            | <b>0</b>              | <b>0</b>                           |
| .10 EMO Cost Control                     | \$10              | \$10                           | \$6                        | 0                    | 0                        | 0                          | 0                   | 0                     | 0                                  |
| <b>Grand Total</b>                       | <b>\$590</b>      | <b>\$532</b>                   | <b>\$85</b>                | <b>417</b>           | <b>32</b>                | <b>49,518</b>              | <b>930</b>          | <b>110</b>            | <b>183</b>                         |

### Years 3-5 (2021-2023)

The EMOs included for the remaining years of this Plan (2021-2023) target an additional annual net electrical and natural gas usage avoidance of 765 MWh and 91,721 m3 respectively. This equates to a total net Energy consumption avoidance of 1,715 eMWh per year, and represents an annual GHG avoidance of 204 tCO2e. The total expenditure for these EMOs will be \$1.24 million<sup>9</sup> and, when including potential incentives and energy cost avoidances of \$148,000

<sup>9</sup> Due to uncertainty in levels of funding this Plan will need to be reviewed and adjusted annually to reflect the level of achievement relative to funding availability. Advocacy for funding to support this Plan will continue with all levels of government.

annually, will result in a simple payback of under 8 years. Table 9 provides details regarding initiatives for Years 3-5 (2021-2023) by Priority and EMO Category.

**Table 9: Years 3-5 Initiatives (2021-2023)**

| Priority and EMO Category                | CapEx (x \$1,000) | CapEx - Incentives (x \$1,000) | Cost Avoidance (x \$1,000) | Elec Avoidance (MWh) | Elec Peak Avoidance (kW) | Natural Gas Avoidance (M3) | Total Energy (eMWh) | GHG Avoidance (tCO2e) | Renewable Energy Generation (eMWh) |
|--|-------------------|--------------------------------|----------------------------|----------------------|--------------------------|----------------------------|---------------------|-----------------------|------------------------------------|
| <b>2. FMCS Capital Plan</b>              | <b>\$1,234</b>    | <b>\$1,123</b>                 | <b>\$148</b>               | <b>765</b>           | <b>95</b>                | <b>91,721</b>              | <b>1,715</b>        | <b>204</b>            | <b>0</b>                           |
| <b>1. Match Load</b>                     | <b>\$698</b>      | <b>\$650</b>                   | <b>\$72</b>                | <b>404</b>           | <b>30</b>                | <b>28,287</b>              | <b>697</b>          | <b>70</b>             | <b>0</b>                           |
| .02 EMO Retro-Commissioning and Controls | \$271             | \$253                          | \$31                       | 186                  | 0                        | 10,885                     | 299                 | 28                    | 0                                  |
| .03 EMO EMIS                             | \$426             | \$397                          | \$40                       | 216                  | 30                       | 17,402                     | 396                 | 42                    | 0                                  |
| .05 EMO Employee Awareness & Outreach    | \$1               | \$1                            | \$1                        | 2                    | 0                        | 0                          | 2                   | 0                     | 0                                  |
| <b>2. Reduce Load</b>                    | <b>\$536</b>      | <b>\$473</b>                   | <b>\$76</b>                | <b>361</b>           | <b>64</b>                | <b>63,433</b>              | <b>1,018</b>        | <b>134</b>            | <b>0</b>                           |
| .01 EMO Capital Expenditure              | \$536             | \$473                          | \$76                       | 361                  | 64                       | 63,433                     | 1,018               | 134                   | 0                                  |
| <b>Grand Total</b>                       | <b>\$1,234</b>    | <b>\$1,123</b>                 | <b>\$148</b>               | <b>765</b>           | <b>95</b>                | <b>91,721</b>              | <b>1,715</b>        | <b>204</b>            | <b>0</b>                           |

### Capital Projects (Conservation and Renewable Energy):

Capital Projects include Conservation measures, which are EMOs including; lighting, electrical, and mechanical, HVAC, and building envelope upgrades as well as major renovations and new construction. Renewable Energy projects involve Solar PV, Solar Wall Ventilation and Solar Hot Water. This Plan identifies Capital Projects which when fully implemented are expected to provide annual net electrical and natural gas usage avoidances of 1,021 MWh, and 298,505 m3 respectively, as well as reduce electrical peak demand by 119 kW. This equates to a total net Energy consumption avoidance of 4,110 eMWh per year, of which 1,445 eMWh per year is due to offsets related to renewable energy generation, and represents an annual GHG avoidance of 605 tCO2e. Refer to Table 10 details. Capital Projects planned for implementation by Priority and EMO Category including but not limited to the following:

- **EMO Building Envelop:** Building Envelope Upgrades (new roofing, and cladding, weather-stripping of doors and windows)
- **EMO HVAC Upgrades:** HVAC Upgrades (motors, variable frequency drives, building automation controls, etc.)
- **EMO Lighting:** Involves lighting upgrades to LED and lighting controls.
- **EMO Electrical:** Includes installation of VFD's other electrical power using equipment.

- **EMO Mechanical:** Involves upgrades to mechanical systems, including hydronic equipment and controls for pumps, valves, boilers and cooling equipment.
- **EMO Renewable:** Solar Wall (ventilation air preheat) and Solar Thermal (hot water reheat or domestic water preheat).

**Table 10: Capital Projects**

| Priority and EMO Category | CapEx (x \$1,000) | CapEx - Incentives (x \$1,000) | Cost Avoidance (x \$1,000) | Elec Avoidance (MWh) | Elec Peak Avoidance (kW) | Natural Gas Avoidance (M3) | Total Energy (eMWh) | GHG Avoidance (tCO2e) | Renewable Energy Generation (eMWh) |
|---------------------------|-------------------|--------------------------------|----------------------------|----------------------|--------------------------|----------------------------|---------------------|-----------------------|------------------------------------|
| <b>2. Reduce Load</b>     | <b>\$6,240</b>    | <b>\$2,395</b>                 | <b>\$229</b>               | <b>1,061</b>         | <b>122</b>               | <b>123,991</b>             | <b>2,344</b>        | <b>277</b>            | <b>0</b>                           |
| EMO Building Envelop      | \$3,669           | \$103                          | \$38                       | 41                   | 14                       | 78,068                     | 849                 | 149                   | 0                                  |
| EMO HVAC                  | \$946             | \$756                          | \$84                       | 354                  | 10                       | 42,382                     | 792                 | 94                    | 0                                  |
| EMO Lighting              | \$463             | \$399                          | \$69                       | 440                  | 92                       | -3,290                     | 406                 | 11                    | 0                                  |
| EMO ELEC                  | \$224             | \$203                          | \$26                       | 157                  | 6                        | 0                          | 157                 | 6                     | 0                                  |
| EMO Mechanical            | \$933             | \$930                          | \$13                       | 70                   | 0                        | 5,194                      | 124                 | 13                    | 0                                  |
| Maint Mech                | \$3               | \$3                            | \$1                        | 0                    | 0                        | 1,099                      | 11                  | 2                     | 0                                  |
| Maint Arch                | \$2               | \$2                            | \$0                        | 0                    | 0                        | 539                        | 6                   | 1                     | 0                                  |
| <b>3. Energy Transfer</b> | <b>\$2,971</b>    | <b>\$572</b>                   | <b>\$56</b>                | <b>-41</b>           | <b>-3</b>                | <b>174,514</b>             | <b>1,766</b>        | <b>328</b>            | <b>1,445</b>                       |
| Renewable Energy          | \$2,935           | \$536                          | \$55                       | -45                  | -3                       | 174,514                    | 1,761               | 328                   | 1,445                              |
| EMO Plant Chiller         | \$36              | \$36                           | \$1                        | 4                    | 0                        | 0                          | 4                   | 0                     | 0                                  |
| <b>Grand Total</b>        | <b>\$9,211</b>    | <b>\$2,967</b>                 | <b>\$285</b>               | <b>1,021</b>         | <b>119</b>               | <b>298,505</b>             | <b>4,110</b>        | <b>605</b>            | <b>1,445</b>                       |

### Retro-Commissioning (RCx) & Controls:

Retro-Commissioning (RCx) of existing buildings involves a process of optimizing a building's operations and maintenance. The goal of RCx is to return the building to either its original designed purpose or to an improved energy efficient state. RCx may result in Capital Projects being identified; however, the main purpose is the optimization of the facility. EA-2013 noted that typically RCx provides energy savings in the range of 8% to 30%. For the purposes of this Plan, a conservative energy savings of 8% is assumed. Controls optimization involves modifications to the Building Automation System (BAS) to change how facilities operate, and minimizing waste and right sizing supply with demand. This Plan anticipates that RCx along with Controls optimization of select facilities will provide annual electrical and natural gas usage avoidances of 265 MWh and 128,800m3 respectively. This equates to a total Energy consumption avoidance of 1,598 eMWh per year, and represents an annual GHG avoidance of 254 tCO2e. Refer to Table 11 for details.

**Table 11: RCx Projects**

| Priority and EMO Category | CapEx (x \$1,000) | CapEx - Incentives (x \$1,000) | Cost Avoidance (x \$1,000) | Elec Avoidance (MWh) | Elec Peak Avoidance (kW) | Natural Gas Avoidance (M3) | Total Energy (eMWh) | GHG Avoidance (tCO2e) | Renewable Energy Generation (eMWh) |
|---------------------------|-------------------|--------------------------------|----------------------------|----------------------|--------------------------|----------------------------|---------------------|-----------------------|------------------------------------|
| <b>1. Match Load</b>      | <b>\$355</b>      | <b>\$316</b>                   | <b>\$84</b>                | <b>265</b>           | <b>8</b>                 | <b>128,800</b>             | <b>1,598</b>        | <b>254</b>            | <b>0</b>                           |
| Retro-Commissioning       | \$154             | \$128                          | \$62                       | 125                  | 8                        | 126,136                    | 1,430               | 243                   | 0                                  |
| EMO Controls              | \$201             | \$188                          | \$22                       | 141                  | 0                        | 2,664                      | 168                 | 11                    | 0                                  |
| <b>Grand Total</b>        | <b>\$355</b>      | <b>\$316</b>                   | <b>\$84</b>                | <b>265</b>           | <b>8</b>                 | <b>128,800</b>             | <b>1,598</b>        | <b>254</b>            | <b>0</b>                           |

### Energy Management Information System (EMIS):

The Energy Management Information System (EMIS) will play an integral role in verifying and tracking the performance of the other initiatives implemented as well as identify in real time unexpected energy waste. The system is in the process of being fully rolled out in multiple phases. Phase 1a (System setup and integration of existing meters) was completed in 2018. Phase 1b involves the installation of additional meters required for building level energy usage tracking. Phase 2 involves additional sub-meters required for further refinement of energy usage within the buildings. Once completed and configured, this system will provide the necessary information and analysis required to monitor energy usage in real time so that action can be taken in a timely manner, ensuring system efficiency is maintained. By identifying wasted energy or inefficiencies immediately, rather than at receipt of the next energy bill or yearly analysis, it is anticipated that an electrical and natural gas energy usage avoidance of 1.5% will be realized annually. This Plan anticipates that the EMIS will provide annual electrical and natural gas usage avoidances of 559 MWh and 43,505 m3 respectively, as well as reduce electrical peak demand by 49 kW. This equates to a total Energy consumption avoidance of 1,010 eMWh per year, and represents an annual GHG avoidance of 105 tCO2e.

### Energy Auditing & Cost Control:

As EMOs are implemented over the course of this Plan and new technology becomes available, it may be beneficial for the energy audit to be updated. Assessment of current list of EMOs will take place in the fourth year of the Plan to determine whether funding to update the Energy Audit will be requested. In addition to auditing and review of energy bills, measures have been identified to reduce operating costs. This involves review of the College’s contracts for energy, as well as improving power factor. Although these measures may not reduce energy usage or consumption, they are anticipated to reduce overall operating costs, which provide overall financial benefit to the College as this Plan is rolled out.

### College Community Awareness & Training:

In consultation with the Energy Team, the Sustainability Coordinator and sustainability groups at Fanshawe; programs (such as Residence energy challenge, Lunch’n Learn’s, and information booths at Orientation, Open House, and student services showcase, events) will be developed to bring about an awareness of energy usage and foster a culture inclined towards reducing



waste and becoming more efficient. It is anticipated that energy awareness, training and College community involvement, will result in energy avoidances. As these initiatives are difficult to quantify, it is estimated that a conservative reduction of 1 - 2 % will be realized annually.

### **Energy Team:**

The Energy Team, formed in 2015 as part of ECDM-2014, consists of key energy champions. This team meets three times per year, aligned with the College's academic semesters (fall, winter, summer), to review progress of the Plan's implementation, identify additional measures, oversee the implementation of the College Community Awareness and Training programs as well as provide recommendations for additional content and improvements.

## Implementation Budget & Plan Life Cycle Analysis

In order to meet the targets as presented in this Plan investment will be required on an annual basis to support expenditures including costs for implementation of Capital Projects, RCx, the EMIS, and initiatives under the Energy Team including College Community Awareness and Training programs. Total capital funding of \$10.21 million will be required over the Term of the Plan, and when potential incentives and grant funding received and cumulated cost avoidances are included, it is anticipated that the maximum “out of pocket” expense will be approximately \$1.24 million occurring in Year 3 (2021).

Table 12 details the allocation of funding and Table 13 details the anticipated benefits of these measures, at each year of the Plan. Figure 27 shows the Plan Life Cycle financial analysis.

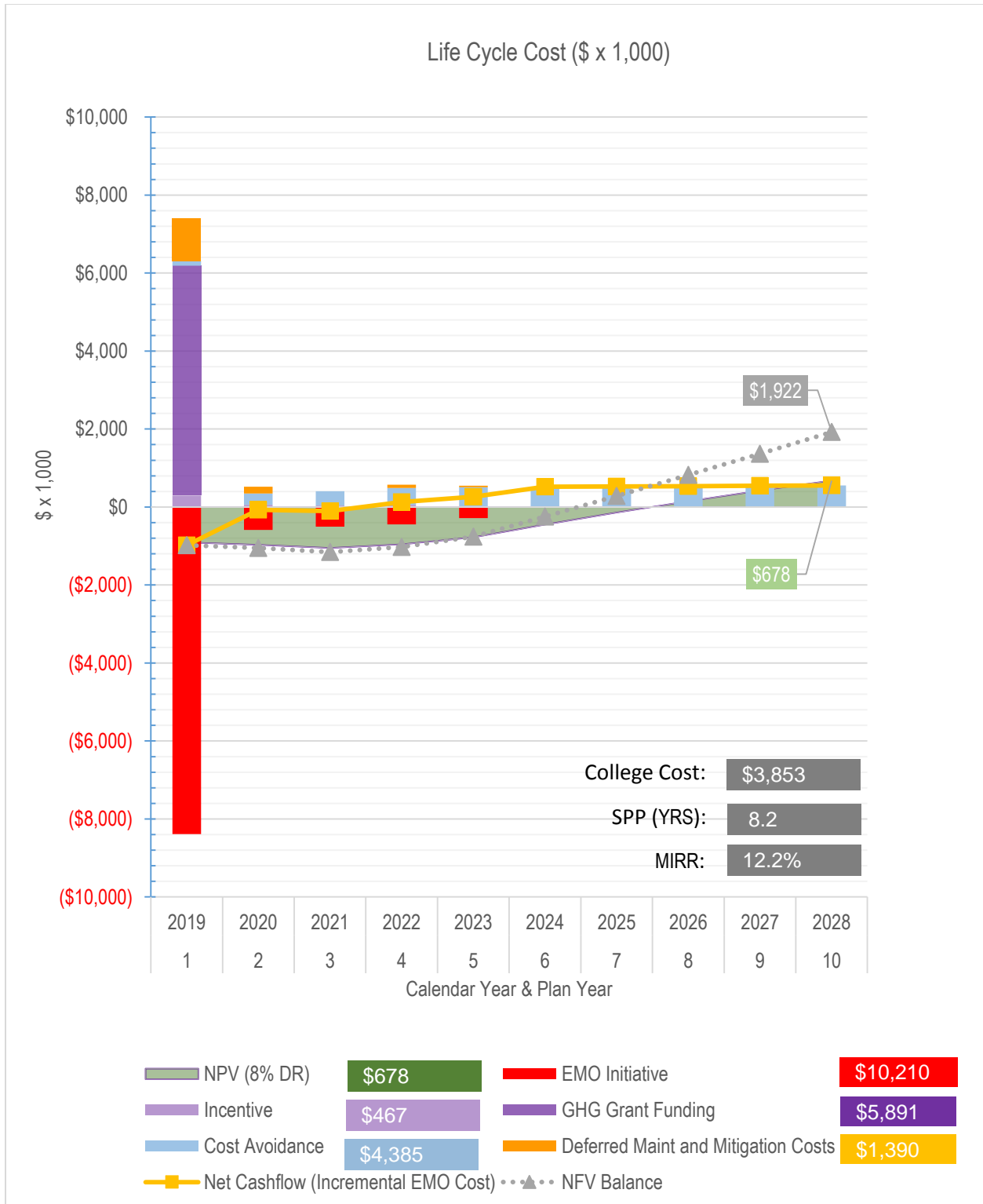
**Table 12: Annual Implementation Budget (\$ x 1,000)**

| EMO Category  | Year 1<br>(2019) | Year 2<br>(2020) | Year 3<br>(2021) | Year 4<br>(2022) | Year 5<br>(2023) | Total           |
|---|------------------|------------------|------------------|------------------|------------------|-----------------|
| <b>Approved</b>   |                  |                  |                  |                  |                  |                 |
| .01 EMO Capital Expenditure   | \$5,208          | \$496            |                  |                  |                  | \$5,704         |
| .03 EMO EMIS  | \$205            |                  |                  |                  |                  | \$205           |
| .05 EMO Employee Awareness & Outreach                                 |                  | \$2              |                  |                  |                  | \$2             |
| .02 EMO Retro-Commissioning and Controls                              | \$71             | \$13             |                  |                  |                  | \$84            |
| .08 EMO Renewable Energy  | \$2,866          | \$69             |                  |                  |                  | \$2,935         |
| .13 Heating Cooling Plant Optimization                                | \$36             |                  |                  |                  |                  | \$36            |
| .10 EMO Cost Control  |                  | \$10             |                  |                  |                  | \$10            |
| <b>Approved Total</b>   | <b>\$8,386</b>   | <b>\$590</b>     |                  |                  |                  | <b>\$8,976</b>  |
| <b>Budgeted Pending Approval</b>                                      |                  |                  |                  |                  |                  |                 |
| .01 EMO Capital Expenditure   |                  |                  | \$52             | \$274            | \$210            | \$536           |
| .03 EMO EMIS  |                  |                  | \$426            |                  |                  | \$426           |
| .05 EMO Employee Awareness & Outreach                                 |                  |                  |                  | \$1              |                  | \$1             |
| .02 EMO Retro-Commissioning and Controls                              |                  |                  | \$28             | \$170            | \$73             | \$271           |
| <b>Budgeted Pending Approval Total</b>                                |                  |                  | <b>\$506</b>     | <b>\$445</b>     | <b>\$283</b>     | <b>\$1,234</b>  |
| <b>Approved</b>   |                  |                  |                  |                  |                  |                 |
| .01 EMO Capital Expenditure   | \$1,481          | \$442            |                  |                  |                  | \$1,922         |
| <b>Capital Expenditure</b>  | <b>\$8,386</b>   | <b>\$590</b>     | <b>\$506</b>     | <b>\$445</b>     | <b>\$283</b>     | <b>\$10,210</b> |
| Approved Budget   | \$8,386          | \$590            | \$0              | \$0              | \$0              | \$8,976         |
| Budget Required   | \$0              | \$0              | \$506            | \$445            | \$283            | \$1,234         |
| <b>Total Cost to College (Expenditure less Incentives and Grants)</b> | <b>\$2,199</b>   | <b>\$532</b>     | <b>\$467</b>     | <b>\$390</b>     | <b>\$266</b>     | <b>\$3,853</b>  |
| Cost Avoidance / Year   | \$239            | \$85             | \$49             | \$63             | \$36             | \$471           |
| Simple Payback  | 35.1             | 7.0              | 10.4             | 7.1              | 7.9              | 21.7            |
| Simple Payback College Funding  | 9.2              | 6.3              | 9.6              | 6.2              | 7.4              | 8.2             |

**Table 13: Annual Energy and GHG Avoidance**

|   | <b>Year 1<br/>(2019)</b> | <b>Year 2<br/>(2020)</b> | <b>Year 3<br/>(2021)</b> | <b>Year 4<br/>(2022)</b> | <b>Year 5<br/>(2023)</b> | <b>Total</b>   |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|----------------|
| Electrical Avoidance (MWh) / Year               | 669                      | 417                      | 263                      | 391                      | 111                      | <b>1,851</b>   |
| Electrical Peak Avoidance (KW)                  | 49                       | 32                       | 38                       | 54                       | 3                        | <b>176</b>     |
| Natural Gas Avoidance (M3) / Year               | 329,573                  | 49,518                   | 22,763                   | 13,937                   | 55,021                   | <b>470,811</b> |
| Total Energy Avoidance (eMWh) / Year            | 4,080                    | 930                      | 499                      | 535                      | 681                      | <b>6,724</b>   |
| Total GHG Avoidance (TCO2e) / Year              | 650                      | 110                      | 54                       | 42                       | 108                      | <b>964</b>     |
| Total Renewable Energy Generation (eMWh) / Year | 1,262                    | 183                      | 0                        | 0                        | 0                        | <b>1,445</b>   |
| Vehicles (GHG Equivalent)                       | 123                      | 21                       | 10                       | 8                        | 21                       | <b>183</b>     |

**Figure 24: Plan Life Cycle Costing<sup>10</sup>**



<sup>10</sup> NPV determined using discount rate of 8% over 10 years. MIRR based on finance rate of 3.7% and re-investment rate of 2% over 10 years.

## Keys to Success & Verification

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This Plan is a living document and requires periodic updates and review of the EMOs implemented, in order to verify performance. Each individual element and phase of the Plan requires targets for implementation, as well as a method for verifying level of performance in meeting specific target. As the nature of the Plan relies on energy cost avoidance to validate payback on investment, and for ongoing investment, the Plan includes utilization of the EMIS and measurement and verification (M&V) best practices to confirm that targets of the Plan are achieved.

Verification of funding availability<sup>11</sup> will be reviewed on an annual basis to confirm the adequacy in meeting the expenditures required. Shortfalls (if any) will be documented and mitigation strategies developed to minimize the impact on targets. The College will pursue other funding opportunities to achieve and accelerate implementation of initiatives and look for ways to incorporate energy measure in non-ECDM capital projects.

Each phase of this Plan plays an integral role in its success. By assigning individual(s) responsibility and pre-determining timelines and milestones for completion, this Plan can be effectively implemented within the annually-approved funding envelop, so that the desired results are achieved.

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11 From operations budget and incentives

## Conclusion

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This Plan will result in a net annual reduction in electrical and natural gas by 1,851 MWh (5%) and 470,811 m<sup>3</sup> (16%) respectively when compared to the Baseline (2023 Projected). This equates to a total net Energy consumption avoidance of 6,724 eMWh (10%) per year, of which 1,445 eMWh per year is due to additional offsets from renewable energy generation. These energy usage avoidances will result in GHG emissions reduction of 964 tCO<sub>2</sub>e (14%), or the equivalent of removing 183 cars or light trucks from use annually. The cumulated amount of GHG reduction over the Plan Life Cycle (10-years) will be 8,864 tCO<sub>2</sub>e, or equivalent to the amount 1,650 vehicles produce in one year.

These EMOs require funding of \$10.21 million of which \$5.89 million is currently funded through provincial GHG funding. Including additional potential incentives of \$467,000, the total “Out of Pocket” expense to the College will be \$3.85 million over the Term of the Plan. Over the 10 year Plan Life Cycle, these investments projected result in total normalized energy cost avoidances of approximately \$4.38 million (\$438,000 average per year). This represents an overall simple payback of just over 8 years when including grants and incentives. In addition to energy and GHG avoidances, \$1.39 million in deferred maintenance is addressed within the measures identified.

This Plan fulfills the College’s regulatory requirements under the Electricity Act, 1998, provides a roadmap for stabilizing and reducing overall operational costs as energy prices increase, and promotes a high-performing and sustainable college.

## Appendix-A: Facility Information

**Table A-1: Facility Info<sup>12</sup>**

| Campus / Facility Name  | Address                            | Owned / Leased | Associated Activity Code | Area (GSF)       |
|-------------------------|------------------------------------|----------------|--------------------------|------------------|
| "A" Building            | 1001 Fanshawe College Blvd, London | OWN            | 1, 2, 3 & 6              | 120,912          |
| "B" Building            | 1001 Fanshawe College Blvd, London | OWN            | 1, 2, 3 & 6              | 199,385          |
| "C" Building            | 1001 Fanshawe College Blvd, London | OWN            | 1, 2, & 3                | 79,842           |
| "D" Building            | 1001 Fanshawe College Blvd, London | OWN            | 1, 2, 3 & 6              | 239,302          |
| "E" Building            | 1001 Fanshawe College Blvd, London | OWN            | 1, 2, 3 & 6              | 49,457           |
| "F" Building            | 1001 Fanshawe College Blvd, London | OWN            | 1, 2, 3 & 6              | 86,466           |
| "G" Building            | 1001 Fanshawe College Blvd, London | OWN            | 1, 2, 3 & 6              | 30,821           |
| "H" Building            | 1001 Fanshawe College Blvd, London | OWN            | 1, 2 & 3                 | 77,138           |
| "J" Building            | 1001 Fanshawe College Blvd, London | OWN            | 1, 2, 3, 5, & 6          | 147,934          |
| "K" Building            | 1001 Fanshawe College Blvd, London | OWN            | 1, 2, & 3                | 13,370           |
| "L" Building            | 1001 Fanshawe College Blvd, London | OWN            | 1, 2, 3 & 6              | 40,893           |
| "M" Building            | 1001 Fanshawe College Blvd, London | OWN            | 1, 2, 3 & 6              | 91,505           |
| "N" Building            | 1001 Fanshawe College Blvd, London | OWN            | 1, 2, & 3                | 4,025            |
| "R1" Residence          | 1001 Fanshawe College Blvd, London | OWN            | 1, 2 & 4                 | 150,018          |
| "R2" Residence          | 1001 Fanshawe College Blvd, London | OWN            | 1 & 4                    | 142,164          |
| "R3" Residence          | 1001 Fanshawe College Blvd, London | OWN            | 4                        | 154,886          |
| "R4" (12 Buildings)     | 900 Fanshawe College BLVD, London  | OWN            | 4                        | 134,625          |
| "SC" Building           | 1001 Fanshawe College Blvd, London | OWN            | 1 & 2                    | 50,717           |
| "SUB" Building          | 1001 Fanshawe College Blvd, London | OWN            | 1 & 2                    | 24,792           |
| "T" Building            | 1001 Fanshawe College Blvd, London | OWN            | 1, 2, 3 & 6              | 111,669          |
| "Y" Building            | 1001 Air Ontario Blvd, London      | OWN            | 1, 2 & 3                 | 81,400           |
| "Z" Building            | 1764 Oxford St, London             | OWN            | 1, 2, 3 & 6              | 149,866          |
| "LD-A" Building         | 137 Dundas St, London              | OWN            | 1, 2, 3 & 6              | 58,598           |
| "LD-B" Building         | 130 Dundas St., London             | OWN            | 1, 2, 3 & 6              | 116,000          |
| 2 Cuddy Facility        | 2 Cuddy Crt, London                | OWN            | 2                        | 45,456           |
| "LR-A" CCPV             | 2555 Bonder Rd, London             | OWN            | 1, 3                     | 37,039           |
| Cuddy Farm              | 28443 Centre Rd, Strathroy         | OWN            | 3                        | 6,501            |
| LSD-NELSON PLAZA        | 155 Clarke Rd., London             | LEASE          | 1 & 2                    | 2,535            |
| HURON-Goderich          | 33 St. David St., Goderich         | LEASE          | 2                        | 1,500            |
| St. Thomas Elgin Campus | 120 Bill Martyn Pkwy, St. Thomas   | OWN            | 1, 2, 3 & 6              | 45,132           |
| Oxford County Campus    | 369 Finkle St, Woodstock           | LEASE          | 1, 2, 3 & 6              | 17,674           |
| JNA Campus Simcoe       | 634 Ireland Rd, Simcoe             | OWN            | 1, 2, 3 & 6              | 31,774           |
| ELGN-STT 417            | 417 Wellington St., St. Thomas     | LEASE          | 1, 2                     | 2,807            |
| "LD-XB"                 | 431 Richmond St., London           | LEASE          | 1 & 2                    | 7,632            |
| <b>Total</b>            |                                    | <b>34</b>      |                          | <b>2,553,835</b> |

12 Current as of commencement of Plan Publication (July 1, 2019)

**Table A-2: Activity Code**

| <b>Activity Code</b> | <b>Description</b>   |
|----------------------|--|
| 1                    | Administrative offices and related facilities  |
| 2                    | Classrooms and related facilities  |
| 3                    | Laboratories   |
| 4                    | Student residences that have more than three storeys or a building area of more than 600 square metres |
| 5                    | Student recreational facilities and athletic facilities  |
| 6                    | Libraries  |
| 7                    | Parking garages  |



## Appendix-B: Energy Usage

**Table B-1: 2017 Usage Data**

| Building                | Electrical Usage (MWh) | Natural Gas Usage (eMWh) | Solar (eMWh) | Total Energy (eMWh) | Natural Gas Usage (M3) | Total GHG (tCO2e) |
|-------------------------|------------------------|--------------------------|--------------|---------------------|------------------------|-------------------|
| "A" Building            | 1,830                  | 947                      | 0            | 2,778               | 91,540                 | 246               |
| "B" Building            | 2,139                  | 1,574                    | 0            | 3,713               | 152,105                | 373               |
| "C" Building            | 529                    | 104                      | 0            | 632                 | 10,030                 | 40                |
| "D" Building            | 3,728                  | 5,349                    | 0            | 9,078               | 516,850                | 1,126             |
| "E" Building            | 836                    | 0                        | 0            | 836                 | 0                      | 33                |
| "F" Building            | 1,358                  | 505                      | 0            | 1,862               | 48,764                 | 146               |
| "G" Building            | 657                    | 62                       | 0            | 719                 | 5,990                  | 38                |
| "H" Building            | 1,315                  | 365                      | 0            | 1,680               | 35,312                 | 119               |
| "J" Building            | 1,601                  | 589                      | 22           | 2,211               | 56,876                 | 172               |
| "K" Building            | 162                    | 149                      | 0            | 311                 | 14,375                 | 34                |
| "L" Building            | 458                    | 0                        | 0            | 458                 | 0                      | 18                |
| "M" Building            | 1,737                  | 603                      | 0            | 2,339               | 58,259                 | 180               |
| "N" Building            | 172                    | 370                      | 0            | 541                 | 35,707                 | 74                |
| "R1" Residence          | 1,093                  | 1,018                    | 0            | 2,111               | 98,380                 | 230               |
| "R2" Residence          | 1,092                  | 1,055                    | 0            | 2,146               | 101,891                | 236               |
| "R3" Residence          | 1,208                  | 898                      | 0            | 2,106               | 86,744                 | 212               |
| "R4" (12 Buildings)     | 405                    | 1,100                    | 0            | 1,506               | 106,316                | 217               |
| "SC" Building           | 656                    | 303                      | 0            | 959                 | 29,300                 | 82                |
| "SUB" Building          | 503                    | 657                      | 0            | 1,160               | 63,477                 | 140               |
| "T" Building            | 1,750                  | 881                      | 0            | 2,631               | 85,138                 | 231               |
| "Y" Building            | 406                    | 861                      | 0            | 1,267               | 83,205                 | 174               |
| "Z" Building            | 1,469                  | 1,939                    | 1            | 3,409               | 187,323                | 413               |
| "LD-A" Building         | 922                    | 528                      | 0            | 1,450               | 51,029                 | 133               |
| 2 Cuddy Facility        | 76                     | 344                      | 0            | 420                 | 33,261                 | 66                |
| "LR-A" CCPV             | 469                    | 301                      | 0            | 770                 | 29,085                 | 74                |
| Cuddy Farm              | 46                     | 54                       | 0            | 100                 | 5,258                  | 12                |
| LSD-NELSON PLAZA        | 62                     | 53                       | 0            | 116                 | 5,149                  | 12                |
| HURON-Goderich          | 17                     | 55                       | 0            | 72                  | 5,266                  | 11                |
| St. Thomas Elgin Campus | 803                    | 900                      | 21           | 1,723               | 86,909                 | 196               |
| Oxford County Campus    | 301                    | 136                      | 0            | 437                 | 13,186                 | 37                |
| JNA Campus Simcoe       | 407                    | 247                      | 0            | 654                 | 23,911                 | 61                |
| ELGN-STT 417            | 23                     | 33                       | 0            | 56                  | 3,234                  | 7                 |
| LC Sign                 | 6                      | 0                        | 0            | 6                   | 0                      | 0                 |
| <b>Total</b>            | <b>28,234</b>          | <b>21,982</b>            | <b>44</b>    | <b>50,259</b>       | <b>2,123,869</b>       | <b>5,145</b>      |

**Table B-2: 2018 Usage Data**

| Building                | Electrical Usage (MWh) | Natural Gas Usage (eMWh) | Solar (eMWh) | Total Energy (eMWh) | Natural Gas Usage (M3) | Total GHG (tCO2e) |
|-------------------------|------------------------|--------------------------|--------------|---------------------|------------------------|-------------------|
| "A" Building            | 1,927                  | 834                      | 0            | 2,761               | 80,534                 | 229               |
| "B" Building            | 2,171                  | 1,907                    | 0            | 4,078               | 184,233                | 435               |
| "C" Building            | 488                    | 173                      | 0            | 661                 | 16,698                 | 51                |
| "D" Building            | 3,926                  | 5,881                    | 0            | 9,807               | 568,252                | 1,231             |
| "E" Building            | 880                    | 0                        | 0            | 880                 | 0                      | 35                |
| "F" Building            | 1,429                  | 618                      | 0            | 2,048               | 59,726                 | 170               |
| "G" Building            | 838                    | 62                       | 0            | 900                 | 6,009                  | 45                |
| "H" Building            | 1,307                  | 448                      | 82           | 1,836               | 43,250                 | 134               |
| "J" Building            | 1,715                  | 476                      | 22           | 2,213               | 46,013                 | 156               |
| "K" Building            | 162                    | 172                      | 0            | 334                 | 16,629                 | 38                |
| "L" Building            | 482                    | 0                        | 0            | 482                 | 0                      | 19                |
| "M" Building            | 1,791                  | 729                      | 0            | 2,520               | 70,439                 | 205               |
| "N" Building            | 177                    | 447                      | 0            | 624                 | 43,173                 | 89                |
| "R1" Residence          | 1,068                  | 1,212                    | 0            | 2,280               | 117,123                | 264               |
| "R2" Residence          | 1,102                  | 740                      | 0            | 1,842               | 71,508                 | 179               |
| "R3" Residence          | 1,245                  | 1,092                    | 0            | 2,337               | 105,497                | 249               |
| "R4" (12 Buildings)     | 438                    | 1,275                    | 0            | 1,714               | 123,225                | 250               |
| "SC" Building           | 686                    | 245                      | 0            | 931                 | 23,704                 | 72                |
| "SUB" Building          | 530                    | 718                      | 0            | 1,247               | 69,334                 | 152               |
| "T" Building            | 1,777                  | 1,037                    | 0            | 2,814               | 100,238                | 261               |
| "Y" Building            | 420                    | 906                      | 0            | 1,326               | 87,537                 | 182               |
| "Z" Building            | 1,498                  | 1,810                    | 1            | 3,309               | 174,879                | 391               |
| "LD-A" Building         | 1,426                  | 496                      | 0            | 1,922               | 47,916                 | 148               |
| "LD-B" Building         | 1,255                  | 963                      | 0            | 2,217               | 93,016                 | 226               |
| 2 Cuddy Facility        | 117                    | 535                      | 0            | 652                 | 51,701                 | 102               |
| "LR-A" CCPV             | 506                    | 351                      | 0            | 857                 | 33,946                 | 84                |
| Cuddy Farm              | 40                     | 91                       | 0            | 130                 | 8,762                  | 18                |
| LSD-NELSON PLAZA        | 62                     | 39                       | 0            | 101                 | 3,747                  | 10                |
| HURON-Goderich          | 18                     | 71                       | 0            | 89                  | 6,872                  | 14                |
| St. Thomas Elgin Campus | 852                    | 965                      | 18           | 1,835               | 93,213                 | 210               |
| Oxford County Campus    | 330                    | 149                      | 0            | 479                 | 14,422                 | 40                |
| JNA Campus Simcoe       | 380                    | 238                      | 0            | 619                 | 23,028                 | 59                |
| ELGN-STT 417            | 21                     | 31                       | 0            | 52                  | 2,977                  | 6                 |
| "LD-XB"                 | 71                     | 32                       | 0            | 103                 | 3,059                  | 9                 |
| LC Sign                 | 5                      | 0                        | 0            | 5                   | 0                      | 0                 |
| <b>Total</b>            | <b>31,138</b>          | <b>24,744</b>            | <b>123</b>   | <b>56,005</b>       | <b>2,390,658</b>       | <b>5,765</b>      |

## Appendix-C: Renewable Energy Generation

### Existing Renewable Energy

The College has several generators of renewable energy in the form of solar electrical and thermal heating (water). Table C-1 shows details regarding the existing<sup>13</sup> current renewable energy generation at the College.

**Table C-1: Renewable Energy (Existing)**

| Phase / Year   | CapEx (x \$1,000) | Cost Avoidance (x \$1,000) | Elec Avoidance (MWh) | Elec Peak Avoidance (kW) | Natural Gas Avoidance (M3) | Total Energy (eMWh) | GHG Avoidance (tCO2e) | Renewable Energy Generation (eMWh) |
|--|-------------------|----------------------------|----------------------|--------------------------|----------------------------|---------------------|-----------------------|------------------------------------|
| <b>2011</b>  | <b>\$30</b>       | <b>\$0</b>                 | <b>0</b>             | <b>0</b>                 | <b>108</b>                 | <b>1</b>            | <b>0</b>              | <b>1</b>                           |
| <b>CATT - Solar Hot Water</b>                        |                   |                            |                      |                          |                            |                     |                       |                                    |
| LC-Z (1764)  | \$30              | \$0                        | 0                    | 0                        | 108                        | 1                   | 0                     | 1                                  |
| <b>2013</b>  | <b>\$179</b>      | <b>\$3</b>                 | <b>17</b>            | <b>10</b>                | <b>0</b>                   | <b>17</b>           | <b>1</b>              | <b>17</b>                          |
| <b>St. Thomas Solar PV</b>                           |                   |                            |                      |                          |                            |                     |                       |                                    |
| ELGN-STT   | \$179             | \$3                        | 17                   | 10                       | 0                          | 17                  | 1                     | 17                                 |
| <b>2017</b>  | <b>\$70</b>       | <b>\$1</b>                 | <b>0</b>             | <b>0</b>                 | <b>2,099</b>               | <b>22</b>           | <b>4</b>              | <b>17</b>                          |
| <b>Solar Water Heating for DHW and System Reheat</b> |                   |                            |                      |                          |                            |                     |                       |                                    |
| LC-J   | \$70              | \$1                        | 0                    | 0                        | 2,099                      | 22                  | 4                     | 17                                 |
| <b>2018</b>  | <b>\$297</b>      | <b>\$23</b>                | <b>153</b>           | <b>129</b>               | <b>0</b>                   | <b>153</b>          | <b>6</b>              | <b>153</b>                         |
| <b>Roof Solar PV</b>                                 |                   |                            |                      |                          |                            |                     |                       |                                    |
| LC-H   | \$297             | \$23                       | 153                  | 129                      | 0                          | 153                 | 6                     | 153                                |
| <b>Grand Total</b>                                   | <b>\$576</b>      | <b>\$26</b>                | <b>170</b>           | <b>139</b>               | <b>2,207</b>               | <b>193</b>          | <b>11</b>             | <b>189</b>                         |

#### St. Thomas Campus Solar Arrays:

This project included the installation of a dual tracking 10kW solar PV Array system at the St. Thomas Elgin Campus. This system was installed in 2013 and generates approximately 17MWh of electricity to offset the usage at this campus.

#### “Z” Building Solar Hot Water:

In 2011, “Z” Building was expanded and renovated to house the College’s Centre for Applied Transportation Technology (CATT), and was equipped with a solar domestic hot water system. This system is estimated to offset the equivalent of 108 m3 of natural gas per year (1.4 MMBtu/year).

13 Existing as of December 31, 2018

### “J-Wellness” Building Solar Hot Water:

In 2017, “J” Building Wellness expansion was completed adding a solar domestic hot water preheat system. This system is estimated to offset the equivalent of 2,099 m<sup>3</sup> of natural gas per year (27 MMBtu/year).

### “H” Building Solar PV:

In 2018 the installed 129 kW DC Solar PV on H Building Roof. This system generates 153 MWh per year, of electricity to offset the usage on H Building, which equates to about an annual reduction in GHG emissions by 6 tCO<sub>2</sub>e.

## Renewable Energy Capital Projects:

Several EMOs are currently underway or identified as candidates for renewable energy implementation. These initiatives included Solar Wall Ventilation air preheat in Buildings B, C, D, R1 & R2 (completion summer 2019), and Solar Hot water heating at the St. Thomas Elgin Campus (targeting completion in 2020). Table C-2 shows details regarding these initiatives.

**Table C-2: Renewable Energy (Future)**

| Phase / Year   | CapEx (x \$1,000) | Cost Avoidance (x \$1,000) | Elec Avoidance (MWh) | Elec Peak Avoidance (kW) | Natural Gas Avoidance (M3) | Total Energy (eMWh) | GHG Avoidance (tCO <sub>2</sub> e) | Renewable Energy Generation (eMWh) |
|--|-------------------|----------------------------|----------------------|--------------------------|----------------------------|---------------------|------------------------------------|------------------------------------|
| <b>2019</b>  | <b>\$2,866</b>    | <b>\$47</b>                | <b>-45</b>           | <b>-2</b>                | <b>152,365</b>             | <b>1,532</b>        | <b>286</b>                         | <b>1,262</b>                       |
| <b>LC-B Ventilation Solar Wall</b>                   |                   |                            |                      |                          |                            |                     |                                    |                                    |
| LC-B   | \$175             | \$3                        | -2                   | 0                        | 9,520                      | 97                  | 18                                 | 79                                 |
| <b>LC-C Ventilation Solar Wall</b>                   |                   |                            |                      |                          |                            |                     |                                    |                                    |
| LC-C   | \$625             | \$9                        | -10                  | 0                        | 28,266                     | 283                 | 53                                 | 234                                |
| <b>LC-D Ventilation Solar Wall</b>                   |                   |                            |                      |                          |                            |                     |                                    |                                    |
| LC-D   | \$1,394           | \$24                       | -28                  | -1                       | 80,537                     | 805                 | 151                                | 667                                |
| <b>LC-R1 Ventilation Solar Wall</b>                  |                   |                            |                      |                          |                            |                     |                                    |                                    |
| LC-R1  | \$317             | \$5                        | -2                   | 0                        | 15,204                     | 155                 | 29                                 | 126                                |
| <b>LC-R2 Ventilation Solar Wall</b>                  |                   |                            |                      |                          |                            |                     |                                    |                                    |
| LC-R2  | \$355             | \$7                        | -2                   | 0                        | 18,838                     | 193                 | 36                                 | 156                                |
| <b>2020</b>  | <b>\$69</b>       | <b>\$8</b>                 | <b>0</b>             | <b>-1</b>                | <b>22,149</b>              | <b>229</b>          | <b>42</b>                          | <b>183</b>                         |
| <b>Solar Water Heating for DHW and System Reheat</b> |                   |                            |                      |                          |                            |                     |                                    |                                    |
| ELGN-STT   | \$69              | \$8                        | 0                    | -1                       | 22,149                     | 229                 | 42                                 | 183                                |
| <b>Grand Total</b>                                   | <b>\$2,935</b>    | <b>\$55</b>                | <b>-45</b>           | <b>-3</b>                | <b>174,514</b>             | <b>1,761</b>        | <b>328</b>                         | <b>1,445</b>                       |

## **Renewable Energy Research and Education:**

In collaboration with various academic programs, the College is completing the installation of Solar PV arrays in D Building courtyard. The electrical energy generated by these panels are connected back to an off grid system, which heats domestic hot water, using the existing tanks as energy storage, and in turn offsetting natural gas consumption. As this is part of research and education, persistence of the generation may vary; the offsets are not included in this Plan. As installed in 2019, a minimum 17 MWh in electricity is estimated to be generated, offsetting 2,053 m<sup>3</sup> in natural gas consumption, and reducing GHG emissions by about 3.8 tCO<sub>2</sub>e annually.

## Appendix-D: Glossary of Terms & Conversions

|                                     |  |
|-------------------------------------|--|
| <b>ASHRAE</b>                       | American Society of Heating, Refrigeration, and Air Conditioning Engineers   |
| <b>British Thermal Units (BTU):</b> | The unit of heat in the imperial system can be defined in two ways: The amount of heat required to raise the temperature of one pound of water through 1oF (58.5oF - 59.5oF) at sea level (30 inches of mercury). 1 BTU = 1055.06 J = 107.6 kpm = 2.931 10 <sup>-4</sup> kWh = 0.252   |
| <b>Cost/Energy Saving:</b>          | The cost/energy savings as result of implementation of EMOs imply cost avoidance   |
| <b>Cooling Degree Day (CDD)</b>     | Degree-days are calculated by the average temperature above or below the base temperature (exterior temperature where heating or cooling is not required depending on desired interior temperature) times the number of days. For example assuming base temperature of 72dF and average exterior temperature of 52df for 5 days, the HDD = (72-52) x 5 = 100 HDD for that period (F days/year).        |
| <b>EMO</b>                          | Energy Management Opportunity  |
| <b>Energy Use(d)</b>                | Energy required for end use or process (or output energy).   |
| <b>Energy (or Fuel) Consumption</b> | Input energy or unit of measure (i.e. MWh electricity or m3 natural gas), from utility or source. Equals Energy required divided by efficiency of energy conversion equipment (boiler, chiller, etc.)  |
| <b>Gigajoule (GJ)</b>               | The unit of heat in the SI-system the Joule is: The mechanical energy, which must be expended to raise the temperature of a unit weight (2 kg) of water from 0oC to 1oC, or from 32oF to 33oF. 1 J (Joule) = 0.1020 kpm = 2.778 10 <sup>-7</sup> kWh = 2.389 10 <sup>-4</sup> kcal = 0.7376 ft.lbf = 1 kg.m <sup>2</sup> /s <sup>2</sup> = 1 watt second = 1 Nm = 1 ft.lb = 9.478 10 <sup>-4</sup> Btu |
| <b>GHG Emission Factors</b>         | GHG Emission Conversion Factors: 1890.63 gCO <sub>2</sub> /m <sup>3</sup> of NG and 80 gCO <sub>2</sub> /kWh.  |
| <b>Heating Degree Day (HDD)</b>     | See note for Cooling Degree Day  |
| <b>HVAC</b>                         | Heating Ventilation and Air-conditioning   |
| <b>Kilowatt Hour (kWh)</b>          | Is the amount of power consumed/generated over a period of one hour  |
| <b>Megawatt hour (MWh)</b>          | 1 MWh = 1,000 kWh  |
| <b>Net Energy Consumption</b>       | Total energy used minus amount of renewable energy generated.  |
| <b>Net Zero Energy (NEB)</b>        | A building with zero Net Energy Consumption  |
| <b>LED</b>                          | Light Emitting Diode   |
| <b>Simple Payback</b>               | Simple Payback is calculated by total expenditure / annual cost savings. Simple payback does not take into consideration increase in energy costs over the years or inflation.   |