Clark University Greenhouse Gas Emissions Update: 2015

As of the calendar reporting year 2015 Clark University has met and exceeded its interim goal of a 20 percent reduction over 2005 emissions levels by 2015. Emissions in 2015 were higher than in 2014, but still display an overall downward trend toward Clark's ultimate goal of zero emissions by 2030.

Background

In June 2007 President Bassett signed the American College and University Presidents Climate Commitment (ACUPCC), making Clark University a charter signatory to an exciting initiative aimed at mobilizing the resources of colleges and universities in efforts to reduce greenhouse gas emissions. The core goal of the commitment is to achieve climate neutrality with net zero greenhouse gas emissions, also known as carbon neutrality. The Clark University Environmental Sustainability Task Force (CUES) accepted the task of developing a Climate Action Plan with mitigation strategies to lead the University toward its goal of climate neutrality. In December of 2009 Clark University released the Climate Action Plan (CAP), detailing strategies for the University to reduce its greenhouse gas emissions. The plan sets two goals: an interim goal of reducing emissions to 20 percent below 2005 levels by 2015 (to 16,357.4 MTCO2e) and the ultimate goal of carbon neutrality by the year 2030. The CUES Task Force retained responsibility for recording and reporting on Clark's emissions. In 2014 the CUES Task Force commissioned an update to assess viability of CAP strategies (i.e. changes in technology or University environment), and to recommend additional strategies with incremental goals; the update was not adopted and the CAP remains as published.

The CAP interim goal set for 2015 was actually achieved in 2010; just one year after the CAP was released. Achieving the significantly more ambitious goal of carbon neutrality by 2030 requires willingness on the part of all members of the Clark University community to recognize and invest in mitigation action as an institutional and personal priority, and to make the trade-offs required.

Methodology

In order to effectively manage carbon footprint and emission reduction strategies, a Greenhouse Gas (GHG) Emissions Inventory has been conducted annually since 2008. (GHG inventories from prior years use actual and estimated data). Data is gathered from a range of campus entities and we utilize the Campus Carbon Calculator (CCC) created by Clean Air-Cool Planet (CA-CP) to calculate our emissions inventory. Once a leading non-profit organization and a standard in the field, CA-CP closed its doors in late 2013. All support operations for the Campus Carbon Calculator have been transferred to the University of New Hampshire Institute for Sustainability as of 2014. The ACUPCC was also replaced in 2014; Second Nature is the non-profit organization that currently monitors greenhouse gas reporting and manages the interests of the former ACUPCC.

In the Inventory, inputs are recorded for Scope 1 sources (on-site combustion, such as boilers and vehicle use); Scope 2 sources (off-site combustion, such as purchased electricity) and certain Scope 3 sources (other combustion such as commuting) according to ACUPCC guidelines. The six greenhouse gases inventoried are those included in the Kyoto Protocol: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydro fluorocarbons (HFCs), perfluorocarbons (PFC), and sulfur hexafluoride (SF6). Of these six, CO2 (produced during the combustion of all fossil fuels) and HFCs (gases that are used in refrigerants and air conditioners) have been shown to be the primary gases emitted on campus. For ease of understanding and comparison, all inventoried greenhouse gases are converted to a common measure: carbon dioxide. The CCC multiplies fuel use and other inputs by updated emissions factors to

determine the amount of metric tons of carbon dioxide equivalent (MTCO2e) added to the atmosphere by campus operations. The results of past inventories have been reported to ACUPCC and shared with University administration via the annual Climate Action Plan (CAP) Update. The annual CAP Updates are also available at Sustainable Clark (www.clarku.edu/sustainability).

Revisions and Updates to the CCC

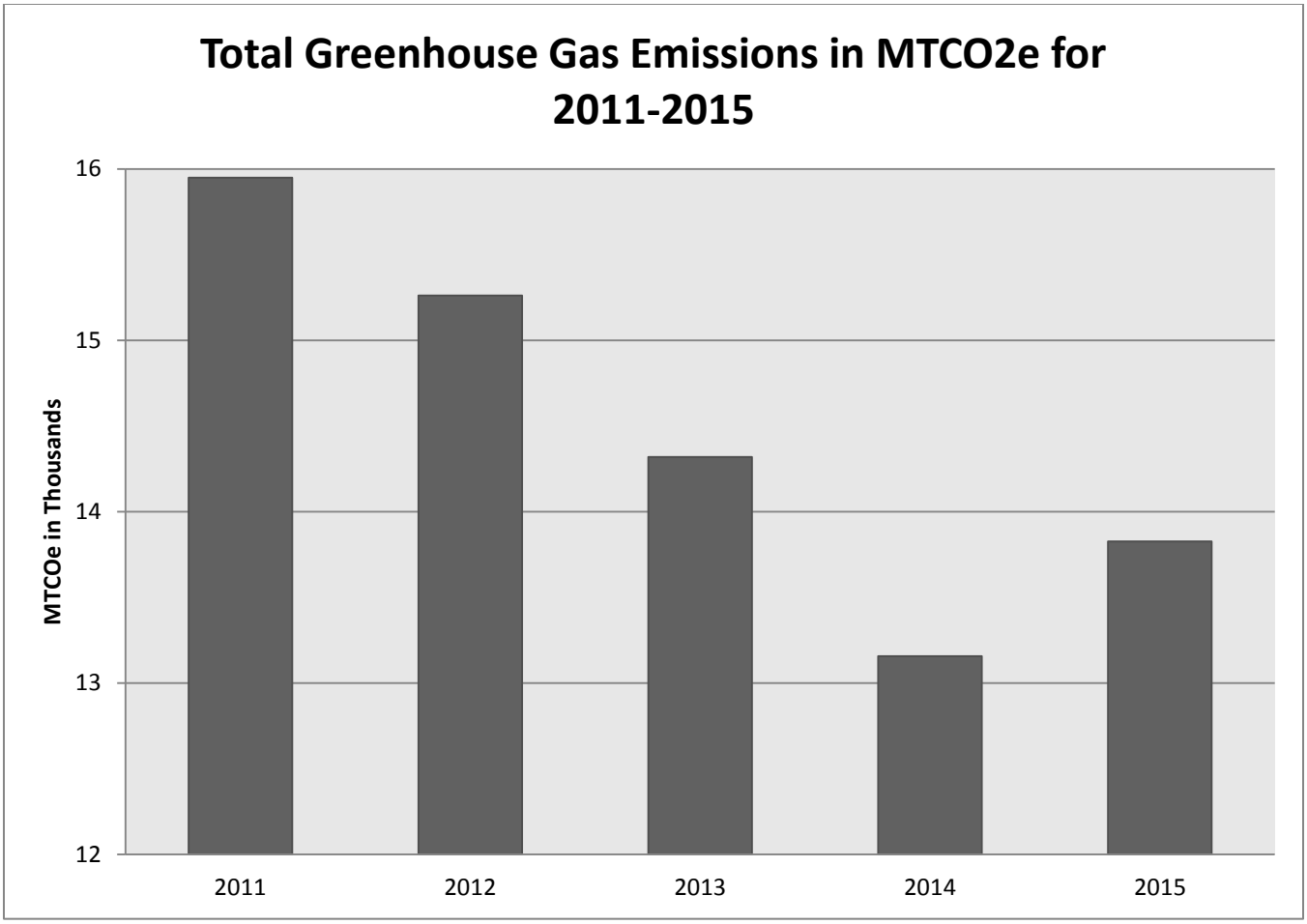
The 2015 greenhouse gas emissions inventory uses version 8.1 of the Campus Carbon Calculator (CCC), in which emissions factors have been updated to reflect the most recent available data from EPA, E-GRID, DOE, IPCC and other public data sources. Many standards are retroactive and almost all of Clark's past data stored in the CCC from 2005-2015 is affected by updates. For example, updates in CCC version 7.0 (2013) impacted Clark's recorded data retroactively to 2009. CCC version 6.85 (issued 2012) included over 40 substantial updates. CCC version 6.7 (issued 2011) included EPA revisions for certain emissions- producing activities which impacted CO2 equivalency calculations retroactive to 2007. The full list of CCC updates as well as more information on the CCC is available on request here: http://sustainableunh.unh.edu/calculator.

Due to the evolving nature of greenhouse gas emission factor science, Clark University consistently utilizes the most current version of the CCC in the annual Update for charts and data analysis. Therefore, previous Updates *may* show annual or category data points that differ from the current Update; included charts will reflect this. Even small changes in the factors will add up over time and retroactively. Clark's interim Climate Action Plan goal for 2015 was based on 2005 emissions and the standards at the time, as were the benchmarks and mitigation strategies; our interim goal therefore remains unchanged at 16,357.4 MTCO2e.

2015 Emissions Data

Total GHG emissions in 2015 were 13,826.2 MTCO2e. This represents an increase of 4.84 percent from total 2014 GHG emissions of 13,156.6 MTCO2e. Net GHG emissions in 2015 after offsets were 13,815.9 MTCO2e, an actual (before offsets) increase of 5.13 percent. The full report below details some of the probable causes for the difference year-to-year.

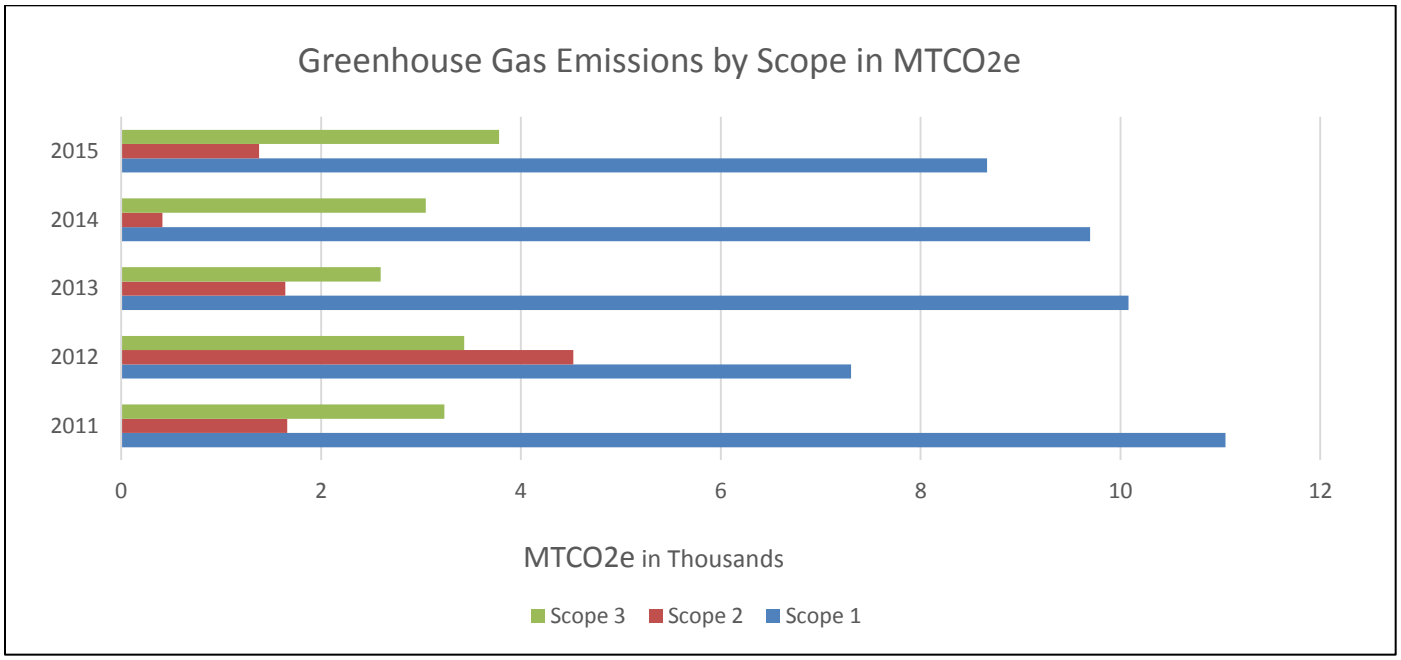
If and when all else is held constant, emissions will change in proportion to individual energy use. However, year-to-year differences in weather, campus operations, sourcing and other conditions beyond our control will impact energy generated on campus for heating, cooling, electrical power and emissions from campus-based vehicles; while external factors also beyond our control will effect emissions from generated electricity and transportation. It should be noted that 2014 was a 'benchmark-normal' year. Weather patterns were typical and therefore the amount of heating and cooling produced on campus (Scope 1) can be termed 'average'. As climate instability increases, it is ever more important to change Clark's core practices to offset the swings beyond our control. 2014 is also a 'benchmark-normal' year in regards to campus operations; the co-generation engine operated throughout the year with normal inputs and there were no major renovation projects (Scope 2). As unforeseen or scheduled operational events occur to influence production capacity and as other factors (including changes in technology, population or footprint) influence Clark's demand for energy it is important to recognize that improving Clark's core energy efficiency and energy consumption practices will be measured against 2014 as a benchmark of 'normal' per capita and per square foot energy usage.



	2011	2012	2013	2014	2015
Total Greenhouse Gas Emissions in MTCO2e	15.95	15.26	14.32	13.16	13.83

Greenhouse Gas Emissions Percent by Scope & Sector

The largest source of Clark's greenhouse gas emissions is always Scope 1: fuel consumed to produce heat and electricity by Clark's cogeneration engine, plus fuel consumed to produce heat in the central heating system and other boilers. This sector is termed Cogeneration and On-Campus Stationary Combustion and comprised 62.7% of all emissions in 2015; in 2014 the same sector was 72.6%. Scope 2 is the smallest sector and emissions here result entirely from the operations of the electric utility (National Grid) which supplies Clark's demand for electricity beyond that which is produced on- site by the cogeneration plant. This sector is termed Purchased Electricity and comprised 10% in 2015, compared to 1.9% in 2014, 11.4% in 2013 and up to 30% in prior years. The second largest emissions contributor is found in Scope 3: primarily from fuel used in faculty and staff commuting and air travel. This sector comprised 27.3% in 2015 compared to 24% in 2014. Scope 3 has continued to increase over time, and is the least amenable to direct institutional control. Smaller sources of emissions also included in Scope 3 include refrigerants, utility-based transmission and distribution losses, and campus fleet direct transportation; all 2% or less. Sector detail is discussed below.



	2011	2012	2013	2014	2015
Scope 1	11,051.8	7,305.3	10,082.2	9,695.7	8,664.3
Scope 2	1,662.4	4,523.2	1,640.7	412.0	1,379.8
Scope 3	3,234.9	3,432.3	2,595.6	3,048.9	3,782.1

Explanations: Scope 1, On-Site Combustion

The co-generation engine was non-operative for part of May, as well as the months of June, July and August while the power plant stack (chimney) was being completely rebuilt to meet safety standards, making emissions from on-site combustion 10.6% lower in 2015 than 2014. Clark has now completed a multi-year long transition from oil to natural gas-fired burners in satellite locations; as natural gas is a cleaner burning fuel this has also had a slight impact on reducing Scope 1 emissions.

Explanations: Scope 2, Purchased Electricity

While Clark's cogeneration plant provides most of the electricity for central campus, we purchase electricity for several reasons: to supply buildings that are not connected to the co-gen, to supply excess demand, and when the co-gen is not operational. We purchased 100% of all demanded electricity during the period that the cogeneration engine was non-operative in 2015. Since the shutdown fell during summer, the period in which we use the most electricity due to the demand of air conditioning, and since 2014 was a benchmark-normal year in which the cogen was fully operational, our Scope 2 emissions were 235% higher than in 2014, although still lower than in most years prior.

Other Impacts: Scope 2

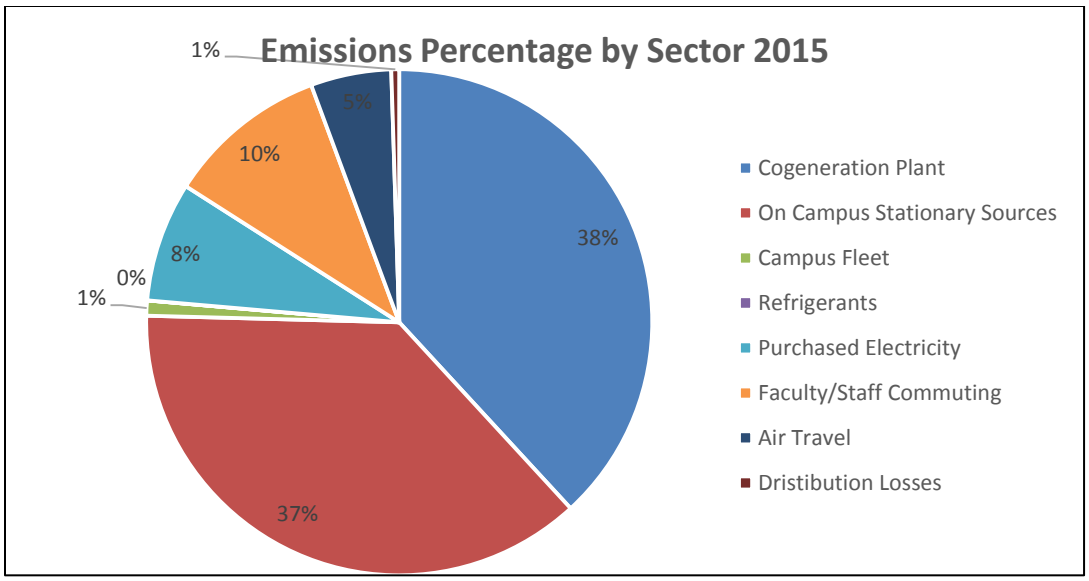
Solar Flair: 2015 marked the first full year of our partnership with Solar Flair providing Clark solar energy "credits". Note that the credit is a financial mechanism: it is expressed in dollars, which must be re-calculated into kWh for emissions reporting purposes. We use yearly average utility-billed retail cost per kWh to arrive at the percentage of Clark's total purchased kWh that can be considered sourced from renewable energy sources. There are a number of variables that will impact the size of the credit such as the retail cost of a kWh and of course the amount of sunlight. (For a full explanation of Clark's arrangement with Solar Flair and National Grid, please see the CAP Update 2014). In 2015, the solar production credit accounted for 48% of Clark's total purchased electricity as measured in kWh. Solar Flair's farms are operating at full build-out production capacity. Therefore, any additional decreases in Scope 2 emissions will require that Clark commit to comprehensive energy efficiency, targeted management of consumption practices, or additional renewable energy sources.

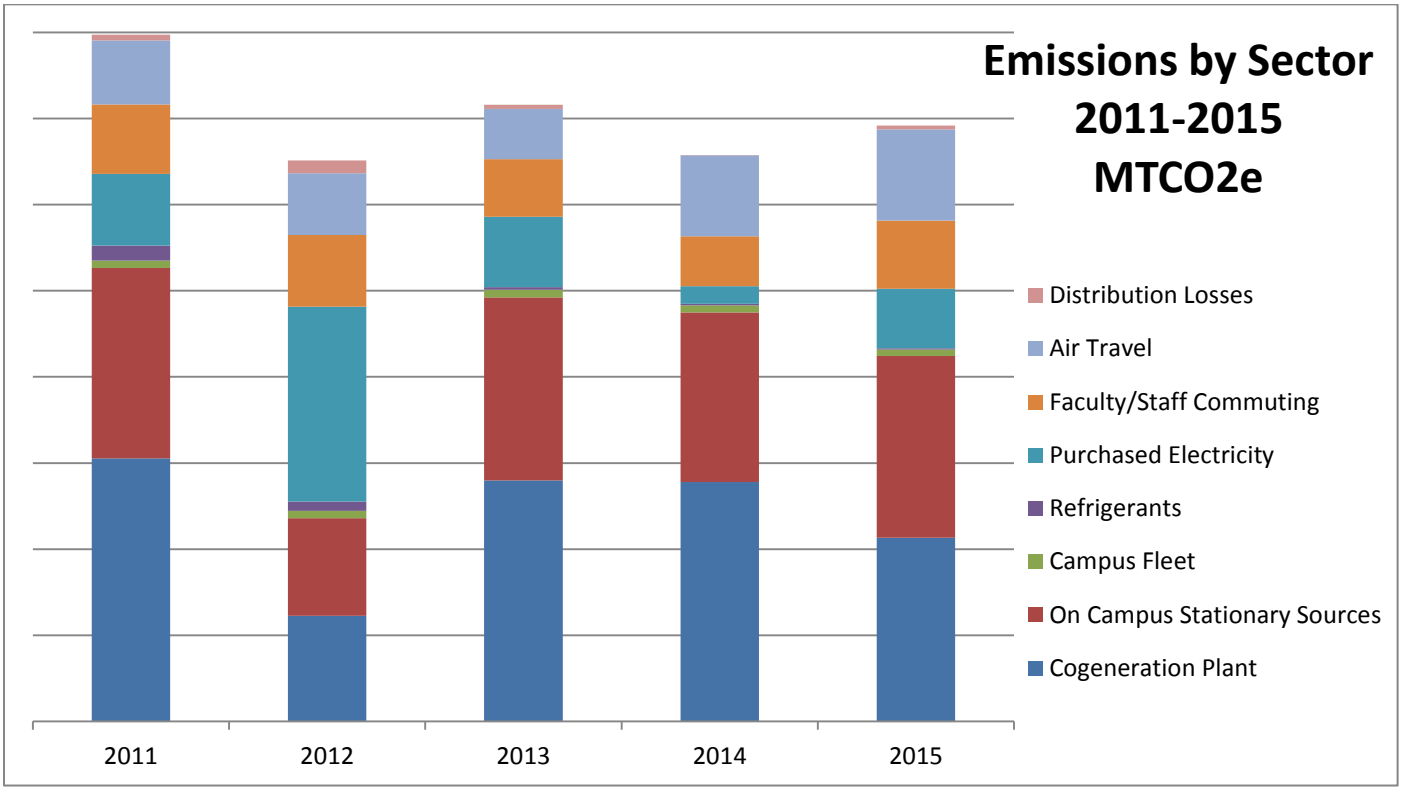
Excess Production: The cogeneration engine runs consistently at optimum load and produces more electricity than campus can use during low-demand hours. This kWh excess production was returned to the electric utility grid without any offsetting credit. In other words, Clark incurred the full burden of production-based emissions without actually using all of the electricity. Future excess production may receive offsetting credits if it is deemed to be in Clark's interest to enter into net metering or other re-sale agreements as an energy producer. The amount is approximately 7.5% of total production, or 156.2 MTCO2e.

Explanations: Scope 3, Travel and Other

Scope 3 increased 24% in 2015 versus 2014; both in the daily (vehicle) commute calculations and the air travel calculations. To calculate emissions from daily commuting we make a per-employee annual mileage assumption based on survey data rather than actual recorded mileages, and use full-time and part-time employee data provided by the institution. A 2015 LEEP Project survey updated the previous formula in use since 2011 and provided a much more detailed assessment of our commuting patterns. The more accurate formula is reflected in the increased emissions for 2015; we may have under-reported in prior years and going forward we will be using the more accurate formula. However, until and unless the University provides incentives and supports alternatives to the single-driver daily commute, this input to our campus emissions will not change significantly.

To calculate air travel emissions, we use industry-accepted average standards and estimates from University sources, and although based on assumptions the calculation method has remained consistent year to year. In 2015 and 2014 we saw a marked increase in the University-based data used in the air travel emissions calculation. (This does not necessarily mean Clark faculty and staff are flying more or further, but as the calculation and the data source has remained consistent, we report an increase in emissions). Air travel produces a large amount of emissions due to the magnified effects of fuel combustion at high altitudes, so even a small change in directly-financed air travel has a significant effect on Scope 3 emissions. If University employees were to record actual air travel miles in expense reporting, there would be a more accurate number which could encourage institutional solutions. Options for carbon offsets to airline travel could be utilized or supported by the University; other alternatives include changing behavior to travel less frequently or more efficiently and electronic options such as video conferencing. Certainly air travel for necessary conferences, recruitment and other institutional functions is vital to the continued success of Clark University. As is the case with faculty and staff commute, this data will not change significantly until viable alternatives are enacted. Neither Study abroad nor student commute is included in Clark's version of the greenhouse gas emissions inventory.





MTCO2e by Sector 2011-2015

	2011	2012	2013	2014	2015
Cogeneration Plant	6107.5	2452.9	5593.7	5560.2	4264.5
On Campus Stationary Sources	4426.1	2266.1	4253	3939.9	4220.7
Campus Fleet	164.6	167.4	174.3	163.6	147.2
Refrigerants	353.6	218.8	61.1	32	31
Purchased Electricity	1662.4	4523.2	1640.7	412	1379.8
Faculty/Staff Commuting	1610.6	1666.1	1337	1160.6	1586.9
Air Travel	1485.8	1432.2	1165.1	1874.2	2119.8
Distribution Losses	138.5	298	93.6	14.1	90.9

Energy Use on Campus

The goals of the Climate Action Plan are expressed in terms of metric tons of carbon dioxide equivalents (MT CO2e). Our mitigation strategies, including energy management strategies, are also expressed in MTCO2e. Technology-dependent strategies (for example lighting efficiency or mechanical system upgrades) will reduce MTCO2e as they reduce energy consumption, although they may be offset by other increases such as population or physical space footprint. For example, by 2013 Clark had completed a program of large-scale technology-based energy and lighting improvements, and although we can track building-specific energy usage data it is not possible to identify overall impact due to other input variables. Non-technological strategies (for example personal energy conservation practices or maximizing use of space) are harder to quantify than technology strategies but in the long run equally significant in managing Clark's energy consumption patterns as they will have an incremental effect. At this time there are no plans for additional comprehensive improvements in energy systems or efficiency, although incremental projects are on-going.

Electricity

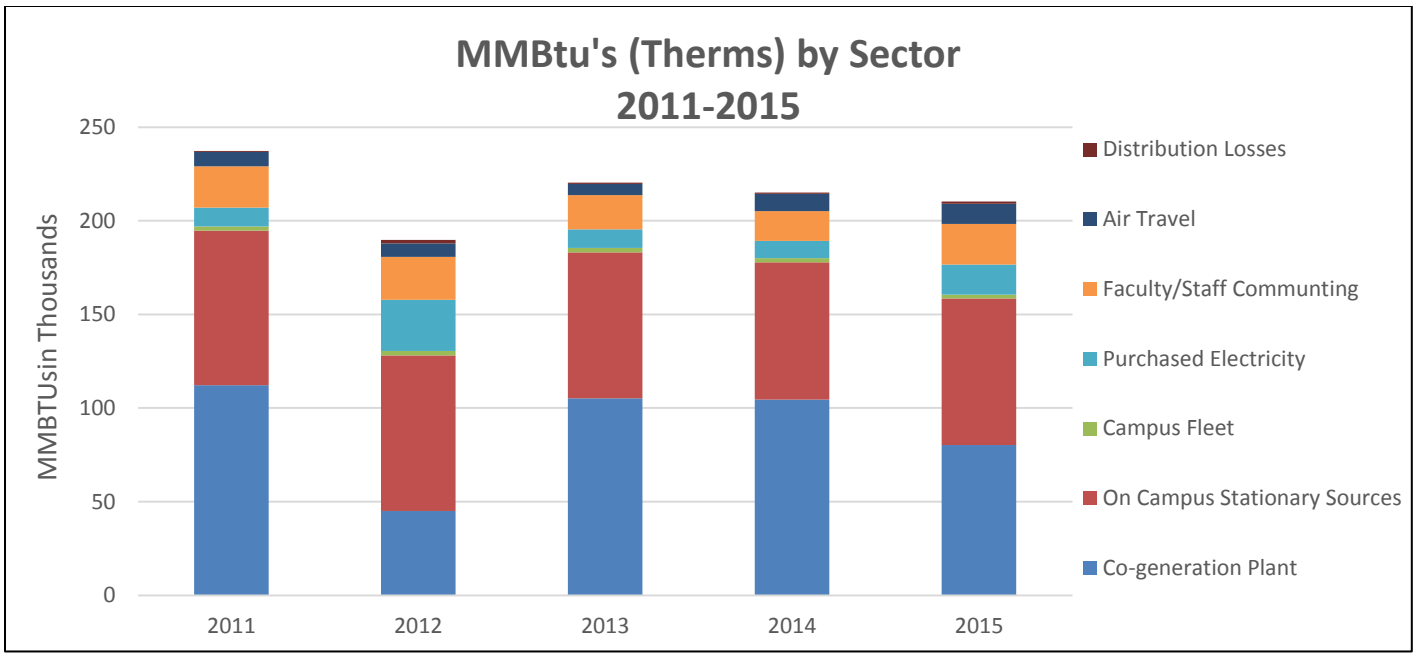
Actual total campus electrical load (Scope 1 electricity produced plus Scope 2 electricity purchased to meet usage demands) of 12,311,734 kWh presented a 2.7% decrease compared to 2014, which was 2% lower than 2013. Note that while the *emissions* from Scope 2 Purchased Electricity increased significantly in 2015, our total *electrical load*, actual energy usage as electricity, decreased. This can be attributed to multiple sources, including the aggregate impact of Clark's energy efficiency upgrades since 2013, offsetting credits from the Solar Flair agreement as explained above, and/or a change in end-user behavior (i.e. more people consistently turning off lights and otherwise conserving energy).

Heat

Clark's thermal energy use decreased in 2015, with emissions from Scope 1 directly related to heating 4.8% lower than 2014 and 4.3% lower than 2013. The winter of 2015 was below normal temperature averages, and so even these slight decreases are a significant indicator of the result of our efficient new cogeneration engine, steam distribution system replacements, and the aggregate impact of building heating system and efficiency upgrades. These influences offset what could otherwise result in an increase due to an unexpected #6 oil burn-off. (The University regularly engages in contractual relationships to ensure advantageous pricing and supply. In 2015 we reached a volume cap on our long-term natural gas supply contract and opted to use our heating oil reserves rather than purchase natural gas at open market costs. It should be noted that for system redundancy, Clark retains an oil reserve sufficient to heat campus buildings).

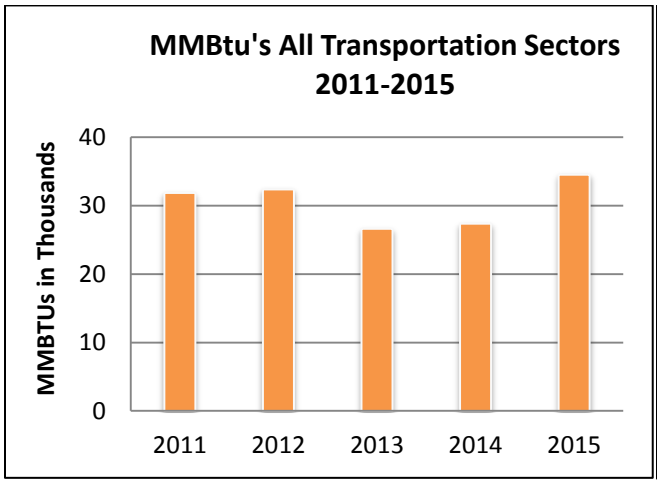
Therms

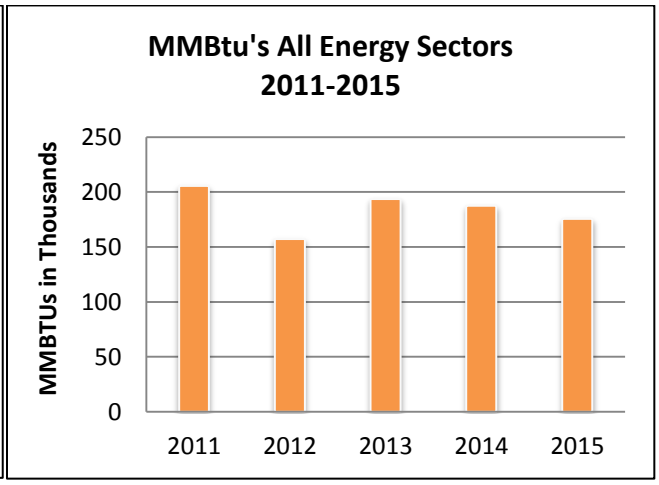
As there is a direct relationship between energy consumption and MTCO2e created, it is helpful to examine the energy-related inventory data in terms of a standard unit of energy measurement: therms. This is expressed in million British thermal units, or MMBtu's, and is in common use when evaluating energy output or usage as a whole. Scopes 1, 2 and 3 can be expressed in therms for a common understanding of energy expended across sectors. The calculations are based on EPA standards in use and derived from the CCC. In the charts below, kWh, fossil fuel gallons and natural gas therms are all combined and expressed in MMBtu's to provide a comparative analysis of actual energy consumption across sectors and across time.



MMBtu's All Sectors 2011-2015

	2011	2012	2013	2014	2015
Cogeneration Plant	112252.5	45076.4	105211	104580.5	80209
On Campus Stationary Sources	82501.6	83089.2	77950.7	73173.8	78337.7
Campus Fleet	2274	2303.9	2394.2	2251.3	2035.3
Purchased Electricity	10080.6	27428.2	9949.1	9253	16090
Faculty/Staff Commuting	21995.7	22753.1	18258.3	15849.3	21672.1
Air Travel	7590.7	7317	5952.2	9272	10829.7
Distribution Losses	664	1806.7	655.4	609.5	1059.9





Conclusion

This is a landmark year in our Climate Action Plan. 2015 is the year of our interim goal: to achieve emissions of 16,357.4 MTCO2e, or 20% below our 2005 baseline. This interim goal was actually achieved in 2010 – a year after the Climate Action Plan was released - and has not been exceeded since. The University has no other interim goals between now and our commitment to zero emissions by 2030. We have achieved and exceeded the first goal.

Since our 2005 baseline year, Clark has reduced total emissions by 35.78 percent. To contrast, since 2009, with the onset of Climate Action Plan strategies, Clark has reduced total emissions by 14.6 percent while our physical footprint, use of electronics, and student population has grown. Beginning now, if we continue at our best annual rate of emissions reduction and hold all else constant, by 2030 we will have reduced emissions by 42 percent over baseline and still be less than halfway to our 2030 goal of carbon neutrality. Perhaps future developments in technology will provide unexpected benefits; there have been numerous technological advances since the CAP was written that are therefore not included in our expressed mitigation strategies and there will be others. Our long-established operations practice of efficiency upgrades and retrofits as appropriate and affordable may continue to be incrementally helpful. A number of strategic initiatives explored in the CAP and in other avenues but not yet enacted may prove impactful if implemented. Finally, simple voluntary behavior change can aggregate and show results over time.

Scope 3 has emerged as the true challenge to the Climate Action Plan goal. Scope 3 emissions are less tractable than controlling Scope 1 or 2, which demonstrably can be impacted by investments in technology and efficiency – an operations solution. Scope 3 on the other hand, especially in the realm of employee commuting and air travel, does not yield to applying a "thing" at scale; it requires soft-resource investment in policy and institutional support for broad behavioral change. For example, University commitment to well-monitored programs and institutional incentives for alternatives such as telecommuting, shuttle service, supported car and van pools, managed parking, or carbon offsets combined with a mandate toward whole-campus engagement could reduce Scope 3 emissions. As the Clark University Environmental Task Force has noted in several reports, the low-hanging fruit has been captured and operations-based investments in technology will continue; but to truly impact our emissions a whole-campus approach that includes every employee, involving high levels of support and direction to ask for significant behavior change, as well as changing long-held habitual and institutionally-condoned practices, will be necessary before 2030.

It appears from the data in the greenhouse gas inventory and Clark's sincere efforts to date that it will require all of this and more: it could require a paradigm shift in strategic institutional priorities. Although we have reached and to date retained our interim goal, it is clear that business as usual for the next 14 years will not achieve the goal of the Climate Action Plan. Continued expansion of the University combined with continuing unstable weather patterns make achieving our 2030 goal of carbon neutrality extremely challenging without addressing significant behavioral, habitual and technological inputs as a community, and without investing in them financially, operationally and personally. Clark's Climate Action Plan provides a roadmap to effectively achieve our Climate Commitment goals, however there is still much to be accomplished that will require the commitment and ingenuity of the entire Clark community if we are to meet our goals of climate neutrality - net zero emissions - by 2030.