Clark University Greenhouse Gas Emissions Update: 2013

Clark University on Track for Emissions and Carbon Neutrality Goals

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 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. The second goal is to achieve climate neutrality (net zero greenhouse gas emissions) by the year 2030. Making progress toward this ambitious goal requires a willingness on the part of all members of the Clark University community to make this a priority for many years to come.

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 2009. Data is gathered from a range of campus entities and we utilize the Campus Carbon Calculator from Clean Air-Cool Planet, a leading non-profit organization in the field, to calculate emissions.

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.

Revised Carbon Equivalencies; Updated Campus Carbon Calculator

The 2013 greenhouse gas emissions inventory uses version 6.9 of the Campus Carbon Calculator (CCC), which updated source reporting categories, but did not substantially change equivalencies or emissions calculations. 2012's CCC version 6.85 included over 40 substantial updates to align with IPCC, EPA, DOE and other agency standards as the science of calculating emissions and carbon equivalencies continually improves. Many standards are retroactive and almost all of Clark's past data stored in the CCC from 2005-2011 was affected by

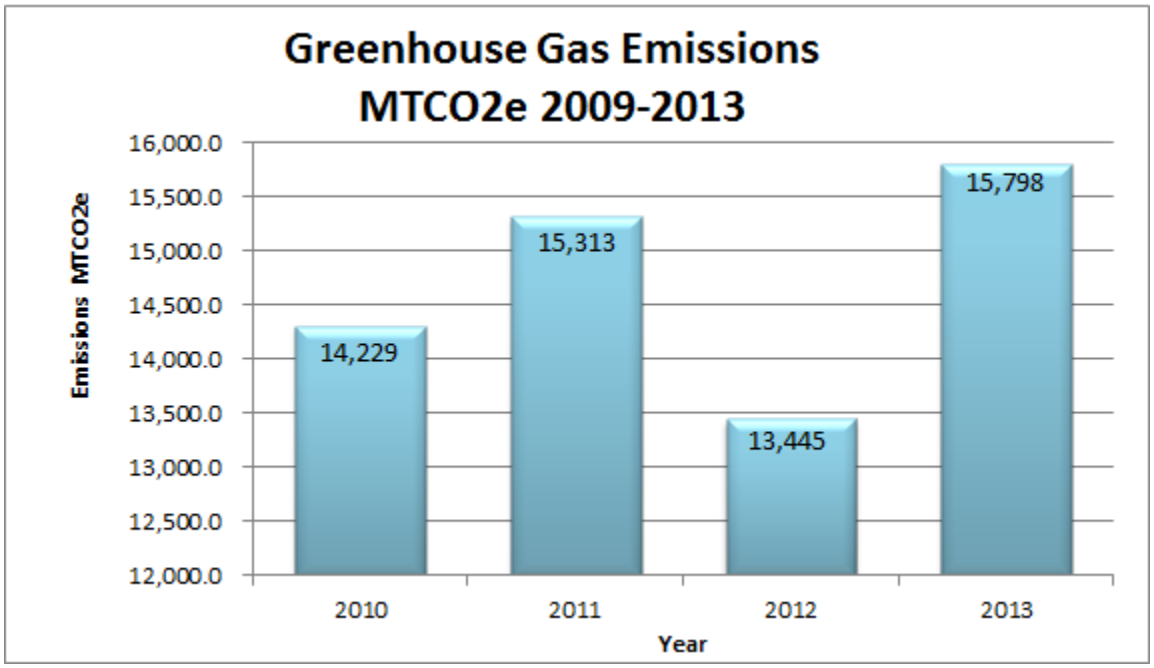
the 2012 updates. The most significant update re-calculates oxidation factors and impacts data retroactive to 2006. Although it's a small percentage change, it can add up to tons of estimated emissions. (Clark's interim Climate Action Plan goal for 2015 was based on 2005 emissions and the standards at the time, as were the benchmarks and mitigation strategies; the interim goal therefore remains unchanged at 16,357.4 MTCO2e.) In 2011 CCC version 6.7 included EPA revisions from 2007 for certain emissions-producing activities which impacted CO2 equivalency calculations retroactive to 2007. The full list of CCC updates is available here: http://cleanair-coolplanet.org/campus-carbon-calculator.

Greenhouse Gas Emissions Inventory Update: 2013

As of the calendar reporting year 2013 Clark University is on track to meet and exceed its interim goal of a 20 percent reduction over 2005 emissions levels by 2015, and therefore closer to the ultimate goal of climate neutrality by 2030.

Total Greenhouse Gas Emissions in Metric Tonnes of Carbon Dioxide Equivalencies (MT CO2e)

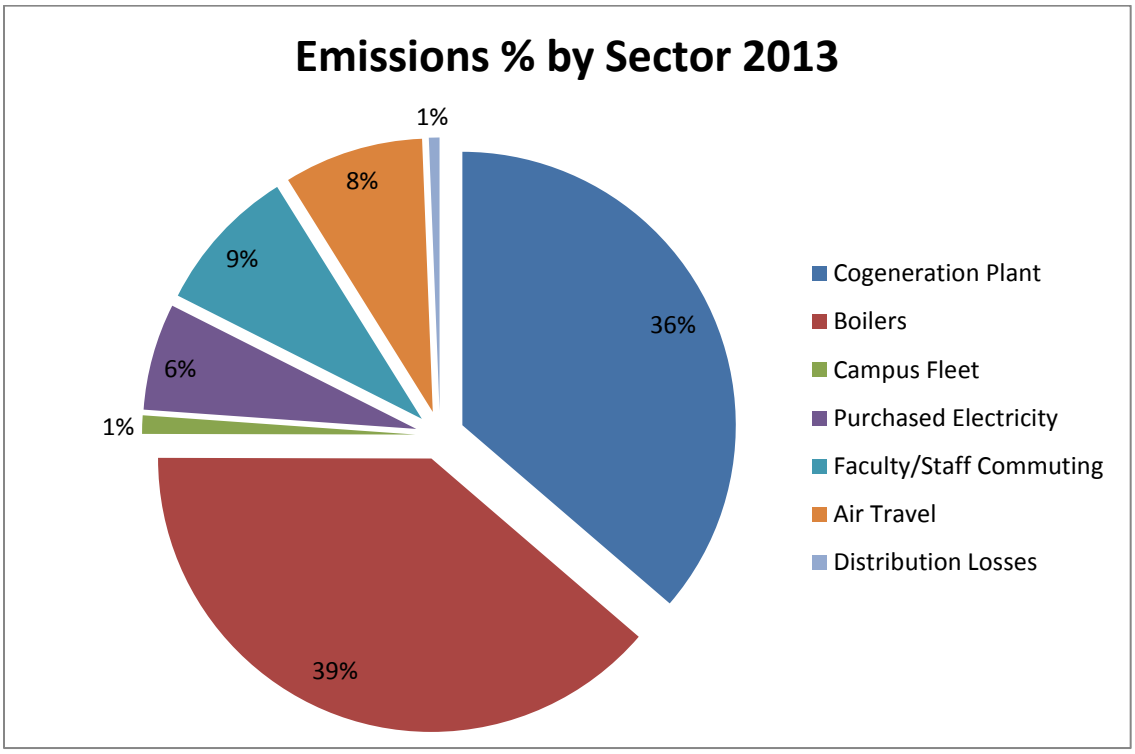
Total GHG emissions in 2013 were 15,798.7 MT CO2e. This represents a 17.5% increase from total 2012 GHG emissions of 13,445.2 MT CO2e. Net GHG emissions in 2013, after offsets, were 15,785.3 MT CO2e. The Explanations section below details some of the probable causes for the difference year-to-year.



Sources of Greenhouse Gas Emissions on Campus

As in prior GHG inventories, the major source of Clark's greenhouse gas emissions is Scope 1: fuel consumed to produce heat and electricity by the cogeneration engine, and to produce heat in both the central boilers and 'satellite' locations not served by the central heating system. This sector is termed On-Campus Stationary Combustion and comprised 71.5% of all emissions in 2013; in 2012 the same sector accounted for 52.5% of total emissions. The second largest contributor is found in Scope 3 emissions, largely comprised of fuel used in transportation (including faculty and staff commuting and air travel); this sector comprised 23% of all emissions in 2012, similar to prior years. 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 5.9% in 2013, compared to approximately 20% of emissions in 2012 and prior years. Smaller sources of emissions included refrigerant leakage, utility-based transmission and distribution losses, and campus fleet direct transportation, all 2% or less.



Explanations: Scope 1

As the management 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 and other conditions beyond our control. 2013 was both an unusually hot and an unusually cold year; causing increases in heating and cooling across campus systems and impacting our emissions. Until and unless we change Clark habits and practices, we will continue thus as climate instability increases.

Campus operations are another factor that impact GHG emissions. A large contributor to elevating 2013 Scope 1 emissions above our previous downward trend was the decision to use #6 oil in the campus boilers. Clark has not used #6 oil in significant volume since 2007; however we had 23,000 gallons remaining in a storage tank from a pre-2007 bulk purchase. The stored fuel had to be removed from the tank before it became unusable sludge or an environmental problem through leakage. The decision was made to burn the entire tank contents in one year as fuel for the boilers. The resulting CO_2e are close to 1,000 tons. The co-gen and the boilers operate on natural gas, however we retain a volume of #6 oil as a back-up measure to ensure that in the event of a natural gas pipeline failure, Clark will not be without heat. It is therefore likely that there will be another emissions contribution from #6 oil at regular intervals in the future.

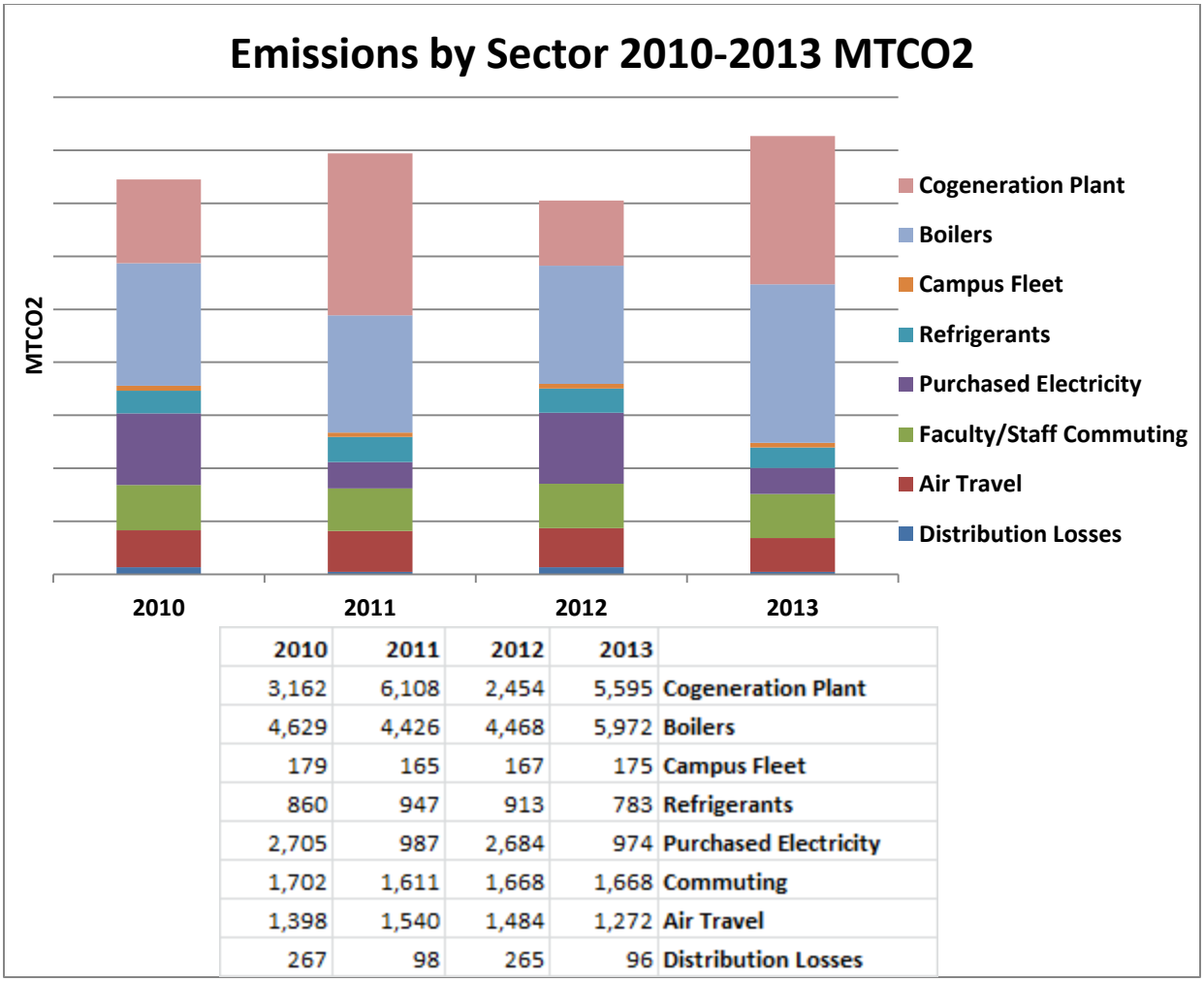
In January 2013 Clark's new, larger cogeneration engine came on line and provided electricity and heat for most of the calendar year. The new engine should increase fuel efficiency and reduce emissions, however, due to continuing issues with the air intake and the turbo which were not resolved until late in 2013, co-gen efficiency was lower than expected and this has increased emissions. The new engine, running consistently at optimum load, also produced 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 gave away electricity but still incurred the full burden of the production emissions. Future excess production may receive offsetting credits as the purchase agreement is formalized.

Explanations: Scope 2

The cogeneration plant supplied 86.8% of campus total electricity demand in 2013, with utility-generated electricity purchased only for outlying buildings (termed satellites) and central campus demand in excess of co-gen production capacity, such as summer air conditioning. To compare, in 2012 Clark purchased electricity for 8 months to supply campus electrical demand while the old engine was dismantled and the new one installed and the cogen supplied only 39% of campus electricity demand. When the cogen is used this heavily, emissions increase unless cogen efficiency is superior. The co gen uses solely natural gas. Purchased electricity consists of a mix of fuel sources; some of them, such as biomass and hydropower, have zero emissions. By purchasing electricity Clark is able to take advantage of zero emissions fuel sources in our total emissions calculations, but loses the efficiency of cogenerating heat, hot water and electricity from the same fuel source.

Explanations: Scope 3

Air travel produces a large amount of emissions due to the magnified effects of fuel combustion at high altitudes, so even a small increase in volume has a significant effect. In 2013, faculty and staff air travel included a higher percentage of domestic travel. Options for carbon offsets to travel exist but are not utilized or supported by the University; alternatives include changing behavior to travel less frequently and electronic options such as video conferencing. Emissions from faculty and staff commuting remained relatively constant 2012-2013, and will probably continue to do so until and unless the University provides incentives or alternatives to the single driver car commute. Both of these data sets use estimations and averages rather than actual recorded mileages, for which the University does not have a mechanism in place. If and when the University is ready to track actual miles, we will have a more accurate number.



2010	2011	2012	2013	
3,162	6,108	2,454	5,595	Cogeneration Plant
4,629	4,426	4,468	5,972	Boilers
179	165	167	175	Campus Fleet
860	947	913	783	Refrigerants
2,705	987	2,684	974	Purchased Electricity
1,702	1,611	1,668	1,668	Commuting
1,398	1,540	1,484	1,272	Air Travel
267	98	265	96	Distribution Losses

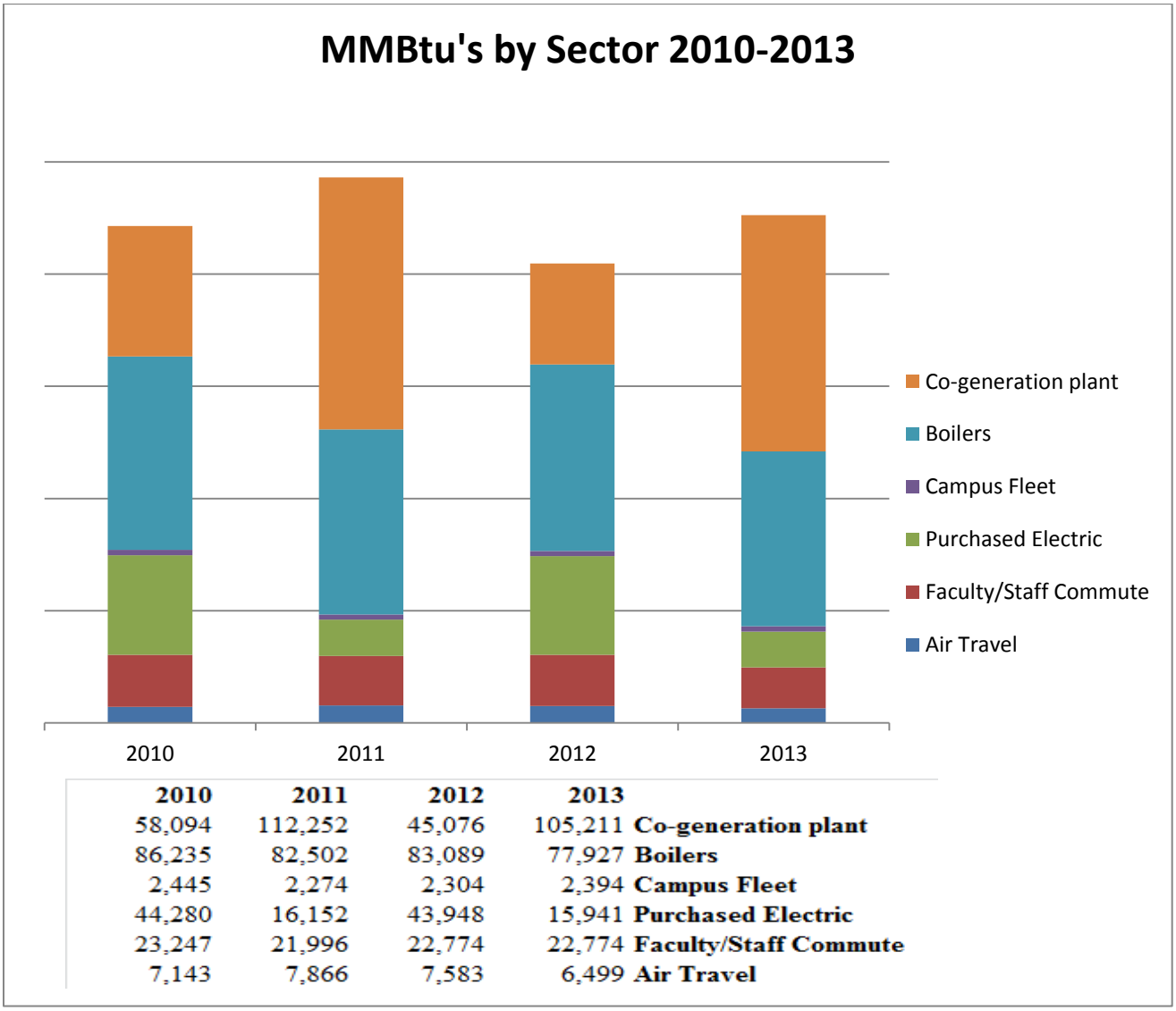
Energy Use on Campus

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 strategies such as improvements to lighting efficiency and systems upgrades will reduce emissions as they reduce energy consumption.

The results of a number of energy and lighting improvements, completed throughout 2012, are reflected in the 2013 data. They are, however, not immediately visible in the gross data, which includes the excess electricity production mentioned previously. Actual electrical load (produced and purchased combined) increased 8.7% from 10,613,389 kWh in 2012 to 11,545,894 kWh in 2013. If the excess production volume is filtered out, total campus electrical usage increased 4.2% in 2013 versus 2012. To add further context, campus electrical usage was 2.6% lower in 2013 than in 2011. Part of the 2013 increase is due to the higher 'parasitic' (i.e. operational) load of the new cogen engine and certainly some is due to uncontrolled use of air conditioning in a warmer than usual summer. Further investigation is needed to determine if Clark's increasing population and an ever increasing use of electronics in offices, classrooms and residences may also be contributing to the increase of campus electrical use. In non-cogeneration heating applications (including

boilers in 'satellite' locations), fossil fuel use (natural gas, oil, biofuel) remained relatively constant between 2012 and 2013.

As there is a direct relationship between energy consumption and MT CO2e produced, 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. The calculations are based on EPA standards in use and derived from the CCC. In the chart below, kWh, fossil fuel gallons and natural gas therms are all expressed in MMBtu's to provide a comparative analysis of actual energy consumption across sectors and across time. Clark's energy use aligns with our greenhouse gas emissions.



2010	2011	2012	2013	
58,094	112,252	45,076	105,211	**Co-generation plant**
86,235	82,502	83,089	77,927	**Boilers**
2,445	2,274	2,304	2,394	**Campus Fleet**
44,280	16,152	43,948	15,941	**Purchased Electric**
23,247	21,996	22,774	22,774	**Faculty/Staff Commute**
7,143	7,866	7,583	6,499	**Air Travel**

Conclusion

Based on 2013 data and examining the results of our annual Greenhouse Gas Inventories, Clark University may exceed its interim goal of reducing emissions 20 percent below 2005 levels by 2015. If weather patterns continue as they have and experts predict will, achieving our interim goal is more challenging without addressing other behavioral and technological inputs. Additional strategies and efficiency measures are currently being implemented or under consideration; the results of these strategic initiatives may be evident in future inventory calculations. Clark's Climate Action Plan provides a roadmap to effectively achieve our interim goal, however there is still much to be accomplished that will require the commitment and ingenuity of the entire Clark community if we are to effectively reduce our emissions and lower our footprint – and meet our goals of climate neutrality and net zero emissions by 2030.