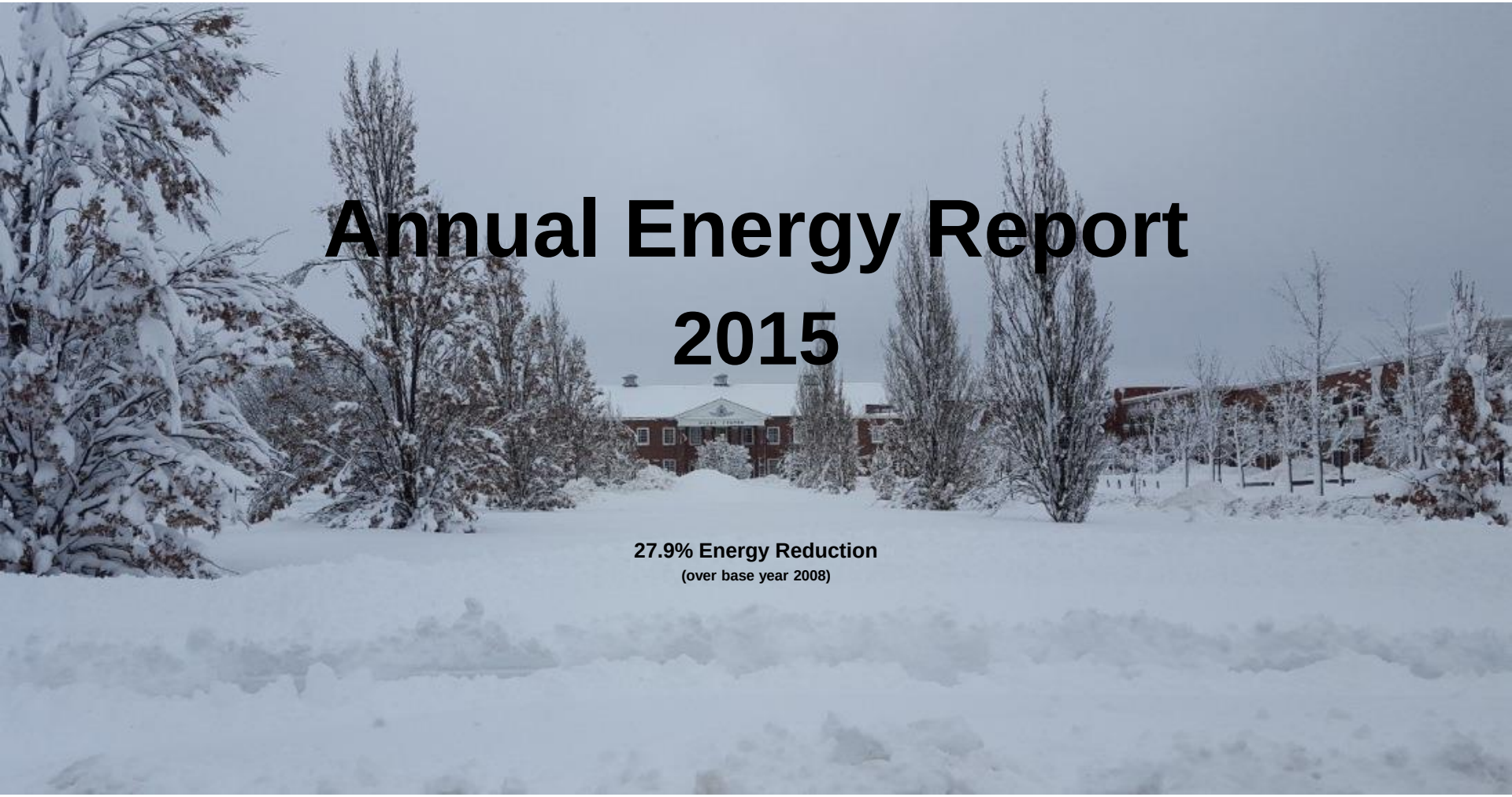
ST. FRANCIS XAVIER UNIVERSITY



Annual Energy Report 2015

27.9% Energy Reduction
(over base year 2008)

CANADA'S PREMIER UNDERGRADUATE EXPERIENCE

CONTENTS

1.0 Introduction and Executive Summary

Introduction:

St. Francis Xavier University started on a sustainability track when the decision was made in 2007 to make the investment to install individual building sub-metering to start tracking electricity and steam consumption at the building level. This metering project was completed in 2008 and the data collecting software installation was completed in 2010.

It was during this time that the decision was also made to proceed with the University's first LEED building construction project – The Coady International Institute (LEED Certified). All new construction since this time has been to LEED standards, Schwartz School of Business 2010 (LEED Silver) and two new residence buildings, O'Regan and Riley Halls 2013 (LEED Silver).

To further strengthen the University's sustainability plan, in the fall of 2010, StFX dedicated the Supervisor of Energy & Utilities to energy management tasks. FM's six (6) year objective is to reduce energy intensity by 30% (compared to 2008) by the end of 2016.

Executive Summary:

This report summarizes the progress of StFX University's energy program from 2008 (base year) to 2015 and provides an outline of future sustainability/energy reduction initiatives.

Energy Consumption
In 2015, StFX University's purchased energy (GJ) was **15.47%** less than that in 2008. Energy Use Intensity **(EUI)** had a reduction of **21.4%** (compared to 2008) and when normalized to weather, the reduction is **27.9%**.

GHG
Total GHG was **28.9%** less in 2015 than 2008.

Cost Avoidance
Total energy cost avoidance in 2015 was **$569,900**.

By 2020, it is FM's objective to reduce GHG by 50% compared to 2008.

2.0 Terms and Definitions

1) Energy Units:

Gigajoule (GJ): is the metric unit used for measuring energy. Common equivalents:

1000 kWh	=	3.6 GJ	Electricity is purchased from the Town of Antigonish Electric Utility
1000 L of Bunker Fuel	=	38.7 GJ	Types of heating fuels used on campus
1000 L of Furnace Oil	=	38.9 GJ	
1000 L of Fish Oil	=	35.0 GJ	
1000 L of Propane	=	25.8 GJ	

2) Area:

Square Metre (M^2): 1 M^2 = 10.76 ft^2

3) Weather and Degree Days:

- Heating fuel use has a direct correlation to outside air temperature.
- Energy use is therefore normalized to weather (this results in a more accurate comparison of consumption.)

Degree Days:

- is the measure of heating or cooling compared to a base temperature.
- if the base temperature is 18 degrees C and the outside temperature is 17 degrees for a 24 hour period, then 1 Heating Degree Day (HDD) is generated. If outside temperature is 19 degrees for a 24 hour period, then 1 Cooling Degree Day (CDD) is generated.
- degree days are calculated in ½ hour increments over 24 hours (in the weather station).

Link to StFX Weather Station: http://people.stfx.ca/schishol/weather/Current_Monitor.htm

4) Energy Use Intensity (EUI):

EUI is the amount of energy **(GJ)** used in a building per sq.ft. **(or M^2)** per year. This report will show EUI in **GJ/M^2.**

For more information on EUI, visit: http://www.nrcan.gc.ca/energy/efficiency/buildings/energy-benchmarking/building/3721

5) Green House Gas (GHG) Emissions:

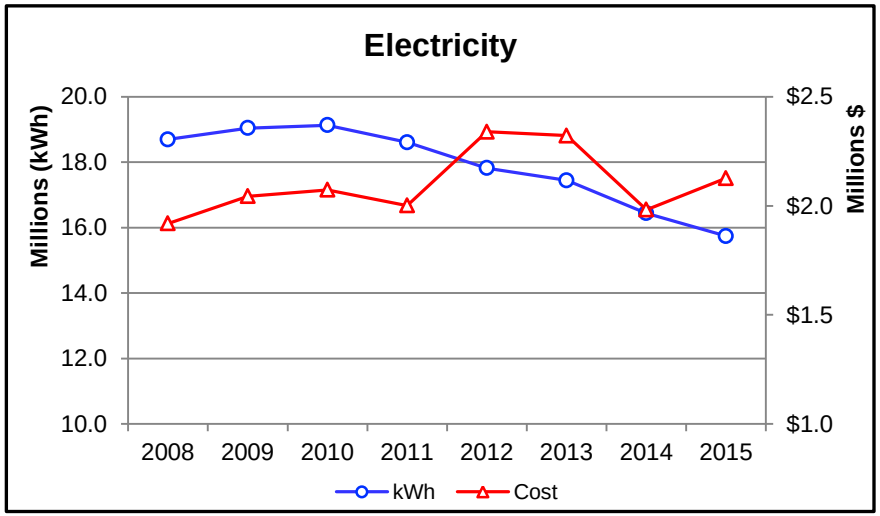
GHG emissions are commonly reported in metric tonnes (**MT**) of carbon dioxide equivalents (**CO_2e**)

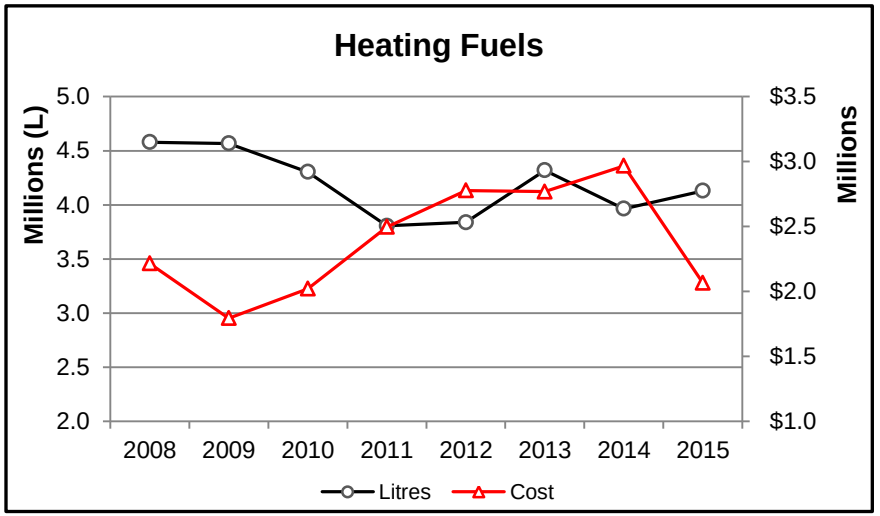
For more information on GHG, visit: https://en.wikipedia.org/wiki/Greenhouse_gas

3.0 Energy Consumption and Cost Table (kWh electricity and litres of fuel)

	Electricity		Heating Fuels								Total Utilities
			CHP		Light Oil		Propane		Total Fuels		
	kWh	Cost	Litres	Cost	Litres	Cost	Litres	Cost	Litres	Cost	Cost
2008	18,692,451	$1,918,922	4,301,731	$1,999,454	124,572	$102,069	92,119	$51,754	4,518,421	$2,153,276	$4,072,198
2009	19,043,207	$2,043,908	4,295,639	$1,657,022	140,732	$78,775	80,408	$33,862	4,516,779	$1,769,659	$3,813,566
2010	19,130,235	$2,072,993	4,052,355	$1,852,694	120,547	$81,606	81,016	$37,215	4,253,919	$1,971,514	$4,044,507
2011	18,605,195	$2,001,095	3,546,756	$2,288,897	132,706	$116,101	78,076	$40,232	3,757,538	$2,445,230	$4,446,325
2012	17,820,865	$2,339,562	3,591,444	$2,559,422	130,053	$120,109	63,386	$27,053	3,784,882	$2,706,585	$5,046,147
2013	17,440,212	$2,321,993	4,061,392	$2,538,743	127,132	$117,583	75,550	$39,408	4,264,074	$2,695,734	$5,017,727
2014	16,438,623	$1,982,293	3,712,488	$2,747,928	86,290	$80,743	113,003	$68,845	3,911,781	$2,897,517	$4,879,809
2015	15,740,243	$2,126,618	3,905,241	$1,943,219	98,540	$61,464	108,528	$41,856	4,112,309	$2,046,538	$4,173,157

4.0 Energy Consumption and Cost Graphs (kWh and litres of Fuel)





5.0 Energy Consumption Table in GJ's

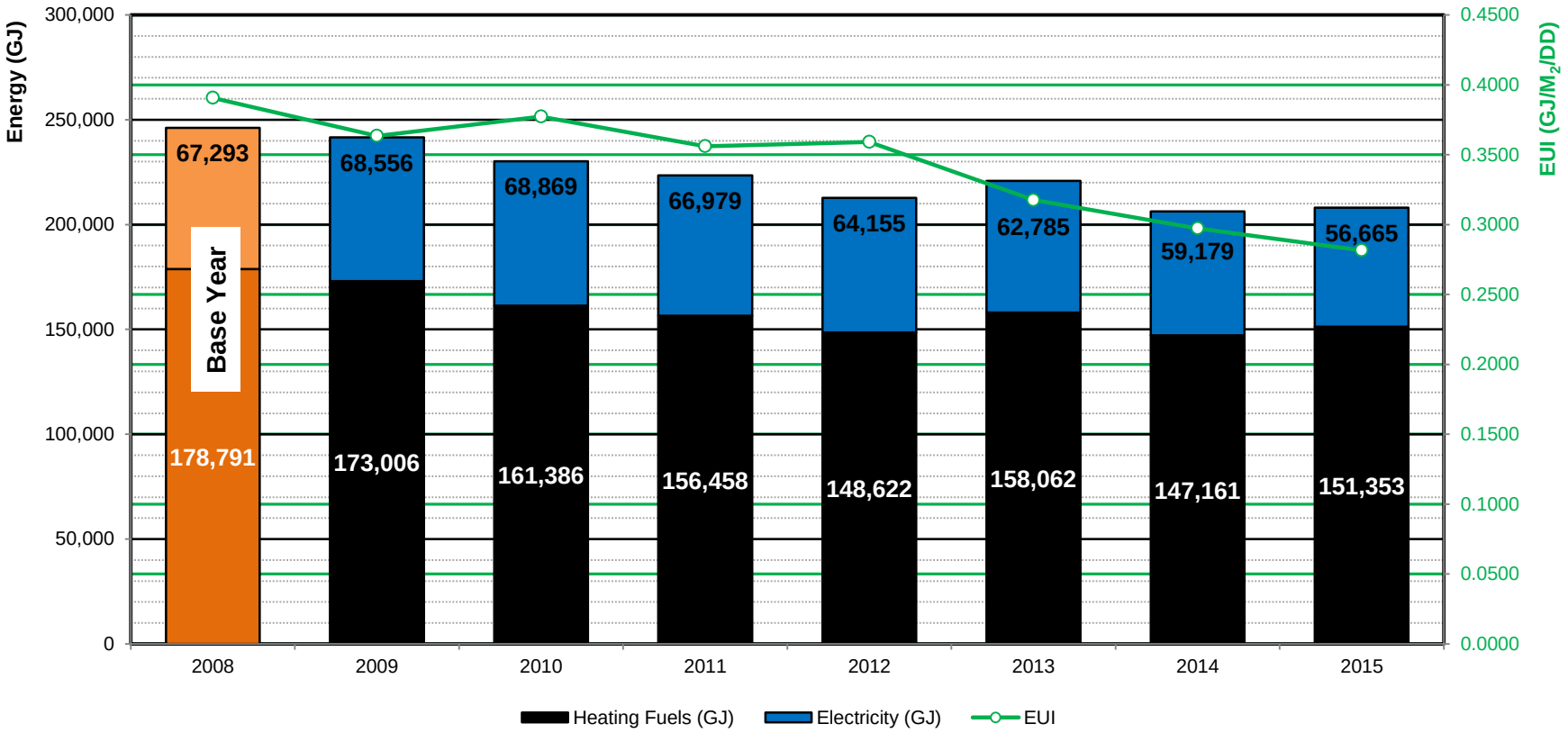
Energy Sources	2008	2009	2010	2011	2012	2013	2014	2015	% Change (2008-15)
Electricity	**67,293**	**68,556**	**68,869**	**66,979**	**64,155**	**62,785**	**59,179**	**56,665**	**-15.79%**
CHP Fuels (Bunker A/B/C, BioFuel, #2)	171,578	165,466	154,615	149,290	141,935	151,176	140,897	144,728	-15.65%
Furnace Oil (#2) - Misc. Bldgs.	4,840	5,468	4,683	5,156	5,053	4,939	3,352	3,828	-20.90%
Propane - Misc. Bldgs.	2,374	2,072	2,088	2,012	1,633	1,947	2,912	2,797	17.81%
Heating Fuels Energy (GJ)	**178,791**	**173,006**	**161,386**	**156,458**	**148,622**	**158,062**	**147,161**	**151,353**	**-15.35%**
Total Energy (GJ)	**246,084**	**241,561**	**230,255**	**223,437**	**212,777**	**220,847**	**206,340**	**208,018**	**-15.47%**

6.0 Energy Use Intensity (EUI)

EUI is the amount of energy **(GJ)** used in a building per sq.ft. **(or M^2)** per year. This report will show EUI in **GJ/M^2.**

	TOTAL ENERGY	CAMPUS AREA	ENERGY USE INTENSITY (EUI)	
	(GJ)	Campus Area (M^2)	GJ/M^2	% Change Compared to 2008
2008	246,084	158,456	1.55	
2009	241,561	159,489	1.51	-2.47%
2010	230,255	159,489	1.44	-7.04%
2011	223,437	159,675	1.40	-9.90%
2012	212,777	159,675	1.33	-14.19%
2013	220,847	170,409	1.30	-16.55%
2014	206,340	170,409	1.21	-22.03%
2015	208,018	170,409	1.22	-21.40%

7.0 Total Energy Consumption (GJ) and Energy Use Intensity (EUI)



8.0 Weather Data

Heating fuel use has a direct correlation to outside air temperature. Energy use is therefore normalized to weather (this results in a more accurate comparison of consumption.)

Degree Days:

is the measure of heating or cooling compared to a base temperature.

if the base temperature is 18 degrees C and the outside temperature is 17 degrees for a 24 hour period, then 1 Heating Degree Day (HDD) is generated.

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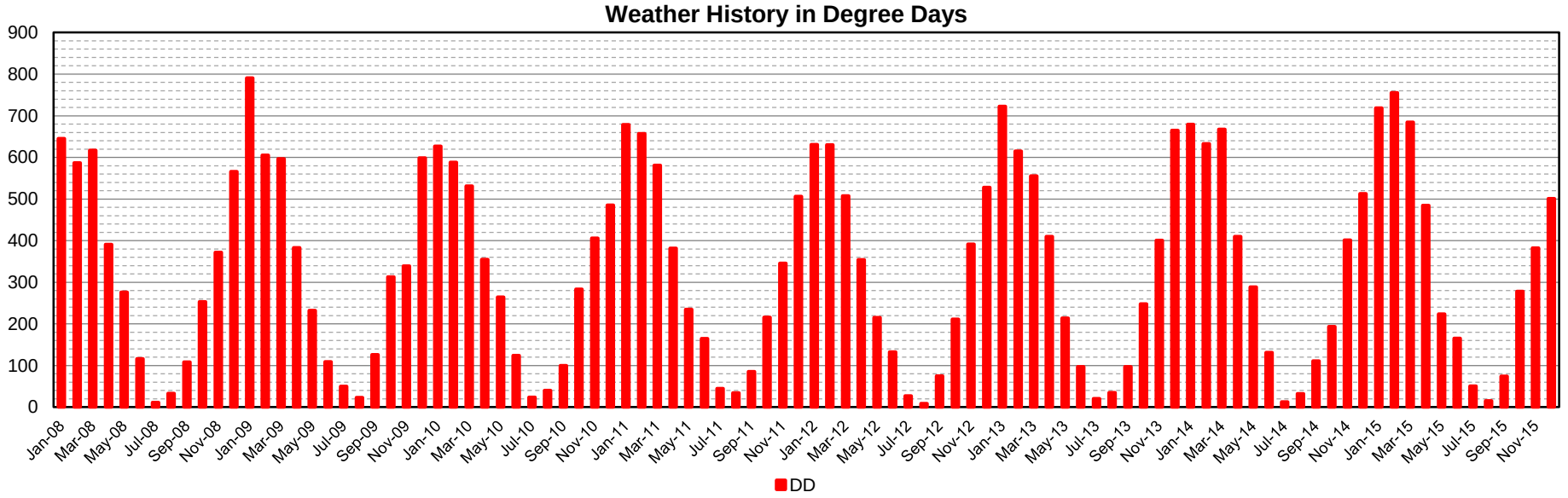


9.0 EUI normalized to Weather

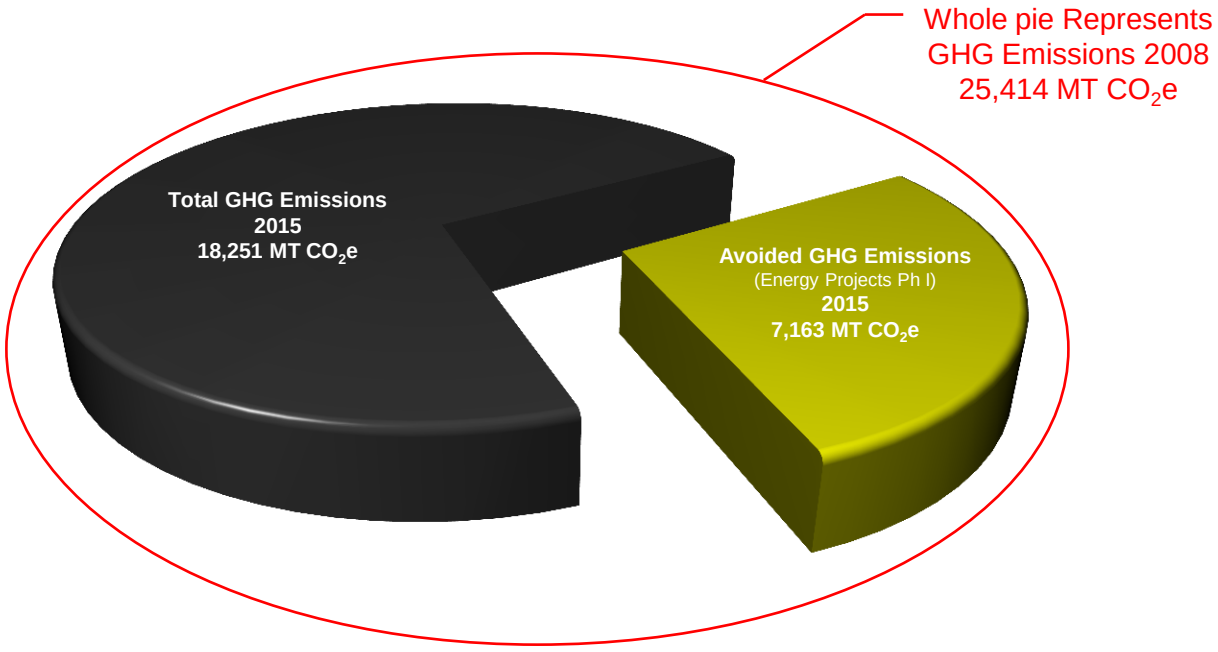
	TOTAL ENERGY	CAMPUS AREA	ENERGY USE INTENSITY (EUI)			
					Weather Normalized	
	(GJ)	Campus Area (M^2)	GJ/M^2	DD	(GJ/M^2/DD)	Percent Change (over Base Year - 2008)
2008	246,084	158,456	1.55	3,975	0.3907	
2009	241,561	159,489	1.51	4,167	0.3635	-7.0%
2010	230,255	159,489	1.44	3,827	0.3772	-3.4%
2011	223,437	159,675	1.40	3,930	0.3560	-8.9%
2012	212,777	159,675	1.33	3,711	0.3591	-8.1%
2013	220,847	170,409	1.30	4,081	0.3176	-18.7%
2014	206,340	170,409	1.21	4,072	0.2973	-23.9%
2015	208,018	170,409	1.22	4,334	0.2816	-27.9%

10.0 Avoided Energy Cost 2015:

	Electricity (kWh)	Heating Fuel (Litres)	Total Avoided Cost
2008	18,753,651	4,518,421	
2015	15,740,243	4,112,309	
Difference	3,013,408	406,112	
Avoided Cost	$ 405,303	$ 164,605	$ 569,908

11.0 GHG Reduction

Reduced energy consumption has resulted in a reduction of **7,163 MT of CO_2e.** comparing 2015 to 2008. This is equivalent to taking **1,950** mid-sized cars off the highway.

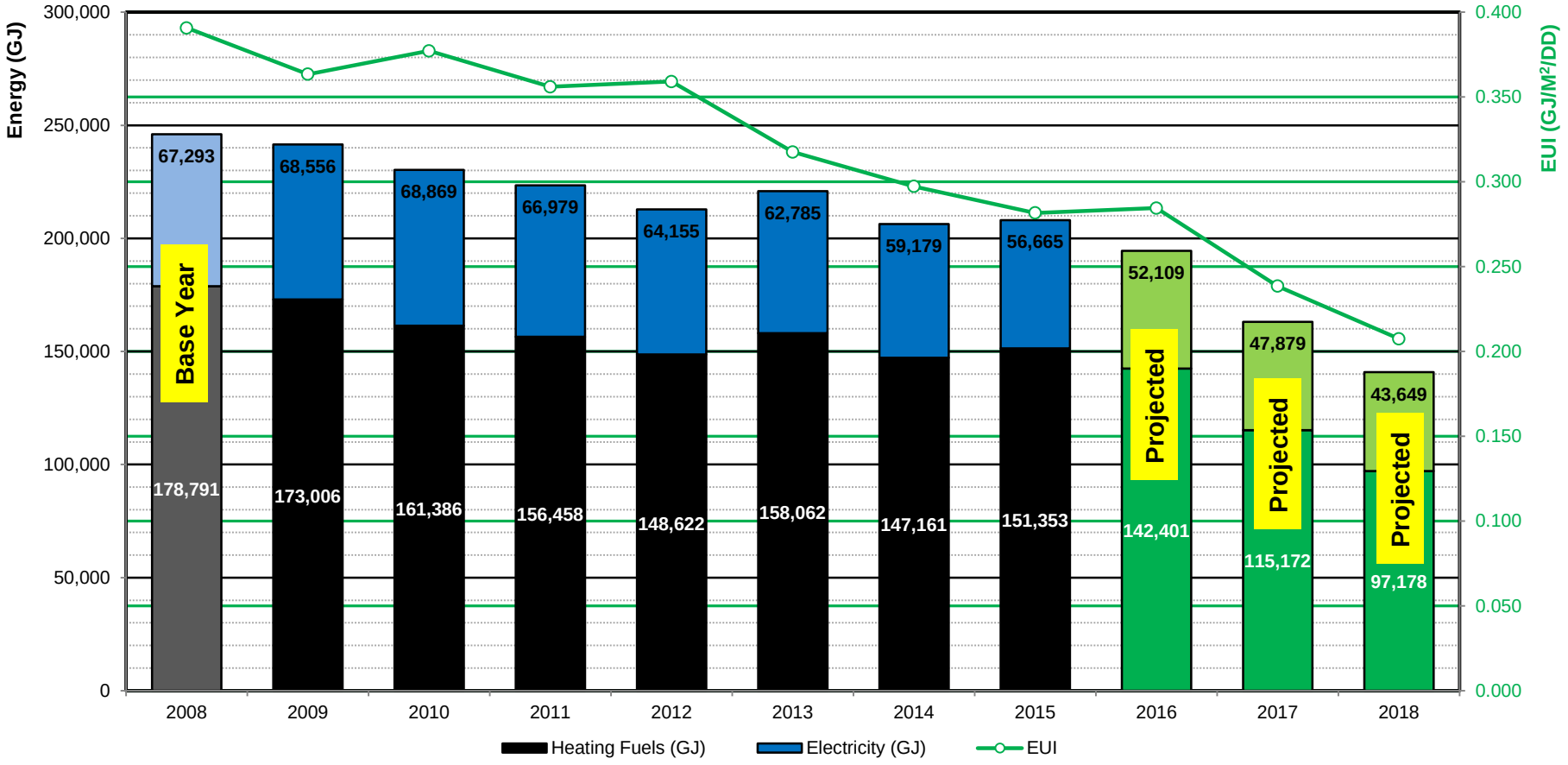


12.0 Future Energy Projects

- **Energy Reduction Action Plan Phase II**
  - This project was approved and is in final tendering phase with work starting March 2016
  - Project entails completing energy conservation measures in remaining buildings campus wide including a major lighting upgrade.
  - At the building level, new digital controls will be installed as well as a combination of AHU replacement and refurbishment as required.
  - This Phase II project will be completed by the fall of 2017 and will further reduce our energy usage as follows:
    - Electricity Reduction - 3,336,708kWh / 12,012 GJ
    - Steam Heat Reduction - 17,091,195 lbs / 17,977 GJ
    - **GHG REDUCTION OF 3,969 MT CO_2e**
  - This project will see an annual energy savings of $883,000. Savings will be used to finance this project over 20years.
  - Over $3.3M of deferred maintenance in building HVAC/lighting will be addressed.

- **Energy Reduction Action Plan Phase III**
  - This project is in the final planning phase, but funding has not yet been approved.
  - Project includes shifting from a central heating plant burning heavy bunker fuels and distributing steam in an aging underground distribution system.
  - New heating system will be a series of 12 smaller plants distributed around campus with hot water distribution.
  - This Phase III project will further reduce our energy usage as follows:
    - Electricity Reduction - 279,000kWh / 1,004 GJ
    - Heating Fuel Reduction - 30,206 GJ
    - **GHG REDUCTION BETWEEN 3,300 and 4300 MT CO_2e**
  - The new boilers will operate on propane and natural gas.
  - This project will see an annual energy savings of $1.8M.
  - Over $15M of deferred maintenance in heating and distribution system.

13.0 Projected GJ and EUI



14.0 Going Forward 2016 - 2020

- **Roll out of staff/faculty/student Energy Awareness Training**
  - This would be accomplished by general information sessions coupled with on-line questionnaire
- **Implementation of a Campus Energy Policy**
- **Installation of Energy Dashboards at the building level**
  - Monitor at each building which would display live energy data for campus and building
- **Additional renewable power projects**
  - Additional Solar PV
  - Solar Hot Water
  - Solar Wall
- **Introduction of sustainability courses**
  - Students and staff

Appendix – Sample Energy Projects

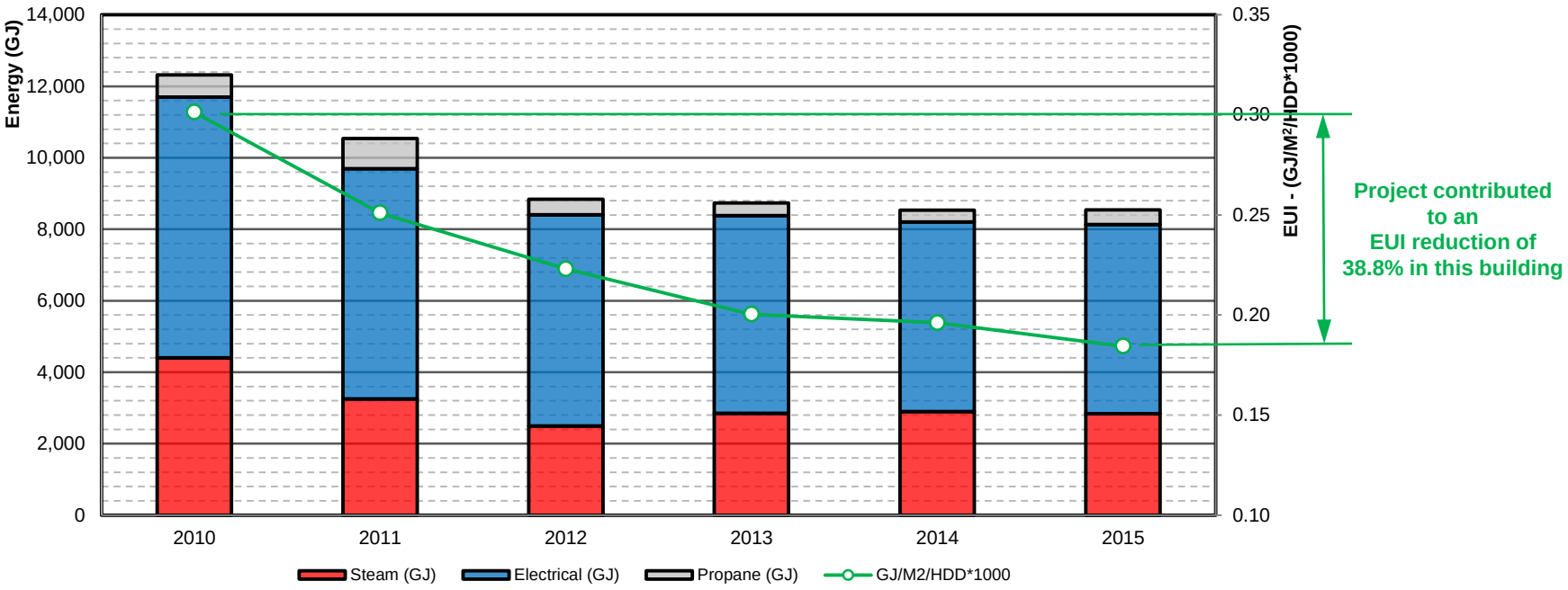
Keating Centre Energy Project:

HVAC/DDC Controls / Lighting Upgrade (SP5013) – Fall of 2011

Re-configuring the HVAC system for the main stadium, installing variable speed drives on AHUs as well as new building controls and space sensors.

Lighting Upgrade Auxiliary Arena (SP5080B) – Fall 2013

Replacement of the HID lighting system with new LED light fixtures. Lighting load was reduced from 26.3kW to 9.0kW plus new system is dimmable from 10% to 100% for further energy savings and lighting control.



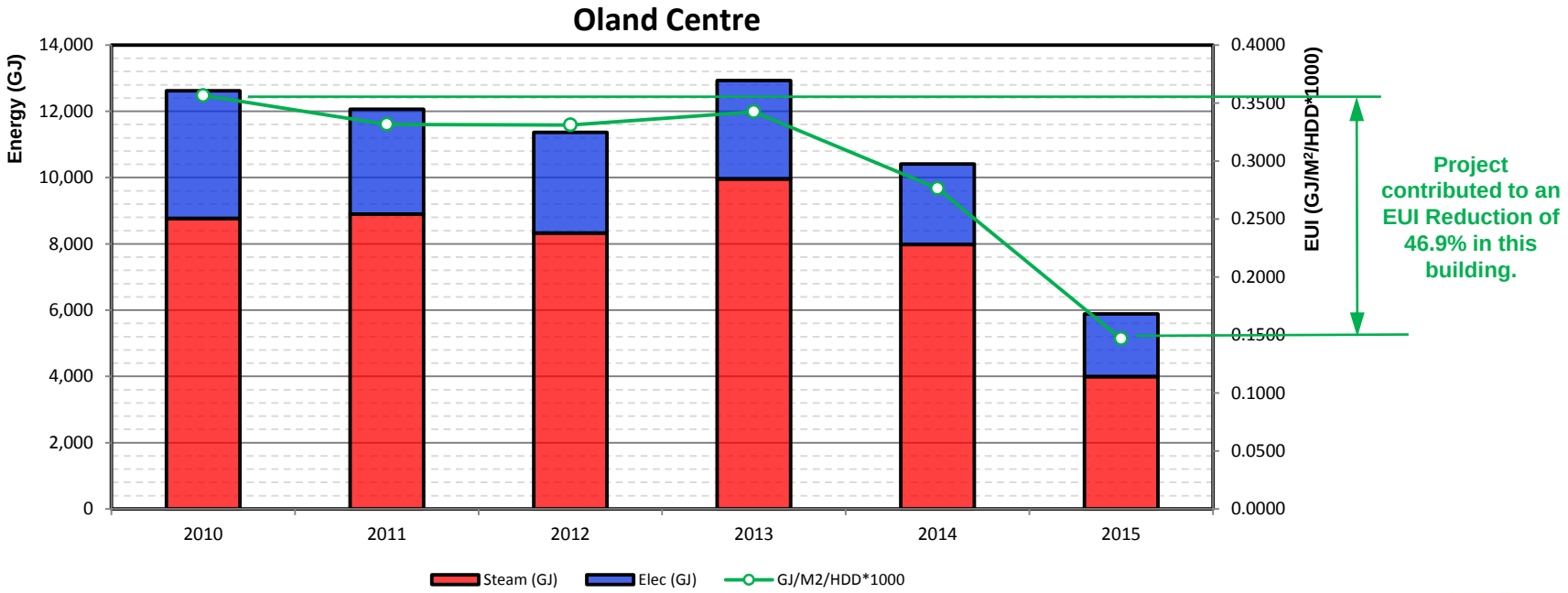
Oland Centre Energy Project:

Oland Centre Gymnasium Lighting Retrofit (SP4990) – June 2011

Replacement of 1960's vintage HID light fixtures, in both gyms, with new T5, 54W HO fluorescent high bay fixtures. The HID fixtures had a total power of 36kW while the new system has a maximum load of only 17.3kW which is less than ½ of the old system.

Oland Centre HVAC/DDC Controls / Lighting Upgrade (SP5080A) – 2014

This project consists of installing a new Building Control System for the Oland and Aquatic Centres; installing six new AHUs which replaced nine old AHUs. There were also three AHUs that were configured with new variable speed drives, damper controls, and instrumentation. Building lighting for the most part were converted to new LED fixtures.



PV Solar Installation 2015:

Installation of 40(260W) Canadian Solar CS6P-P solar panels. Each panel is mated to a 250W Enphase micro inverter. The system is connected to the web for energy monitoring with an Enphase “Envoy” gateway which allows the use of Enphase Enlighten on-line software for system monitoring. Annual energy production estimated at 11,500kWh which is consumed directly in this building. The energy production of this system can be viewed by following the internet link below:
https://enlighten.enphaseenergy.com/pv/public_systems/KFA3673024/overview

Estimated Annual GHG (CO_2e) Reduction of 7.9MT

Screen shot of mobile APP that is used to monitor the energy production of the Bloomfield Solar array. Screen shot taken on March 14, 2016.