



Brock University

Carbon Project
Annual
Report



July 2016

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Introduction

Through NSI's proven approach to engaging organizations in setting and achieving reduction targets, members are able to minimize their environmental impact while improving their financial bottom line: a two-fold accomplishment. **Brock University is currently a Committing Member of the Carbon Project and has set a 10-year intensity based reduction target of 20% below 2013 levels (Milestone 4).**

This year, additional statistic related to benchmarking between the Carbon Project Members has been included in the report. A "Carbon Project Score" has also been added, in order to recognize effort through participation, reporting and results. **Brock University scored well overall, achieving a Carbon Project letter grade of B+.** Opportunities for continual improvements have been identified and NSI has highlighted a number of recommendations within the "Moving Forward" section.

Brock University is uniquely positioned as an educational institution to exemplify sustainability practices through their facilities, both old and new. The university has the opportunity to demonstrate both community engagement and building innovation as it continues to develop and grow. Brock has put sustainability into practice through their cogeneration system and chiller projects; these initiatives significantly decrease peak energy use. The University's leadership in sustainable management influences students, faculty and community partners to apply sustainable practices outside of the institution.

As a member of NSI's Carbon Project, Brock University has undertaken the process of calculating its corporate carbon footprint and measuring its progress. The purpose of this report is to update and inform the organization regarding the results of 2015's greenhouse gas (GHG) inventory.

Scope of Inventory

This report describes the corporate carbon footprint of Brock University, covering the time period from January 1 to December 31, 2015. International GHG accounting standards were followed to determine Brock University's carbon footprint. According to these standards, emissions generating activities were classified under three scopes, as outlined below. Brock University currently reports on Scope 1 and 2 emissions.

Scope 1: All GHG emissions resulting from direct combustion.

- Gas & Stationary Combustion
- Fleet & Mobile Combustion

Scope 2: Indirect GHG emissions from consumption of purchased electricity.

- Purchased Electricity



Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, and others. Brock University currently does not report any Scope 3 emissions.

Inventory

The total corporate carbon inventory for 2015, including offsets, totalled 27,625.42 tonnes of CO₂e (tCO₂e). This represents an increase of 1,898.07 tCO₂e (6.87%) from Brock University's new¹ 2013 baseline emissions of 25,727.35tCO₂e. As part of the Carbon Project, facilities that are not in the Niagara Region have been excluded from the report. For Brock University, the only facility that was not included in the calculations was the Hamilton campus. For comparison purposes, emissions including Hamilton with offsets are 28,200.26 tCO₂e.

The carbon footprint was predominantly comprised of Scope 1 emissions (96.98%), with stationary combustion (26,909.2 tCO₂e) and vehicle fleet (169.2 tCO₂e) representing the largest emissions source by scope (Table 1, Figure 1). Specifically, within Scope 1, 99% of emissions were a result of stationary combustion while the remaining 1% was a result of vehicle fleet related emissions (Figure 2). Scope 2 represented the remainder of Brock's corporate carbon emissions at 842.03 tCO₂e (3.02%) resulting from electricity consumption.

Table 1. Actual corporate carbon footprint by scope for 2015.

Scope 1 (tCO ₂ e)		Scope 2 (tCO ₂ e)		Scope 3 (tCO ₂ e)		Offsets (tCO ₂ e)	
Fleet Vehicles	169.2	Purchased Electricity	842.03	Employee Commuting	--	Campus Greenery	-295
Stationary Combustion	26,909.2			Business Travel	--		
Refrigerants	--			Waste	--		
				Water	--		
Total	27,078.9		842.03		0		-295
Total without offsets						27,920.42	
Total with offsets						27,625.42	

¹ Tufts University Office of Sustainability: Carbon Sequestration - <http://sustainability.tufts.edu/carbon-sequestration/>

¹ American Forests: Tree Facts: <http://www.americanforests.org/discover-forests/tree-facts/>

¹As of 2014, the baseline has been moved to 2013 from 2012, due to discrepancies in the data that Facilities Management had identified and have since updated.

Figure 1 Illustrating Brock's 2015 corporate carbon footprint by scope (tCO₂e), including percentage by scope.

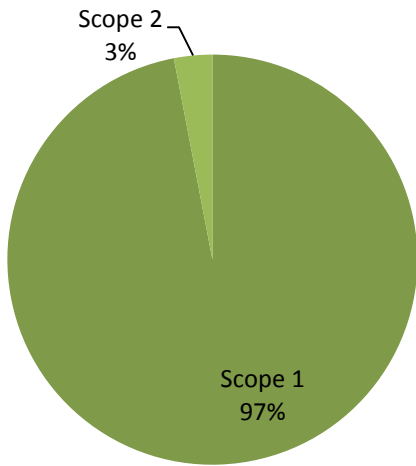
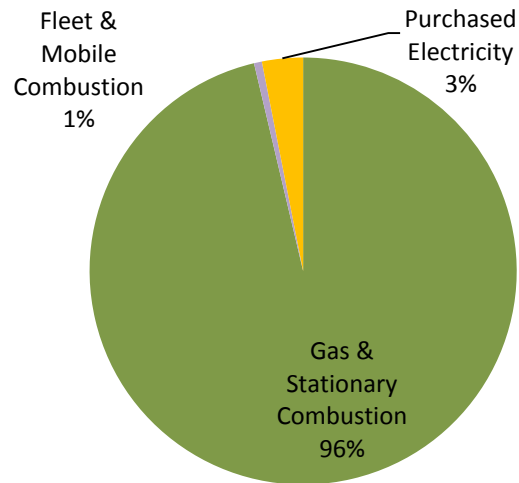
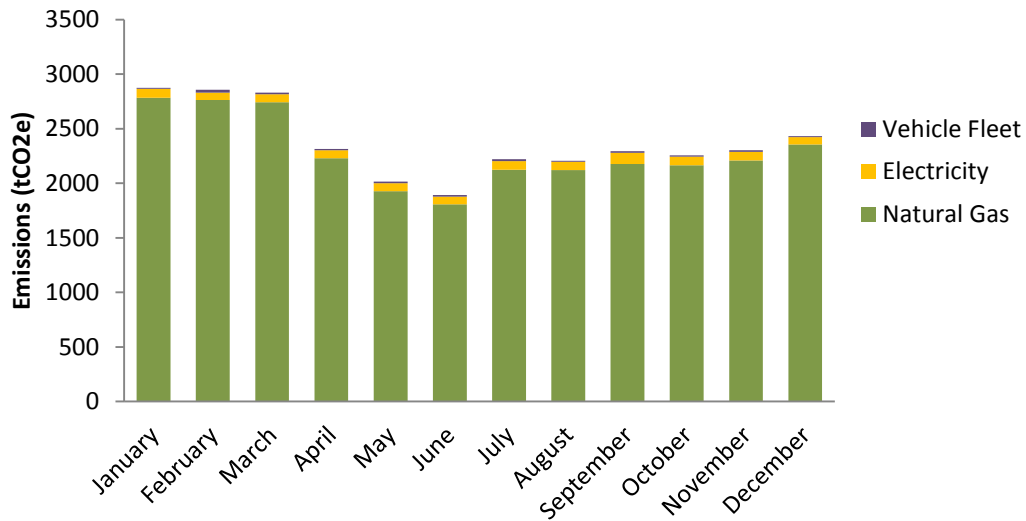


Figure 2 Illustrating the breakdown of scope emissions (tCO₂e) by source activity type, including percentage.



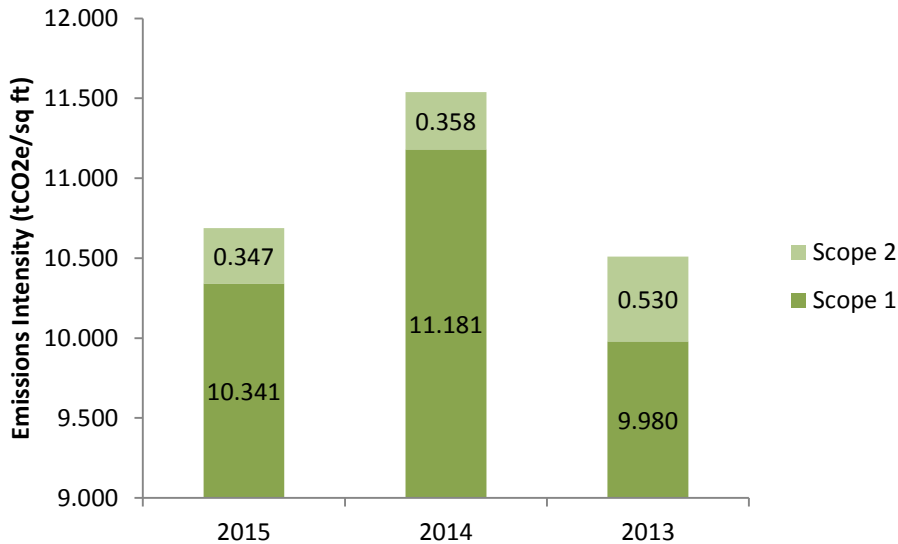
Brock University experienced peaks in their 2015 emissions between the months of January and March, consistent with previous years. The highest recorded monthly emission was 2,784.91 tCO₂e in January (Figure 3). These peaks in emissions are associated with the heating of the facilities during the winter months. Electricity and vehicle fleet emissions remained relatively consistent throughout the year. The residence buildings have significantly fewer students in the summer, resulting in reduced electricity usage and no cooling of these buildings during that time period.

Figure 2 Brock University's 2015 carbon footprint (tCO₂e) monthly by activity type. These are the total emissions without offsets.



Brock University has set an intensity-based reduction target using square footage to account for growth of the overall campus. In 2015, Brock reviewed the square footage from previous years and has recalculated those numbers. The updated values are correct for the purpose of the Carbon Project and the calculations have been updated to reflect the changes. Brock's area of heated space for 2015 was 2,666,185 square feet. It should be noted that the emission intensity within this report has been calculated per 1,000 square feet of the facilities. By calculating the intensity per 1,000 sq ft, the resulting intensity values are larger and more meaningful for comparison purposes. **The total carbon emission intensity is 10.472tCO₂e per 1,000 square feet without offsets. Last year's emission intensity was 11.323 tCO₂e per 1,000 sq ft, a 7.5% decrease (Figure 4).**

Figure 3 Comparison of Brock University's year-by-year carbon intensity without offsets (tCO₂e/ 1000 sqft)



Comparison by Year

Since the baseline year of 2013, the carbon emissions with offsets produced by Brock University's operations have grown by 6.87%. Emission intensity however, has only increased by 1.69%. **To reach Brock's reduction target of 20% below baseline, means that the 2015 emission intensity should be reduced by 21.69% or be reduced to 8.11tCO₂e per 1,000 sq ft with offsets by 2023.**

Brock's offsets are calculated from the emission sequestration of their forest cover. It is estimated that 55 hectares of the properties are tree covered, which was equated to 108 tCO₂e in 2013, the baseline year. This value increases at a rate of 1.7 tonnes per hectare every year afterwards to account for forest growth. In 2015, the offsets amounted to 295 tCO₂e and in the 2023 will increase to 1,043 tCO₂e. Figure 5 shows a

comparison between overall emissions intensity and the intensity with offsets included. Overtime the disparity will increase.

Figure 5 Comparison of yearly intensity per 1,000 sq ft with and without offsets

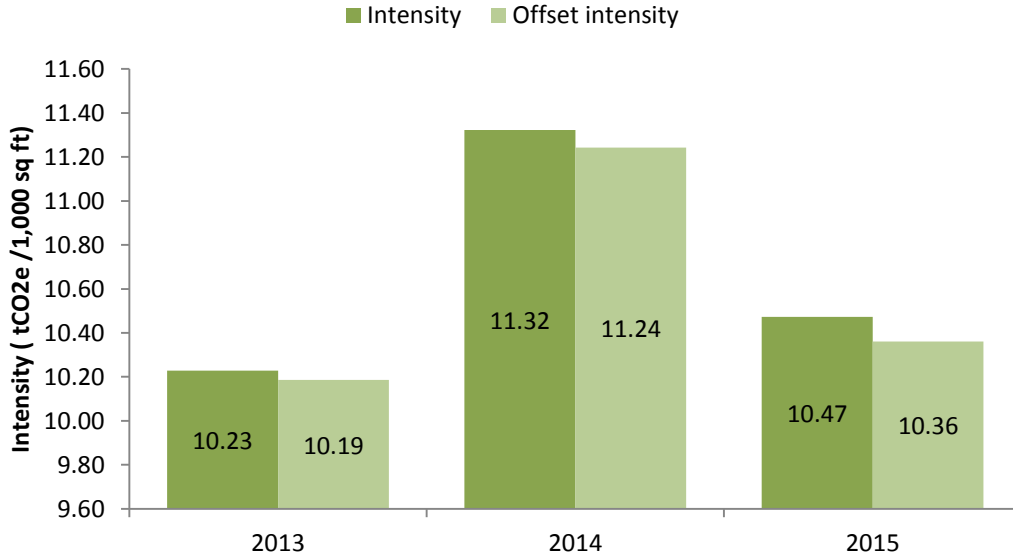
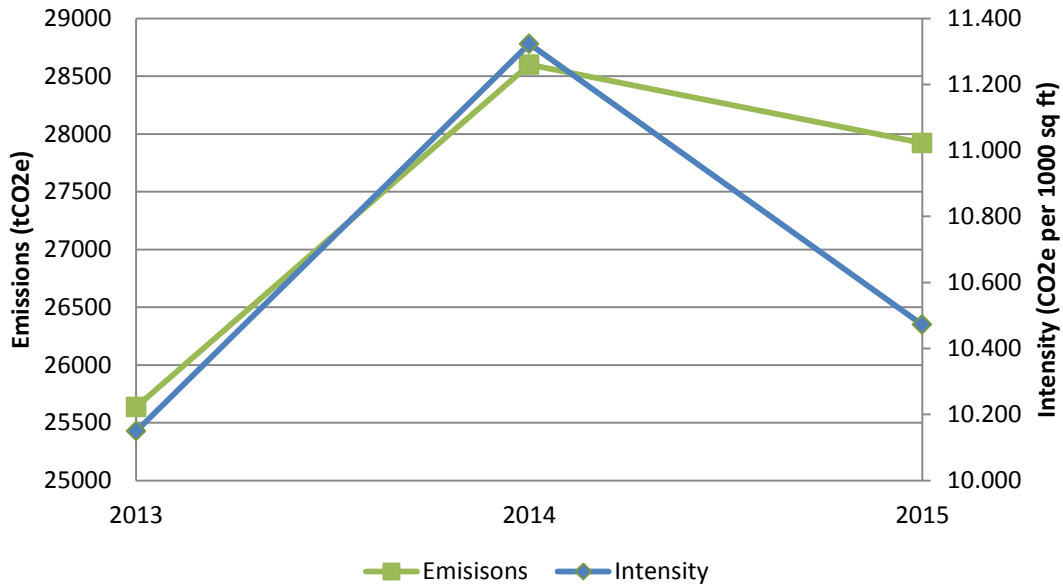


Figure 6 Comparison of yearly emissions and intensity per 1,000 sq ft without offsets



In 2014, both the emissions and intensity experienced an increase of 10.36% (Figure 6). This increase in Scope 1 emissions was largely due to the observed increased use of the Central Utilities Cogeneration Plant (Table 2), an unusually cold winter and the addition of the CAIRNS building. Scope 2 emissions were reduced by 32.41% due to an electricity reduction project, which transferred chilling load from an inefficient older model to the

#1 process chiller in the new CAIRNS complex. The program was estimated to reduce 2514kWh/day or 392 tCO₂e in a year.

Table 2. Emission Intensities by Scope and percentage reductions. Does not include offsets.

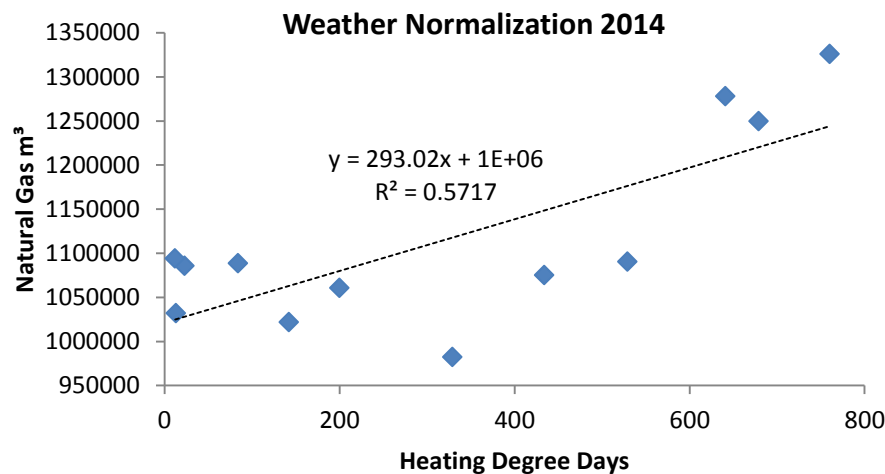
	2013	2014	2015
Scope 1 - Fleet and Stationary Combustion			
tCO ₂ e per 1,000 sq ft	9.980	11.181	10.341
% difference	-	+10.741	-7.512
Scope 2 - Electricity			
tCO ₂ e per 1,000 sq ft	0.530	0.358	0.347
% difference	-	-32.415	-3.236
Total Emission Intensity			
tCO ₂ e per 1,000 sq ft	10.149	11.323	10.472
% difference	-	+10.364	-7.514

The University’s focus on electricity reduction to support its *Energy Conservation and Demand Management Plan* has resulted in an additional decrease in Scope 2 carbon emissions of 3.236% in 2015; this comprises a total of a 34.6% reduction since the baseline. Additionally, Scope 1 emission intensity has also decreased by 7.512% in 2015.

Weather Normalization

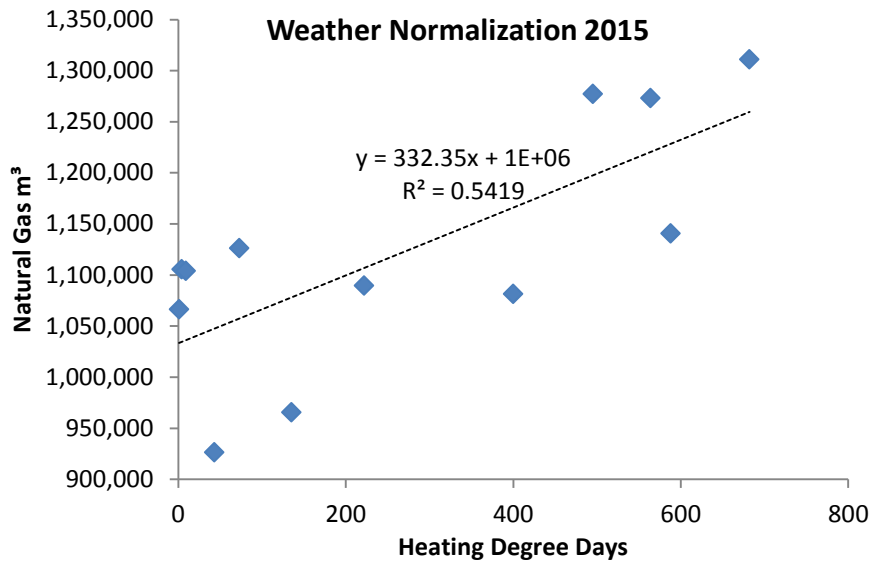
Weather can influence the natural gas consumption of an operation. Heating Degree Days are a measure of how much and for how long a building required heating, based on outdoor temperatures. In this analysis, the temperature at which a building requires no heating or cooling in order to maintain human comfort levels is 18°C.

Figure 7 Weather Normalization for all buildings (not including Hamilton) for 2014



The total natural gas consumption for all Brock University's buildings in the Niagara Region was used for this analysis. The R2 value indicates the strength of the correlation; the closer this value is to 1 the more efficient the energy system. An R2 value of 0.571 and 0.541, for 2014 and 2015 respectively, indicates how the University manages how heat is used in response to weather patterns. The weather station used to collect the heating degree days was St. Catharines Airport, ON.

Figure 8 Weather Normalization for all buildings (not including Hamilton) for 2015



Moving Forward

“Measure, manage and mitigate” make up the central pillars of carbon management. Following these guidelines, the NSI Carbon Services Support Team has highlighted several moving forward recommendations for Brock University with respect to their carbon footprint.

Measure

This is the second year under which Brock University has reported on the revised 2013 baseline. Data quality assurance is integral to ensuring reliability. Improving data collection methods aids quality assurance and enhances transparency. The following recommendations have been made in order to improve data collection and measurement methods. These recommendations are given with the ultimate goal of 20% reduction in GHG emissions by 2023-2024:

- **Scope Enhancement:** Consider including Scope 3 emissions such as employee commuting, business travel and water consumption in order to increase the transparency and completeness of the carbon footprint. NSI highly recommends the inclusion of the following two activities for the main campus:

Water Consumption: With the implementation of water conservation projects during the past year, in the form of low flow and dual flush toilets, Brock estimated a savings of 601,000L of water per year. Water consumption totals from the baseline of 2013 could be measured and added to the carbon inventory to determine the emissions savings. This would likely reflect positively on the University’s overall carbon footprint.

Improve Natural Gas Data Collection, with a focus on the Cogeneration Plant: Natural gas accounts for 96 percent of the University’s carbon inventory. The Central Utilities Cogeneration Plant represent 85 percent of the total natural gas emissions (See Table 3). Brock has installed approximately 12-15 meters to regularly measure and report the utility data for the Cogeneration Plant. Continuing with this detailed monitoring of the Cogeneration Plant will ensure that the results for the natural gas data from this source are as complete and correct as possible.

Top Emitters

The organizational facilities of Brock University have been arranged in NSI’s carbon accounting software in the breakdown outlined in Table 3. Each campus is reported as a whole. However, the institution has the ability to measure significant equipment or buildings’ carbon footprint independently of the total inventory. Units such as the Cairns Family Health & Bioscience Research Complex (CFH and BRB), Central Utilities Cogeneration Plant and Diesel or Gasoline vehicle fleets have been separated for this purpose.

The Main Campus contributes the largest proportion of the institution’s total emissions (88%) and within the Main Campus the Cogeneration Plant represents 22,975.1 tCO₂e of the 24,613.23tCO₂e emissions. A distant second emissions generator is CFH and BRB at 1,725.32tCO₂e. East Campus and all other Satellite Campus buildings are ranked third and fourth respectively.

Table 3: Brock University facility emissions inventory - top emitter ranking (without offsets)

Rank	Facility/ Sub-facility	Major Emissions Activity Type	Annual Emissions (tCO ₂ e)
1	Main Campus	Natural Gas Combustion	24,613.23
1.1	<i>Central Utilities Cogeneration Plant</i>	Natural Gas Combustion	22,975.1
1.2	<i>Campus Buildings</i>	Natural Gas Combustion	1,629.78

1.3	<i>Gasoline Vehicles</i>	Diesel Fuel Combustion	105.92
1.4	<i>Diesel Vehicles</i>	Gasoline Fuel Combustion	63.28
1.5	<i>Central Utilities</i>	Purchased Electricity	8.35
2	CFH and BRC	Natural Gas Combustion	1,725.32
3	East Campus	Natural Gas Combustion	405.65
4	Satellite Campus Buildings	Natural Gas Combustion	164.99
Total Top Emitter Emissions			26909.19
Total Emissions			27,920.42

Manage

By understanding the GHG emissions from business operations, NSI can identify opportunities for improvement within the organization. There are opportunities to better manage carbon reductions through analyzing structural and behavioural tendencies within the facilities. **Recommendations are provided below within each reported scope:**

Scope 1 Reductions

Stationary combustion within Scope 1 emissions is by far the greatest contributor to Brock's GHG emissions according to the present reporting framework.

- **Natural Gas Reduction:**
 - **Cogeneration Plant:** It is recommended that this facility continues to undergo regular reviews, maintenance procedures and upgrades in order to ensure that Brock's infrastructure to take advantage of current and upcoming technological efficiencies. The University is currently undertaking a feasibility study for retrofitting the Utility Plant with high efficiency generators with the aim to tackle Brock's largest carbon emitter.



- **Fleet Vehicle Management:**
 - **Continue Upgrading Vehicles:** Brock has made improvements to their vehicle fleet through upgrading three of their vehicles and will be installing a new fuel management system which shall allow them to track individual fuel usage.
 - **Route Optimization:** Minimizing driving through the use of a Route Optimizer will find the most efficient route for the University's service vehicles. A smart phone fleet management application such as *FleetMatics* would allow the organization to track total mileage and route efficiency.

Scope 2 Reductions:

Through energy saving projects such as the winter chilling load transfer Brock University have experienced net decreases in electricity related emissions. Scope 2 emissions are derived exclusively from electricity consumption. The following recommendations were made for scope 2 reductions:

- **Electricity Management**
 - **Upgrade existing equipment and systems:** In April 2015, Brock installed a new energy efficient Cisco UCS within its on-site data centre and was responsible for a 42,640 kWh/year decrease in annual energy consumption. It is recommended that the institution continue to find and put into practice opportunities to make electricity consumption on all campuses more efficient including upgrading lighting to LED, installing low flow toilets and faucets and increasing monitoring/metering capabilities.
 - **Diversify on-site energy generation:** There are currently feasibility studies underway to explore the potential for solar and wind power projects on campus. These renewable energies will serve to further reduce Brock University's emissions and increase the resilience of their energy systems.

Mitigate

The final pillar of carbon management involves mitigating the emissions that cannot be managed and reduced. A meaningful carbon reduction plan helps an organization to meet business objectives, while reducing environmental impacts.

- **Sustainability Communication Strategy:** in collaboration with departments across the University including the Sustainability Committee, Brock University Student Union (BUSU), Marketing & Communications and even Waste Management; work together to develop a cohesive and comprehensive communication plan. The plan should help foster an enhanced level of

awareness towards sustainability projects on campus and the importance of these investments. A culture of conservation amongst the students and staff can be promoted. Externally, the region and stakeholders (incoming students, professors, investors, etc.) would ideally regard Brock as an institution that is a leader in sustainability.

- **Carbon Offsetting:** significant efforts have been made in order to reduce emissions since baseline. In order to assist in reaching the 20 percent intensity based reduction objective and future goals of carbon neutrality; it is recommended that the purchase of carbon offsetting be considered. NSI can provide advice regarding the types and standards of offsets available.

Carbon Project Benchmarking and Grade

The carbon intensity of all Carbon Project members was calculated using two metrics: (1) tonnes of carbon dioxide equivalent emissions per 1000 square feet of heated space and, (2) tonnes per full-time employee (FTE). The results from this assessment demonstrate a fairly strong correlation between actual tCO₂e emissions and intensity. The square footage used was 2,666,185 square feet. Brock University scored at 10.47 tCO₂e/1000 square feet compared to the best score in the project which was 1.7 tCO₂e/1000 square feet. Brock University's intensity per full-time employee is 17.96 tCO₂e/FTE as compared with the lowest intensity score which as 1.65 tCO₂e/FTE. However, it is important to note that in the case of Brock, the institution's facilities are used by not just the 1526 full-time employees, but also by many more students and visitors on a regular basis.

This year, a new letter grade score has been introduced for the first time for all Carbon Project members. This letter grade is called the "Carbon Project Score" and was calculated based on three criteria: Participation, Reporting and Results. All three categories were individually scored out of 100 and given equal weightings to determine the final letter grade. Brock University's Carbon Project Score for 2015 is B+. This grade indicates that the College is an active and engaged member of the Carbon Project.

Table 4: Brock's Carbon Project Score by criteria and letter grade

Criteria	Score	Letter Grade
<i>Participation</i>	80	B+
<i>Reporting</i>	100	
<i>Results</i>	60	

Summary

Although Brock's total emission intensity with offsets have grown by 1.69% since the baseline year of 2013, the University has taken progressive steps towards sustainability in order to pave the way for future reductions.

In 2014, increases in Scope 1 (natural gas usage) amounted to 10.74% due to the use of the Cogeneration system. In the past year, reductions of 7.5% have been achieved following the improvements made to the existing Cogeneration system. Improvements are expected to continue over the subsequent years and negate the initial increases seen in 2014. The University's efforts towards electricity reduction through its *Energy Conservation and Demand Management Plan* have experienced large success with a total reduction of 34.6% since the baseline.

NSI recommends focusing on reductions for natural gas emissions in future sustainability initiatives and has presented several targeted strategies to enhance measurement, management and mitigation of carbon emission at the University.

References

Bizee Degree Days (n.d) Retrieved from www.degreedays.net