Clark University Greenhouse Gas Emissions Update: 2014

Clark University Still on Track for Emissions and Carbon Neutrality Interim Goal

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, detailing strategies for the University to reduce its greenhouse gas emissions while strengthening many of its existing sustainability practices. The plan sets two goals: an interim goal of reducing emissions to 20 percent below 2005 levels by 2015 and the ultimate goal of climate neutrality by the year 2030. The CUES Task Force retained responsibility for recording and reporting on Clark's emissions. Achieving the ambitious goal of carbon neutrality by 2030 requires a 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.

Greenhouse Gas Emissions Inventory

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.

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 Campus Carbon Calculator multiplies fuel use and other inputs by updated emissions factors to determine the amount of metric tons of carbon dioxide equivalent (MT CO2e) 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.

Revised Carbon Equivalencies; Updated Campus Carbon Calculator

The 2014 greenhouse gas emissions inventory uses version 7.0 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. The updates in CCC version 7.0 impact 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. Many standards are retroactive and almost all of Clark's past data stored in the CCC from 2005-2013 is affected by updates. The full list of CCC updates as well as more information on the CCC is available on request here: http://sustainableunh.unh.edu/calculator.

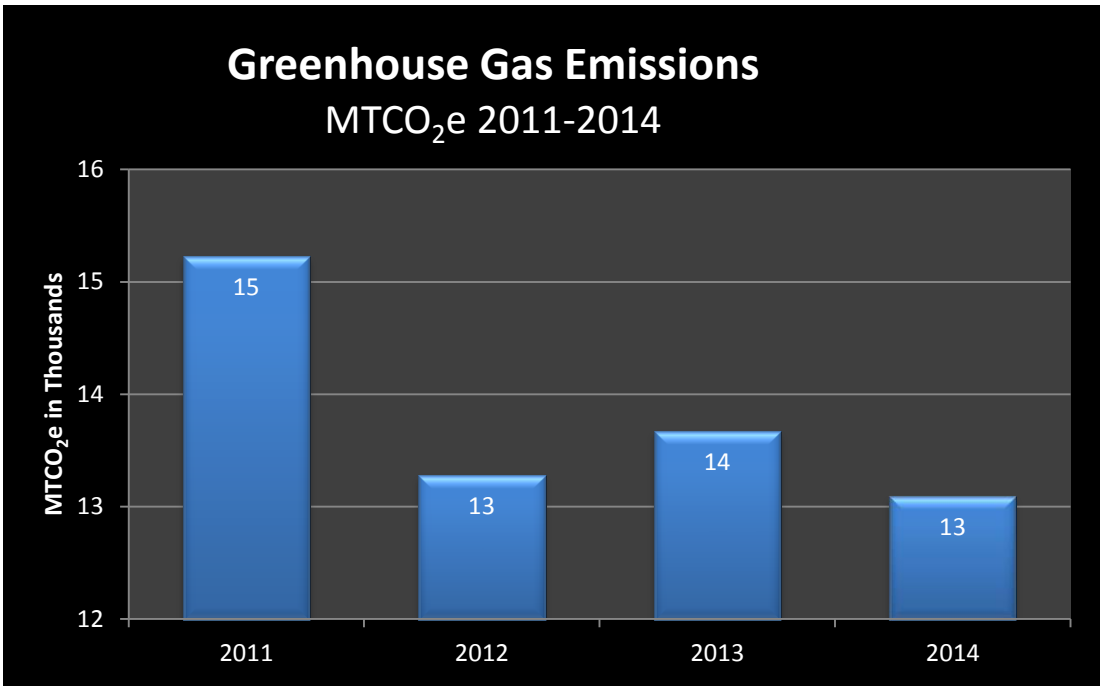
Due to the evolving nature of greenhouse gas emission factor science, Clark University consistently utilizes the most current version of the CCC in the annual Update for charts and data analysis. Therefore, previous Updates *may* show annual or category data points that differ from the current Update; 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.

Greenhouse Gas Emissions Inventory Update: 2014

As of the calendar reporting year 2014 Clark University is on track to meet and exceed its interim goal of a 20 percent reduction over 2005 emissions levels by 2015, and slightly closer to the ultimate goal of climate neutrality by 2030. A number of influencing factors are discussed below.

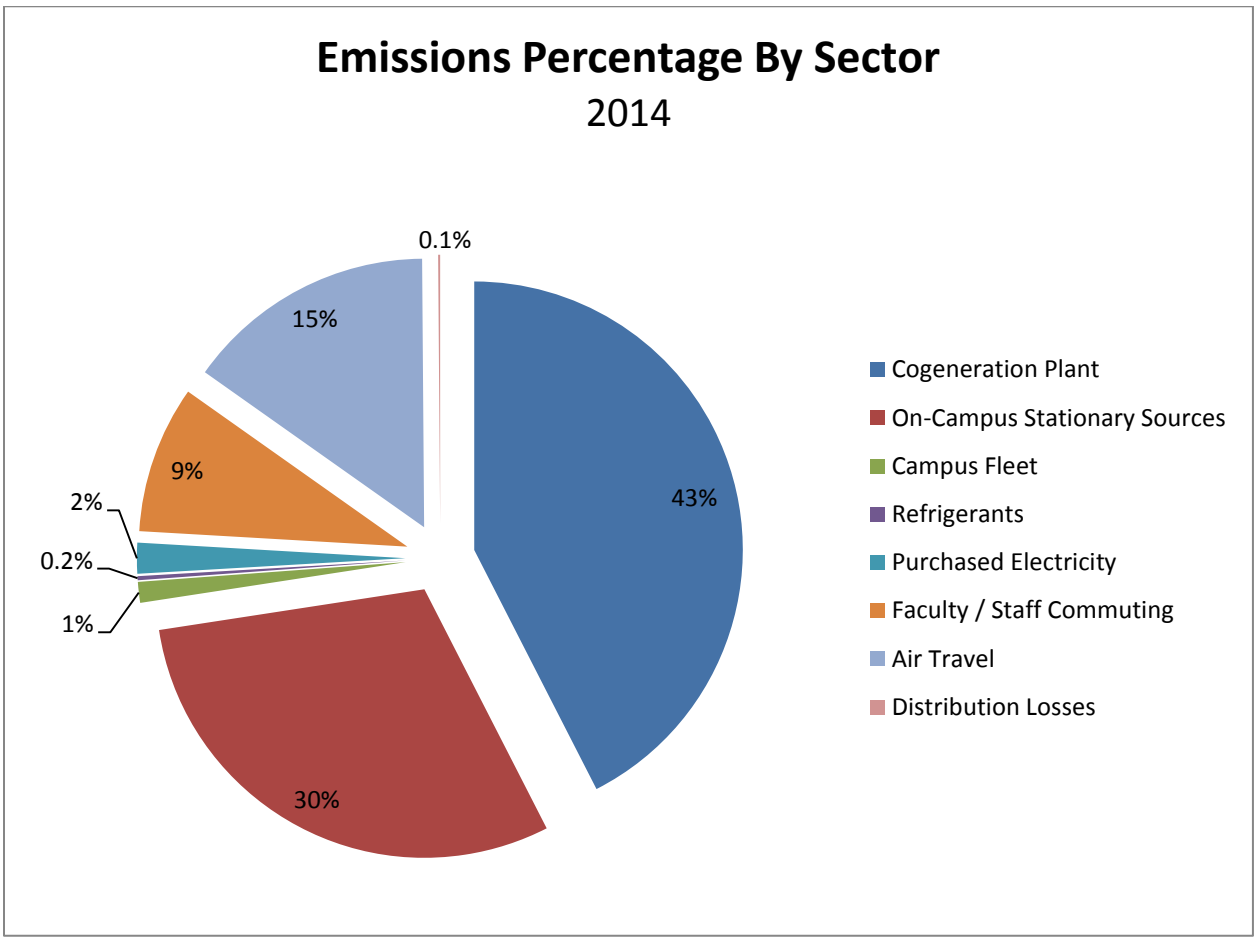
Total Greenhouse Gas Emissions in Metric Tonnes of Carbon Dioxide Equivalencies (MTCO2e)

Total GHG emissions in 2014 were 13,077.66 MTCO2e. This represents a decrease of 4.3 % from total 2013 GHG emissions of 13,658.6 MTCO2e. Net GHG emissions in 2014 after offsets were 13,023.7 MTCO2e. The Explanations section below details some of the probable causes for the difference year-to-year.



Sources of Greenhouse Gas Emissions on Campus: Scopes 1, 2, 3

As in prior GHG inventories, the largest source of Clark's greenhouse gas emissions is 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. The Cogeneration and On-Campus Stationary Combustion sectors comprised 72.6% of all emissions in 2014; in 2013 the same sector was 72.1%. Scope 2 emissions result 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 1.9% of total emissions in 2014, compared to 7.1% in 2013 and up to 20% in prior years. The second largest emissions contributor is found in Scope 3 and is primarily fuel used in faculty and staff commuting and air travel; this sector comprised 24% in 2014, compared to 18.8% in 2013. Smaller sources of emissions include refrigerants, utility-based transmission and distribution losses, and campus fleet direct transportation; all 2% or less. See the Explanations sections below for details of the 2014 data and analysis.



Explanations: Scope 1

As the mitigation strategies of the Climate Action Plan are implemented we may see emissions decrease in proportion to changes in energy use, if and when all else is held constant. Each annual greenhouse gas inventory will also reflect year-to-year differences in weather, campus operations, and other conditions beyond our control. Interestingly, 2014 appears to be the first year that can be considered 'normal' in regard to Scope 1 and campus energy measures.

2014 can be considered a benchmark-normal year in that weather patterns were typical and all else being equal, this is about the amount of heating and cooling expected on average. In contrast, 2013 was both an unusually hot and an unusually cold year with higher than usual emissions directly related to the greater use of heating and cooling systems. As climate instability increases, it is ever more important to change Clark's core practices to offset the swings beyond our control.

2014 was also a benchmark-normal year regarding campus operations in that Clark's new (on line as of January 2013) co-gen operated throughout the year with normal inputs and there were no major construction or retrofit projects on campus. In contrast, 2013's Scope 1 emissions spike resulted primarily from burning leftover #6 oil in the campus boilers, whereas 2012 was a year of construction and severely limited co-gen operations (for more detail on this burn and co-gen operational constraints see prior GHG Updates). 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.

Explanations: Scope 2

Clark's cogeneration plant provides most of the electricity for central campus. Utility-generated electricity is purchased from National Grid only for outlying buildings (termed satellites) that are not connected to the co-gen; for central campus demand in excess of co-gen production capacity (for example, high air conditioning demand); and when the co-gen is not operational. The cogeneration plant supplied 77% of total campus electricity demand in 2014; 78% in 2013; 33% in 2012. Purchased Electricity in Scope 2 supplies the balance.

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 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 agreements. The amount is approximately 6% of total production.

2014 marks the beginning of a very positive development in our Scope 2 emissions tracking. Beginning in 2014, Clark entered a financial arrangement with two solar farms operated by Solar Flair in Charlton, MA. Under the terms of the 20-year agreement, Clark will receive credit for a proportion of the kWh's generated by the solar farms. The credit will appear on our monthly electricity invoices from National Grid, apportioned across a number of Clark's accounts. While Solar Flair retains the value of the Renewable Energy Credits (REC's) on the carbon market and National Grid is the actual recipient of the generated kWh, Clark is able to reduce Scope 2 emissions across the board as the credits serve to offset our emissions source of Purchased

Electricity as recorded in the CCC. 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.

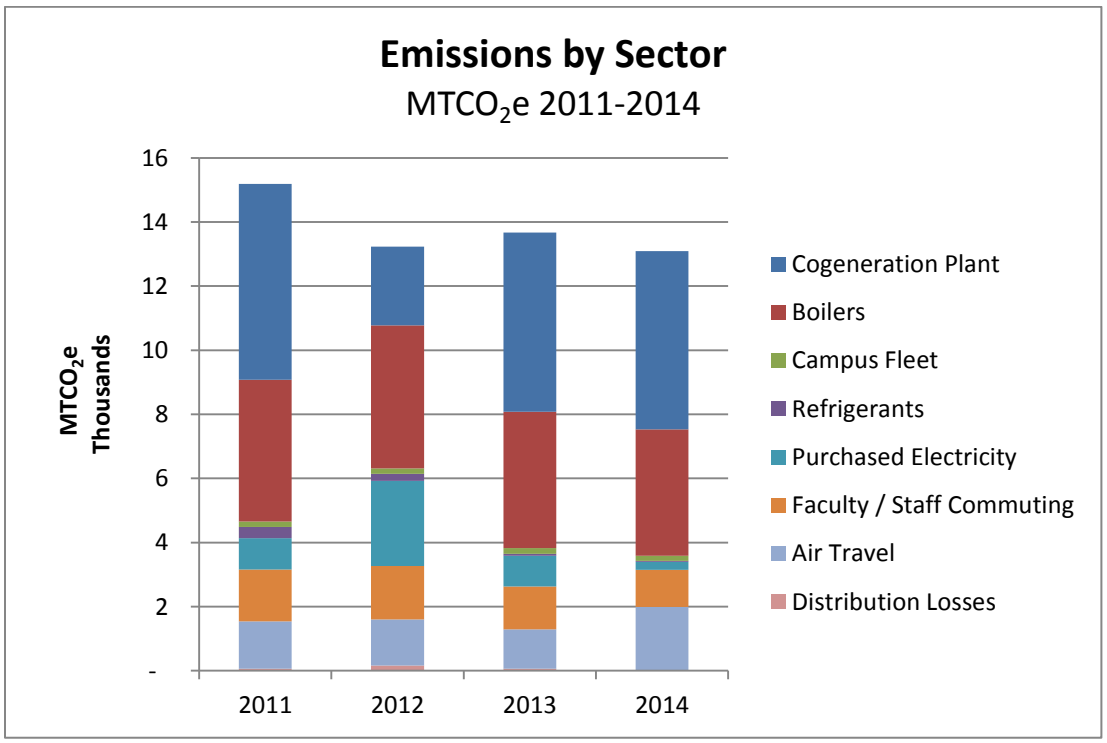
In 2014, the solar production credit accounted for 73% of Clark's Purchased Electricity, reducing our emissions to 242 MTCO2e in this sector. This represented a significant decrease in Scope 2 emissions compared to 965 MTCO2e in 2013 and up to 2,400 MTCO2e in prior years. It is expected that this level will be maintained over the life of the 20-year agreement with Solar Flair, bringing us past our 2030 deadline for carbon neutrality. Both 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.

Explanations: Scope 3

Emissions from faculty and staff commuting have decreased slowly since Clark began tracking emissions, partly due to changes in full-time employee count. Federal standards used in the calculation reflect increasing fuel efficiency of an 'average' vehicle, also contributing to the gradual decline in emissions. To calculate this data set we make a per-employee annual commuting assumption based on survey data rather than actual recorded mileages. The calculation formula remains consistent year to year. More accurate tracking could support institutional incentive for University commitment to alternatives such as telecommuting, shuttle service, supported car and van pools, managed parking, or carbon offsetting. Until and unless the University provides incentives and alternatives to the single-driver daily commute, this data will not change significantly. Student commute is not included in Clark's version of the greenhouse gas emissions inventory.

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. This data set is also based on industry-accepted average standards and estimates from University sources, and the calculation method has remained consistent year to year. In 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 flew more or further in 2014; but as the calculation and the data resource has remained consistent, we report an increase in emissions. If the University were to track actual air travel miles, 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 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. Study abroad or commuting student air travel is not included in Clark's version of the greenhouse gas emissions inventory.

Emissions-causing refrigerants are being successfully phased out at Clark in response to federal and state regulations, increasingly replaced by lower or zero emissions alternatives. As older equipment is upgraded and regulatory-compliant equipment is installed, this sector continues to decrease.



2011	2012	2013	2014	
6,108	2,453	5,594	5,560	**Cogeneration Plant**
4,426	4,466	4,253	3,940	**Boilers**
165	167	174	164	**Campus Fleet**
354	219	61	32	**Refrigerants**
978	2,661	965	242	**Purchased Electricity**
1,611	1,668	1,338	1,162	**Faculty / Staff Commuting**
1,486	1,432	1,228	1,975	**Air Travel**
60	164	60	16	**Distribution Losses**

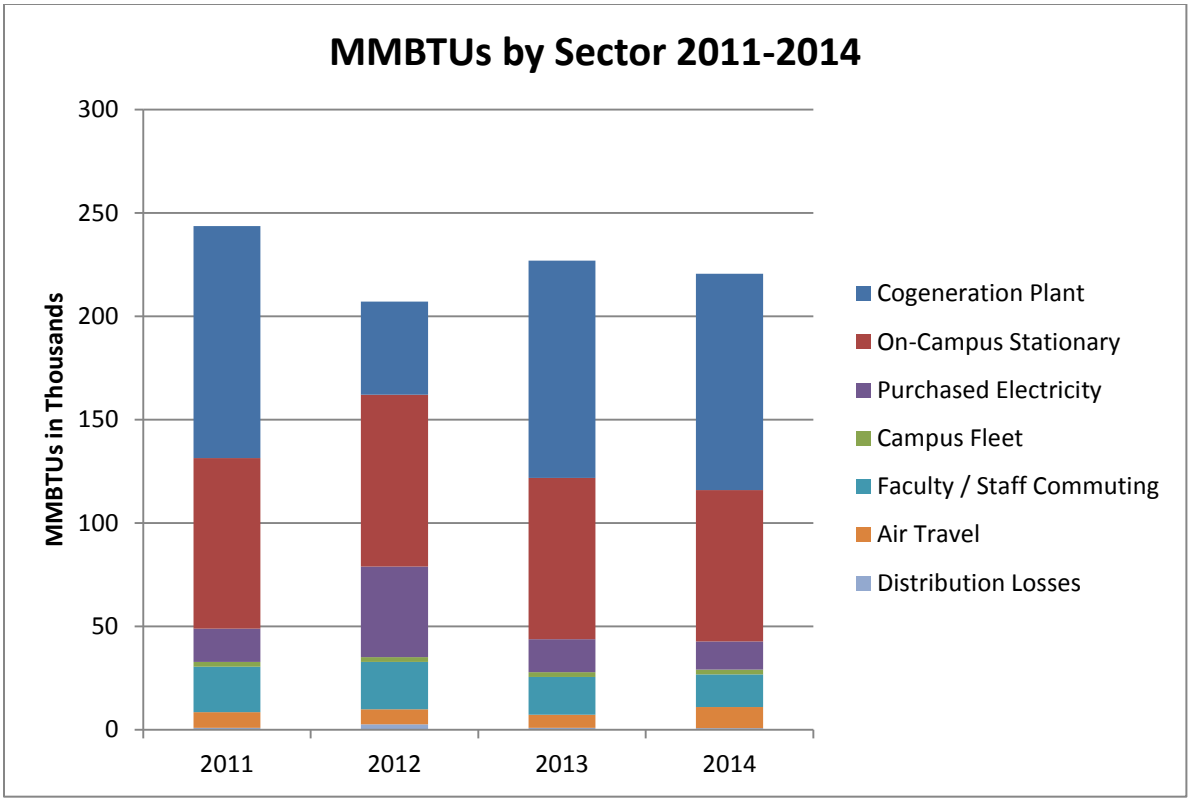
Energy Use on Campus

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. 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.

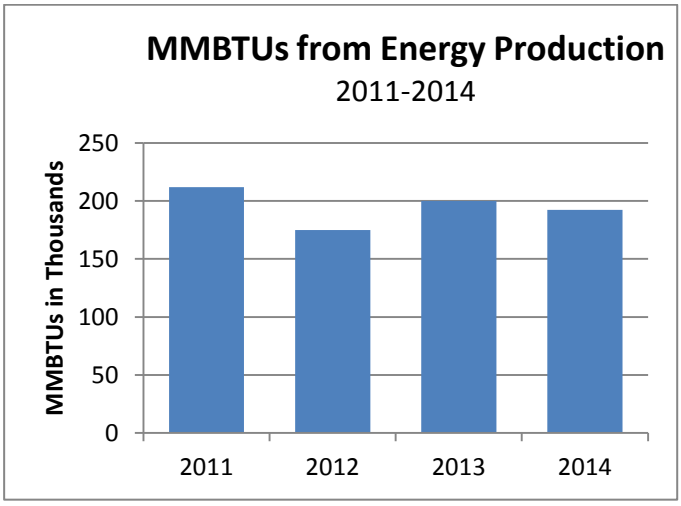
Electricity: Clark had completed a program of large-scale technology-based energy and lighting improvements by 2013 in excess of $1.5M invested; no other major infrastructure improvements have occurred since and none are scheduled although smaller scale projects are on-going. It is difficult to identify if the investment has had an overall impact because of other variables, although there are indications of building-specific energy reductions. The new co-generation engine has demonstrated improved fuel efficiency in electrical production. Actual total campus electrical load (produced, purchased, central and satellite combined) was 14,135,377 kWh in 2014; a 2% decrease from 14,481,941 kWh in 2013, which was 4.2% higher than 2012. Note that while the *emissions* from Scope 2 Purchased Electricity declined significantly in 2014, the *electrical load*, actual energy usage as electricity, did not show the same decrease. This is due to the nature of the agreement explained above.

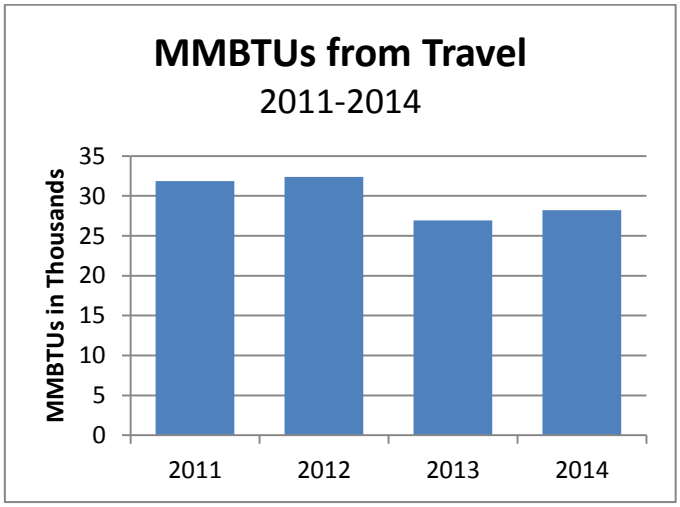
Thermal energy: Clark invested in a new cogeneration engine which came fully on-line in 2013. The new engine is more efficient and contributes a higher steam output to our central heating system, thereby increasing fuel efficiency in the central system boilers as well as in on-site electrical generation. Both the co-gen and the boilers operated in 2014 on natural gas, a relatively clean fuel source. Additionally, in the summer of 2014 our long-term program of steam line replacement continued with new piping in the Alden Quad renovation and reduced steam leakage in that area. However, even inclusive of the unique #6 oil burn in 2013 mentioned earlier, our emissions from fossil fuel use (natural gas, oil, biofuel) in all campus heating applications (including the central system boilers plus individual boilers in satellite locations) and total thermal energy increased by 1.5% in 2014 compared to 2013. As in the discussion of electricity above, no additional comprehensive improvements in heating systems or efficiency are planned, although incremental projects are on-going.

As there is a direct relationship between energy consumption and MTCO2e created, it is helpful to examine the inventory data in terms of a standard unit of energy measurement: therms. This is expressed in million British thermal units, or MMBtu's. 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.



2011	2012	2013	2014	
112,252	45,076	105,211	104,581	**Cogeneration Plant**
82,502	83,089	77,951	73,174	**On-Campus Stationary**
2,274	2,304	2,394	2,251	**Campus Fleet**
16,152	43,948	15,941	13,721	**Purchased Electricity**
21,996	22,778	18,278	15,867	**Faculty / Staff Commuting**
7,591	7,317	6,271	10,088	**Air Travel**
998	2,716	985	889	**Distribution Losses**





Conclusion

Based on 2014 data and examining the results of our annual greenhouse gas inventories, Clark University will again exceed its interim goal of reducing emissions 20 percent below 2005 levels by 2015. (20% below 2005 emissions is 16,357.4 MTCO2e) This interim goal was actually achieved in 2009 – the year 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.

Since our 2005 baseline year Clark has reduced total emissions by 34.3 percent. Since 2009, with the application of some of the strategies in the Climate Action Plan, Clark has reduced total emissions by 16.8 percent while our physical footprint, use of electronics, and student population have grown. Beginning now, if we continue at the post-CAP annual rate of emissions reduction and hold all else constant, by 2030 we will have reduced emissions by 42 percent over baseline and be less than halfway to our ultimate 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; there could be more. Our long-established practice of efficiency upgrades and retrofits as appropriate may continue to be marginally helpful. A number of strategic initiatives explored in the CAP and in other avenues but not yet enacted may prove impactful if implemented. Even simple voluntary behavior change can aggregate and show results over time.

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 will not suffice for the next 15 years. 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 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.