Clark University Greenhouse Gas Emissions Update: 2020

Executive Summary

Clark University's greenhouse gas emissions in 2020 were 10,752.23 metric tons of carbon dioxide equivalents ($MTCO_2e$), a 22% decrease from 2019 emissions of 13,802.28 $MTCO_2e$. This year's emissions are 34% below our 2015 interim goal of 16,357.4 $MTCO_2e$ and 47.4% below our 2005 baseline of 20,442 $MTCO_2e$. While this brings us closer to our 2030 goal of net zero emissions, it must be noted that 2020 does not represent business as usual given the University's comprehensive response to the COVID-19 pandemic, which impacted a wide range of campus-based emissions-causing activities and on-site population. A few activities such as electricity demand had a larger footprint than previous years, while some such as employee commute were nearly eliminated. These impacts on Clark's greenhouse gas emissions are due to external factors and therefore 2020 should not be considered part of a trend or fall within our Climate Action Plan's strategies for emissions decrease. On the other hand, 2020 is instructive in what did have an impact on our overall emissions profile.

Clark's Climate Action Plan (CAP) 2015 interim goal was achieved in 2010, just a year after the CAP was released. It has not been exceeded since. The next goal in the Climate Action Plan is carbon neutrality by 2030. To achieve this goal in 9 years will require significant and continual investment in technological and behavioral mitigation actions, if it is considered an institutional priority.

Since 2013 Clark has made strides in energy reduction strategies relating to infrastructure: adding renewable energy sources via ASEC and Solar Flair; replacing an inefficient cogeneration engine and aging steam distribution lines; completing energy efficiency upgrades with LED lighting, controls, motors and more; adding technology to 'smart rooms' to manage downtime energy use, and other infrastructure upgrades. Energy upgrades in 2020 were limited as the campus was focused on safety during the COVID-10 pandemic and activity was constrained. Insulating doors to the large walk-in refrigeration units in the kitchen were replaced. A 'hodgepodge' of lighting installations in Lasry Bioscience were replaced with state-of-the-art control system and LED fixtures throughout the building. COVID-19 precautionary measures included exhaustive air balancing studies in all major buildings which resulted in repair or replacement of a number of controllers, condensers, motors and ductwork that were deemed defective or not operating to capacity. This will improve building systems efficiency in the long term as well.

Background

In June 2007, President Bassett signed the American College and University Presidents Climate Commitment (ACUPCC), making Clark University a charter signatory to a ground-breaking initiative that would mobilize the resources of academic institutions to reduce their greenhouse gas emissions and serve as models and resources. The core goal of the commitment is to achieve climate neutrality with net zero greenhouse gas emissions, also known as carbon neutrality. In 2007-2009, Clark University Environmental Sustainability (CUES) Task Force researched, wrote and published Clark's Climate Action Plan (CAP). The Plan included two sets of detailed emissions mitigation strategies with two goals: an interim goal of reducing emissions 20% below 2005 baseline levels by 2015 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 considered but was not able to act on an update to the CAP in light of technological and other changes since 2007. The Task Force has not convened since 2014, pending the appointment of a Chair and Task Force members by the President.
ACUPCC's reporting and administrative platform was replaced by Second Nature.org in 2015. Second Nature redefined the ACUPCC signature Climate Commitment as a Carbon (emissions) plus a Resilience plan. Clark chose to remain with our Carbon Commitment. Second Nature suggests an update to the Climate Action Plan every 10 years; in 2018 Clark chose to continue with our Climate Action Plan as published without updating.

Methodology

Data Gathering

In order to effectively manage carbon footprint and emission reduction strategies, data for a Greenhouse Gas (GHG) Emissions Inventory has been collected annually since 2008. (GHG inventories for 2005-2008 use largely estimated data). Data is gathered from a range of campus entities, and their cooperation is essential to ensure reasonably accurate and complete calculations.

Calculator

2020 represents Clark's fourth year of using an on-line third-party calculator from UNH's Institute for Sustainability, SIMAP. Previously (2008-2016) we used the Campus Carbon Calculator. For additional information regarding our choice of third-party calculators and software, please see previous Annual Updates. There is confidence from Second Nature that SIMAP is a valid replacement for the CCC.

Inventory Inputs

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). The six greenhouse gases inventoried are those included in the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydro fluorocarbons (HFCs), perfluorocarbons (PFC), and sulfur hexafluoride (SF_6). For ease of understanding and comparison, all gases are converted to a common measure: Carbon Dioxide Equivalents, CO_2e. The results of past inventories in CO_2e and Kyoto Protocol gasses have been reported to ACUPCC/Second Nature and shared with University administration via the annual Greenhouse Gas Emissions Update. The annual Updates are also available at Sustainable Clark, under Energy & Climate.

Scope 2 Purchased Electricity: Custom Fuel Mix

SIMAP defaults to the Emissions & Generation Resource Integrated Database (eGRID) to calculate emissions equivalents in our Scope 2 Purchased Electricity. The eGRID is a regionally based averaged "source of data on the environmental characteristics of almost all electric power generated in the United States", according to the EPA, and is considered a standardized approach to comparative measurement of emissions. Our assigned eGRID sub-region is NPCC (Northeast Power Coordinating Council) New England which publishes averaged regional resource mixes and emissions data; the most recent data in use by SIMAP are from eGRID 2019. The alternative in SIMAP is to select Custom Fuel Mix and input the state-specific resource mix data published by the utility provider in a Disclosure Label under requirement of the MA Department of Public Utilities. The most recent Disclosure Label from our purchased electricity supplier, National Grid, was published in 2020 and is specific to Massachusetts, although it is also noted that the information in the Disclosure Label comes from a range of suppliers in an integrated power grid, not from specific power-generating plants.

In 2017, the GHG Protocol, which is the international arbiter of "best practices" in carbon accounting across all sectors, issued an updated guidance document for Scope 2 emissions calculation. That document recognized that there are inherent strengths and weaknesses in both approaches (using supplier-specific versus regional eGRID factors) and recommended that organizations understand the results and implications of both types of calculations. The Protocol does not require a specific method. Given the specificity of the 2020 Disclosure Label combined with the fact that Massachusetts ranks high in renewable power generation compared to regional averages, and in the interest of providing the most

accurate greenhouse gas emissions inventory for the University, Clark has elected to use the CustomFuel Mix option in SIMAP with the fuel mix data supplied in the Disclosure Label. SIMAP still calculates the emissions factors for each category of fuel based on accepted standards.

Updated Equivalencies

Due to the evolving nature of greenhouse gas emission factor science, third-party calculators such SIMAP update emissions factors annually with information from the EPA, IPCC, E-grid, DOE and other sources to determine the number of metric tons of carbon dioxide equivalent ($MTCO_2e$) added to the atmosphere by campus operations across all inventoried inputs. Many standards are retroactive and almost all of Clark's past data stored in SIMAP from 2005-2018 is affected by various updates. Even small changes in the factors will add up over time and retroactively. Therefore, previous Updates from 2009 – 2018 *may* show annual or category data points that differ from the current Update; included charts will reflect this. Clark's interim goal was based on 2005 emissions and the standards at the time, as were the benchmarks and mitigation strategies in the CAP; our interim goal therefore remains unchanged at 16,357.4 $MTCO_2e$.

Benchmarking

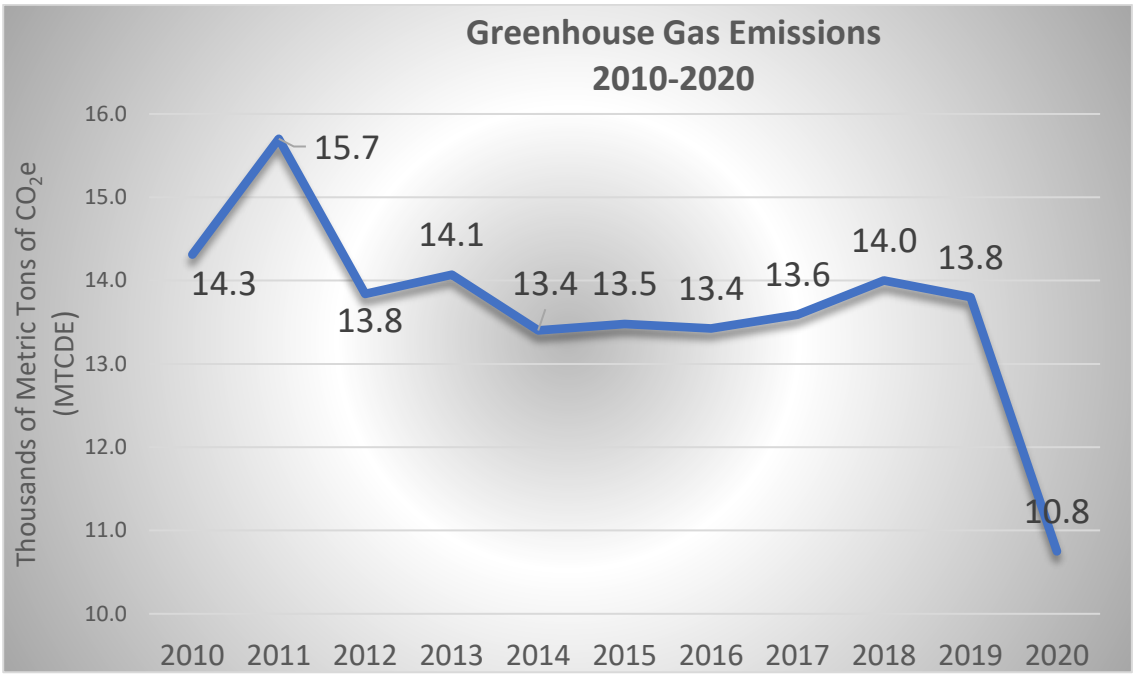
It should be noted in all data comparisons that 2014 is considered a 'benchmark-normal' year. Weather patterns were typical and therefore the amount of heating and cooling produced on campus (Scope 1) can be termed 'average'. 2014 is also a 'benchmark-normal' year in regard to campus operations; the 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.

2020 Emissions Data: Overview

Total GHG emissions in 2020 were 10,752.23 $MTCO_2e$. This represents an 22% decrease over total 2019 GHG emissions of 13,802.28 $MTCO_2e$. GHG emissions in 2019 were slightly lower than than 2018 emissions. This report details some of the probable causes for the differences in 2020.

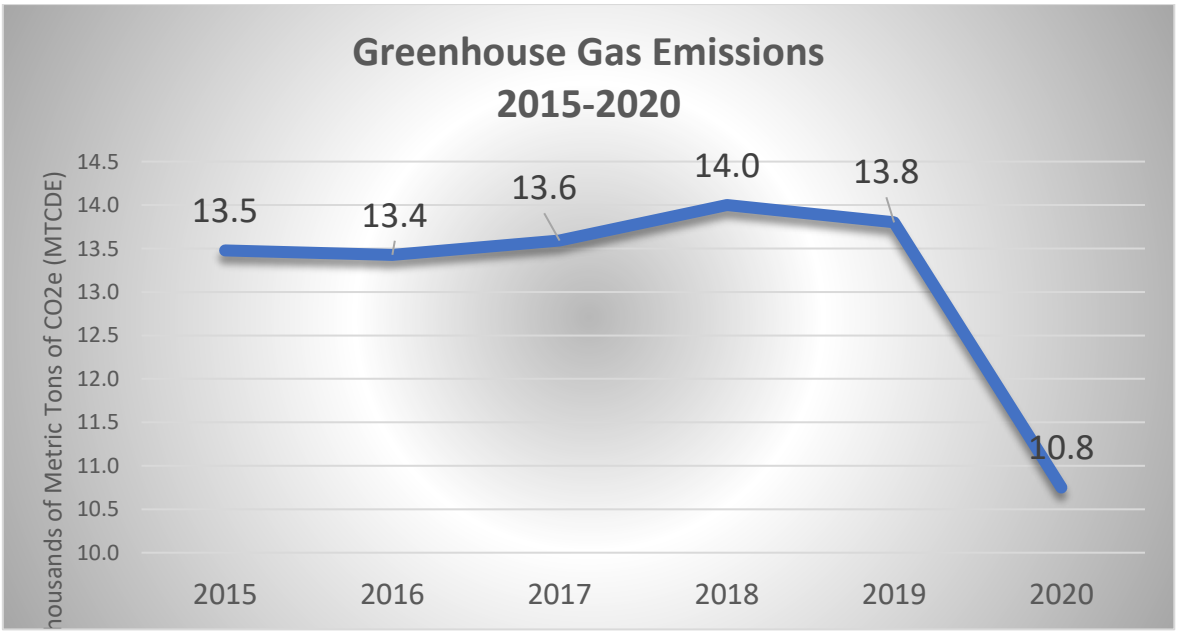
If and when all else is held constant, emissions will change in proportion to aggregated personal energy use. However, year-to-year differences in weather and other conditions beyond University control will impact larger scale, generated emissions from energy production and campus fleet. External factors will also affect emissions from purchased electricity and personal transportation. As climate instability increases it is ever more important to manage those University practices that do fall within our sphere of influence, and to consider resilience as a proactive strategic planning approach for those factors that fall without. Patterns of campus use due to COVID-19 restrictions – an external factor beyond our control - certainly had an effect in 2020, and it is interesting to note the impacts. The expectation that a smaller on-campus population would reduce emissions overall is not fully the case across all categories of emissions and sheds light on our ability to reduce emissions without significant adjustments to operating practices.

Below are charts showing the trend over time in Clark's greenhouse gas emissions, measured in $MTCO_2e$.



Total Greenhouse Gas Emissions in thousands of MTCO2e

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
14.32	15.72	13.85	14.08	13.41	13.49	13.44	13.60	13.97	13.80	10.75



2020 Emissions Detail: Percent by Different Scopes and Categories

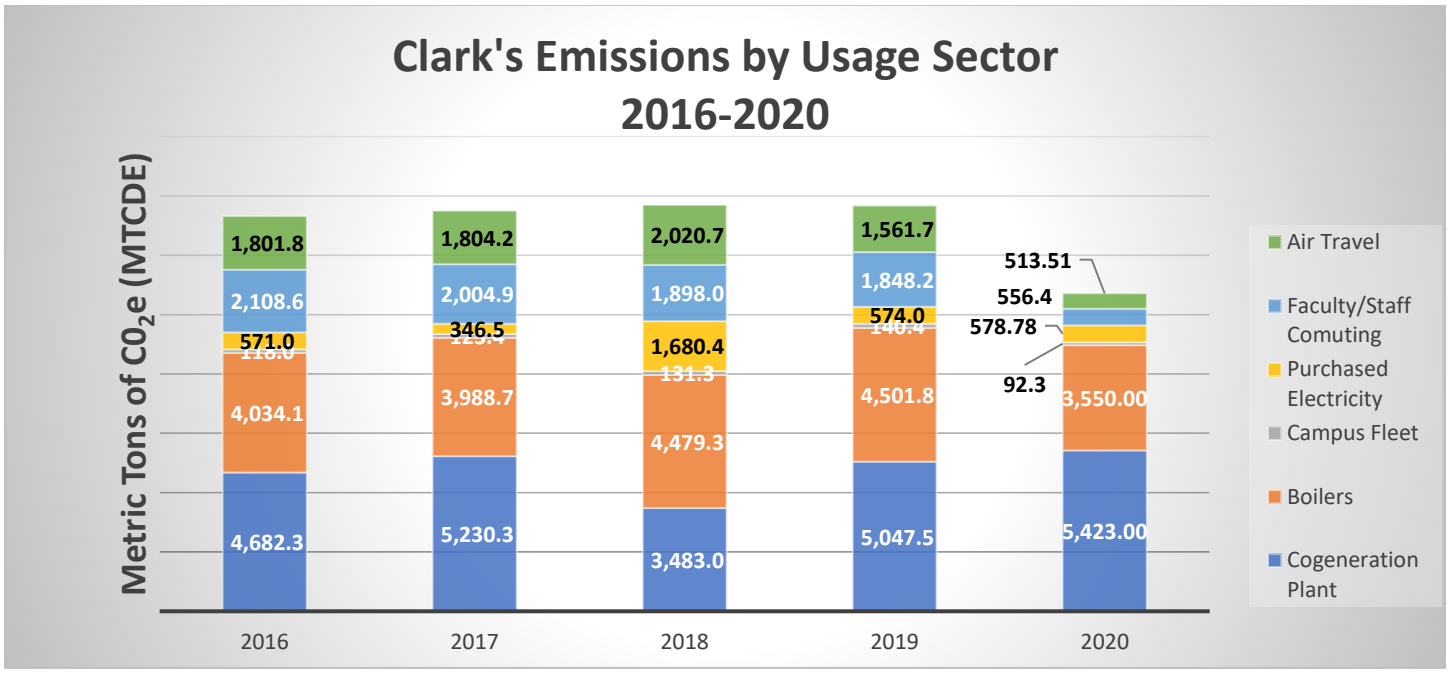
The largest source of Clark's greenhouse gas emissions is Scope 1: fossil fuel consumed on-site at Clark, accounting for electricity, light and heat in campus buildings. This Scope is primarily two categories: the Co-generation engine and Stationary Boilers. Smaller contributors include back-up generators and campus fleet. Scope 1 comprised 88% of all emissions in 2020; in 2019 Scope 1 comprised 71% of all emissions. The percentage of total difference in 2020 is worth exploring. Scope 1 major outputs are electric and thermal energy. While electricity consumed on central campus was 1.41% higher in 2020, thermal energy was 4.5% lower. It appears that the difference in percentage year to year then is largely due to Scope 3's activity effecting relative percentages, not to Scope 1 actual usage.

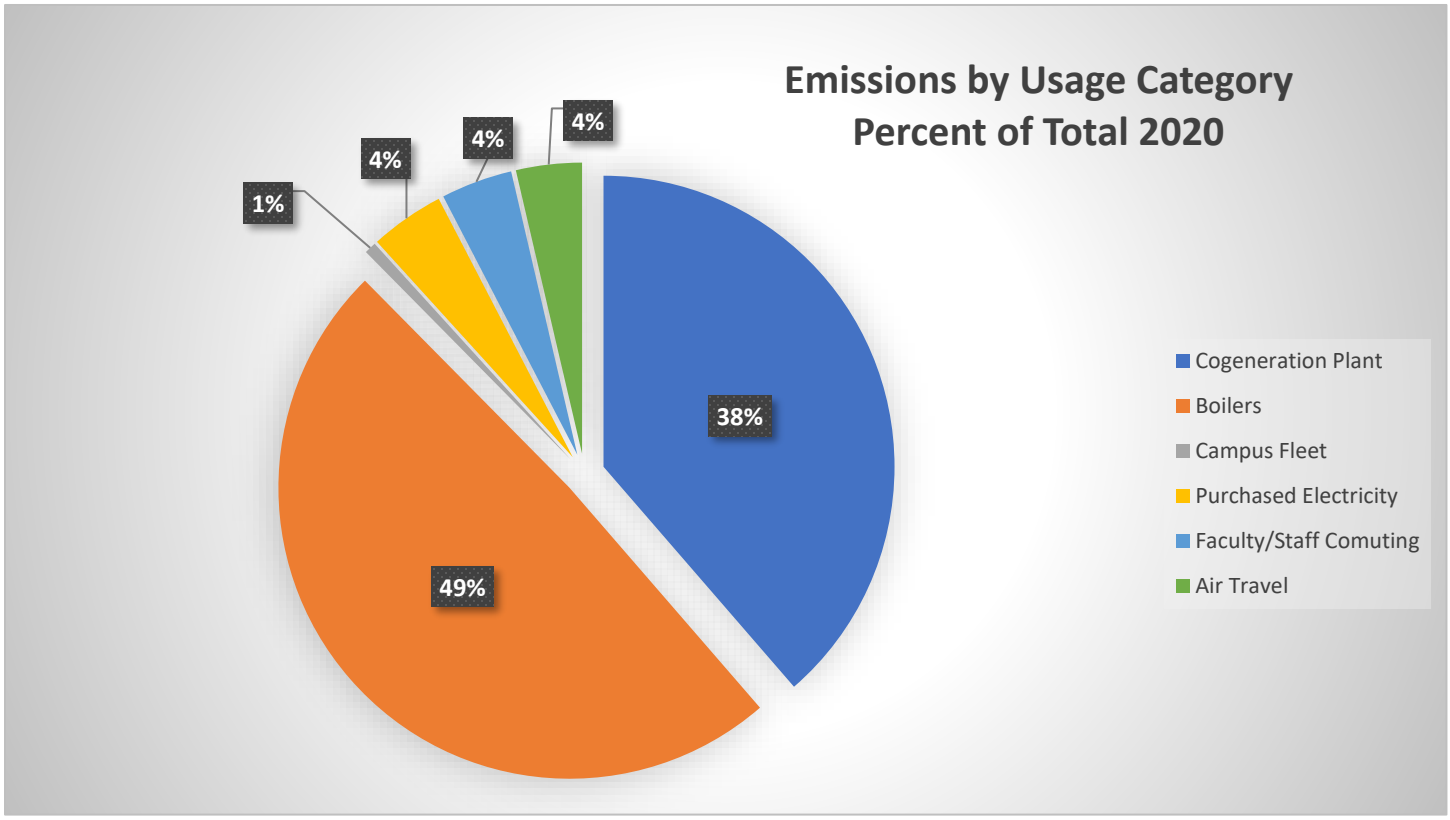
Our second largest emissions source is Scope 3, also primarily two categories: Employee Commute and University Sponsored Air Travel. This Scope comprised 8% in 2020 compared to 25% in 2019 and similar percentages in prior years. The difference in 2020 can be entirely explained by reduced activity in these categories due to COVID-19 restrictions on travel and Clark's safe staffing and teaching practices for the majority of the year. Scope 3 solutions include both technological and behavioral strategies. Going forward, in the absence of institutionally managed behavior modification solutions for transportation (e.g. incentives for carpooling or public transit), Scope 3 will continue to present a challenge as we expect to return to travelling for institutional purposes as well as on-site staffing and instruction, thus cancelling out the reduction due to the technological solutions (e.g. remote learning and work) employed during the pandemic.

Our Scope 2 emissions, Purchased Electricity, derive entirely from the operations of the electric utility National Grid. Clark purchases electricity for needs not produced or served by the co-generation plant. Scope 2 was 4% of all emissions in 2020, identical to 2019. Scope 2 comprised up to 30% in the years prior to Clark's partnership with Solar Flair; more on this beneficial arrangement below.

Lesser emissions sources in Scopes 1 and 3 include refrigerants, utility-based transmission and distribution losses, waste to energy (incineration), and campus fleet; all less than 1% of total emissions.

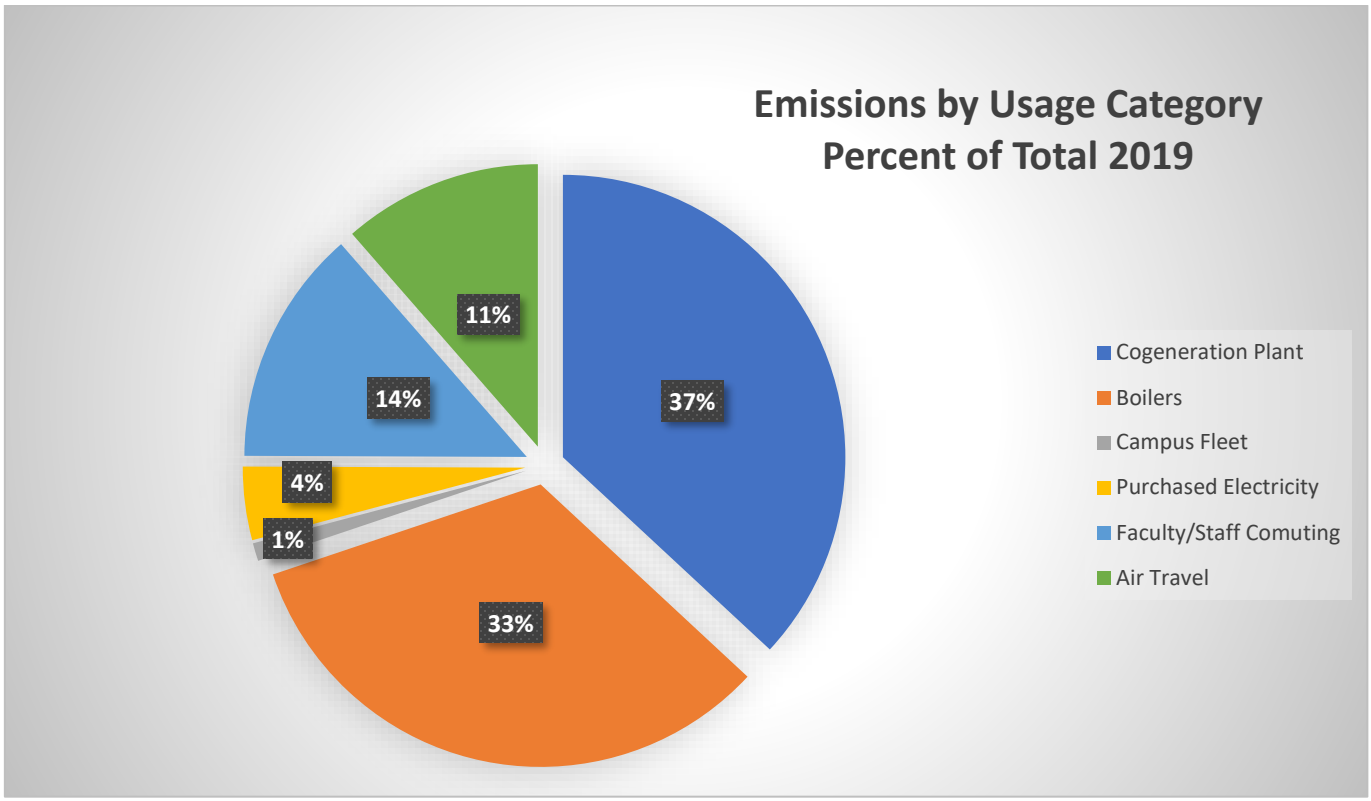
Charts below show percentage of emissions by Scope, significant category and within categories from 2015-2020. Note that the individual category charts are useful to see patterns as the scales differ (see Y axes).



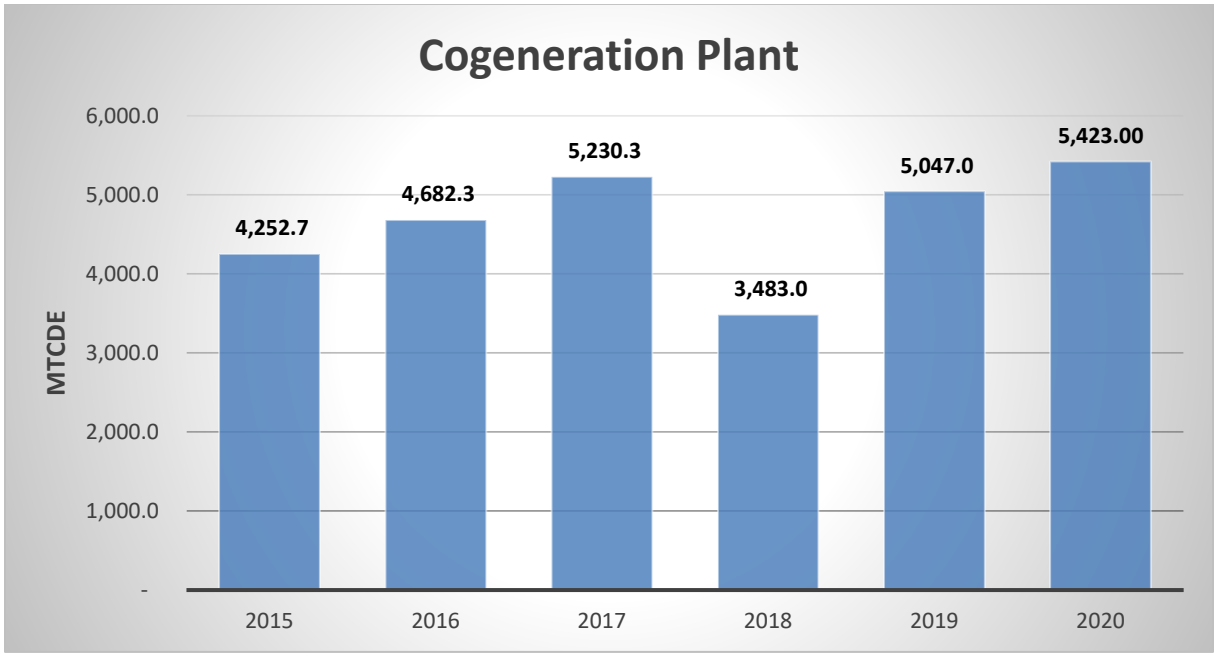


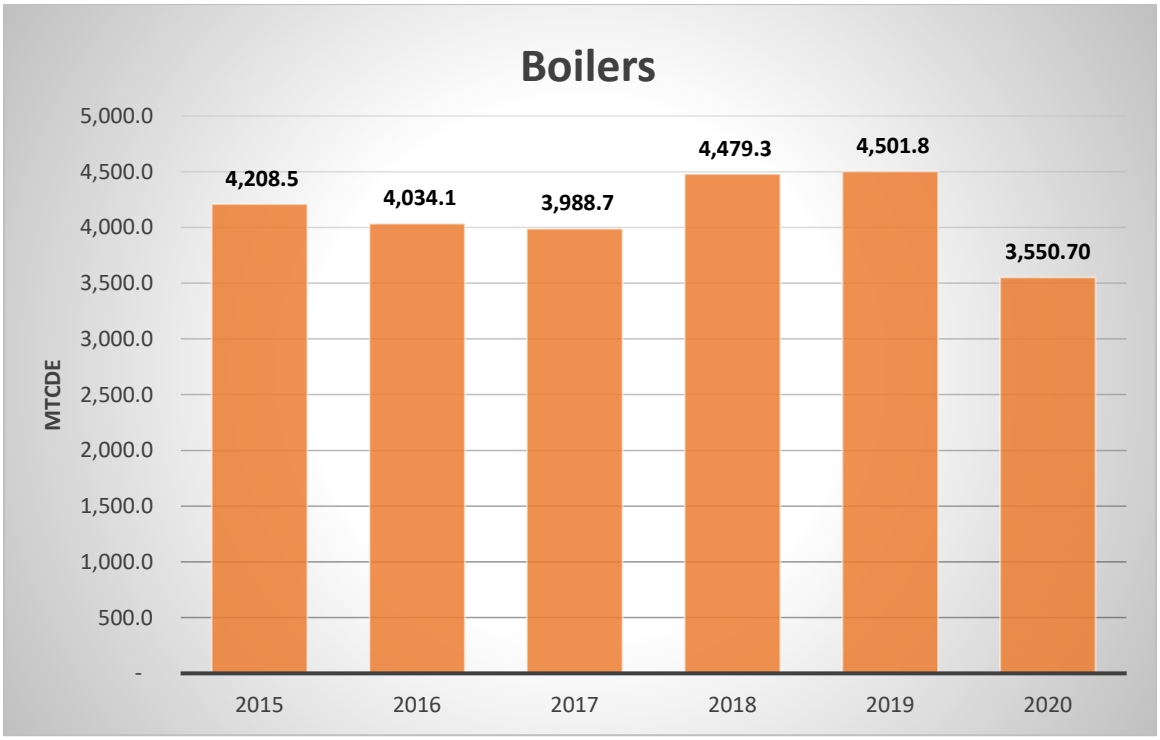
The chart above indicates percent-of-total emissions for the major contributing categories in 2020.

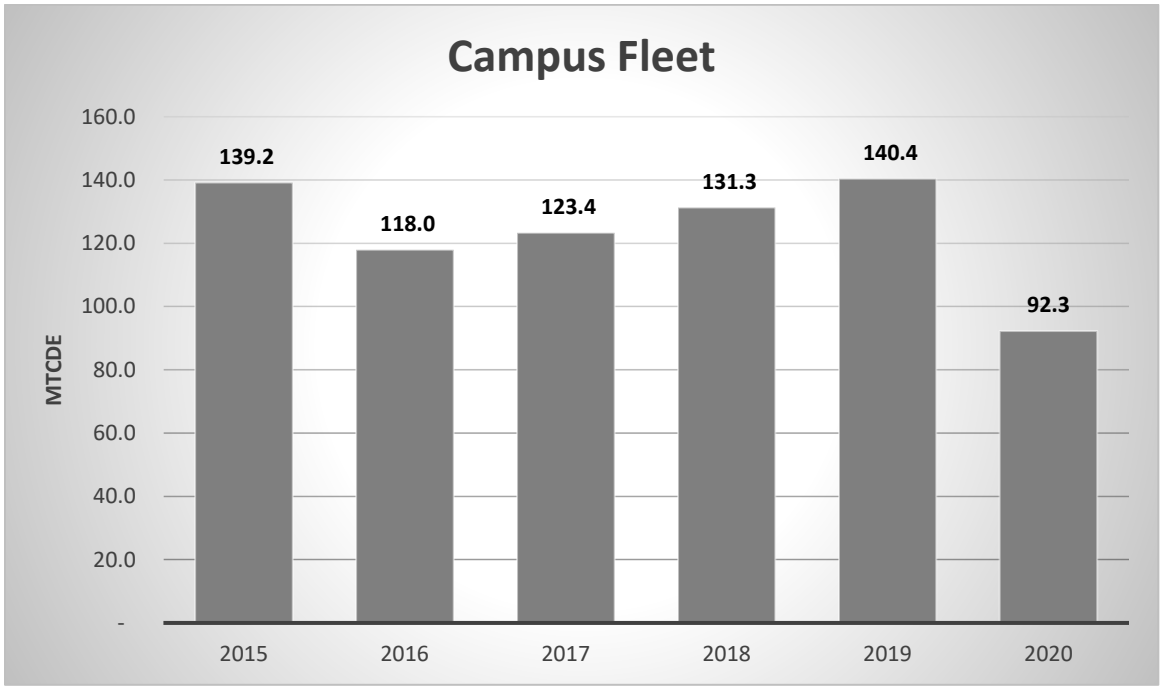
For comparison to a more normal year, the chart below shows percent-of-total emissions in 2019. Scope 3 categories Commute and Air Travel are 'normally' a much greater percent of total emissions.

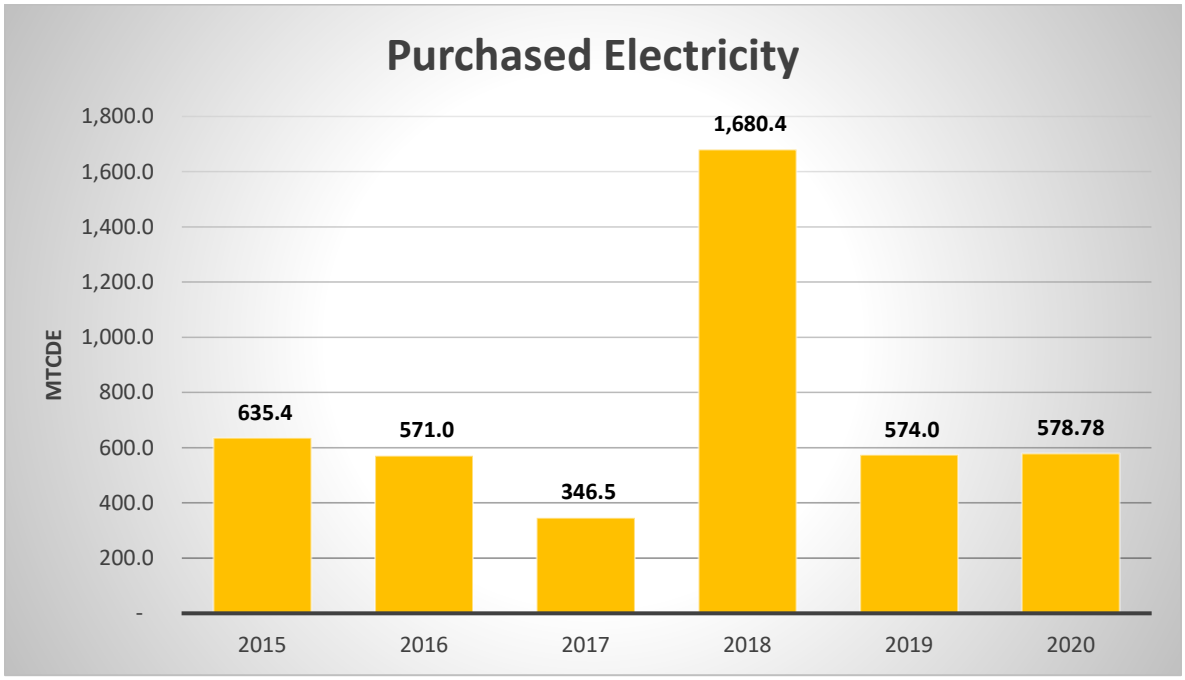


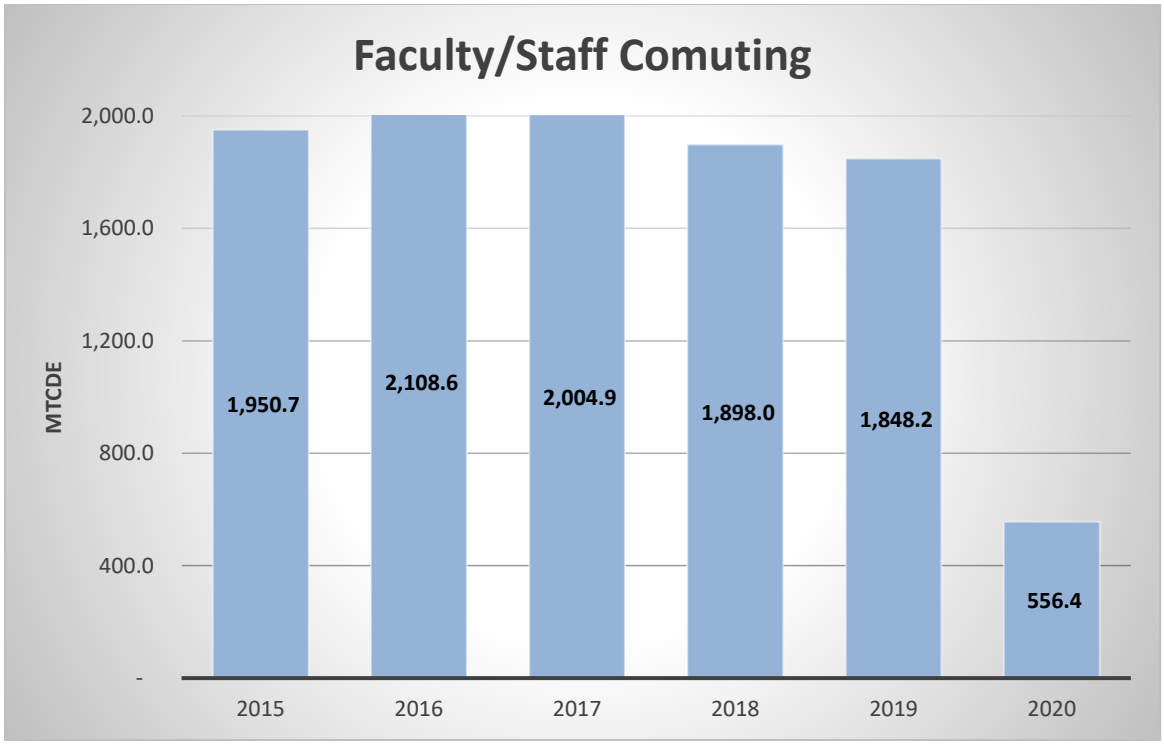
The series of charts below, while at varying scales (see Y axes), indicate the specific annual volumes and therefore overall trend of individual categories from 2015 – 2020. All measures are in MTCO2e; Scope and Sector totals by year are found in the stacked bar chart above.

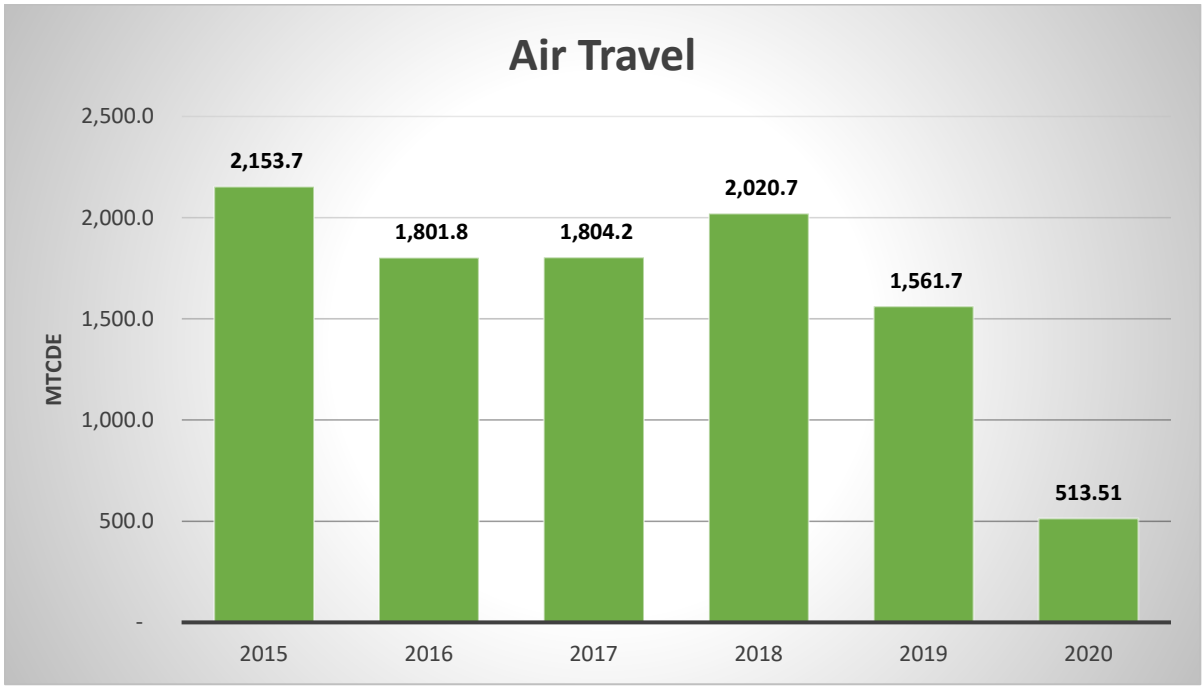





Campus Fleet
MTCDE
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
-
139.2
118.0
123.4
131.3
140.4
92.3
2015
2016
2017
2018
2019
2020


Purchased Electricity
MTCDE
1,800.0
1,600.0
1,400.0
1,200.0
1,000.0
800.0
600.0
400.0
200.0
-
635.4
571.0
346.5
1,680.4
574.0
578.78
2015
2016
2017
2018
2019
2020


Faculty/Staff Comuting
MTCDE
2,000.0
1,600.0
1,200.0
800.0
400.0
-
1,950.7
2,108.6
2,004.9
1,898.0
1,848.2
556.4
2015
2016
2017
2018
2019
2020


Air Travel
MTCDE
2,500.0
2,000.0
1,500.0
1,000.0
500.0
-
2,153.7
1,801.8
1,804.2
2,020.7
1,561.7
513.51
2015
2016
2017
2018
2019
2020

Explanations Scope 1 Emissions: On-Site Fuel Combustion from Cogeneration and Boilers; Fleet

Our co-generation engine and boilers in the power plant consume fossil fuels (natural gas and oil) to produce heat and electricity for campus demand with the resultant greenhouse gas emissions that are included in Scope 1 calculations. Fuel consumption in other boilers and generators across campus and in Clark-operated fleet vehicles are part of Scope 1 as well. The co-generation engine operates at a consistent level for engine efficiency, establishing a baseline of electricity production – and therefore fuel consumption - at which we remain regardless of other factors.

Clark operated under normal conditions during the first quarter of 2020, but after the campus population was reduced in mid-March demand for electrical energy changed radically. To put it simply, fewer people meant fewer lights or devices powered on and less fuel consumption to produce electricity from the co-generation plant. This lasted through the year as Clark continued to operate with reduced population on-site of students and employees.

There were however, a number of power demands that acted to offset the reduced population-based demand. It is important to recognize that Clark's campus remained technically open throughout the pandemic response (with the exception of one building, Alumni Office), so baseline electrical load demand remained unchanged in all buildings. Additional electricity demands came from special operations required to manage COVID-19 protocols and ensure our safety and health and resulted in increased emissions. Examples include the always-on external air circulation and cooling units installed at the Higgins University Center and the Kneller Athletic building to meet CoVid requirements. Additionally, all Clark buildings were extensively tested for ventilation and air exchange, resulting in a number of existing control systems being disabled, replaced or repaired. This included some energy-saving systems, and therefore a slight electrical load increase.

As noted above, the co-gen engine runs at a constant level 24/7 for the sake of efficient operation. Not all electricity produced is used due to the time of day. In 2020, excess electricity production was routed to the new electric boiler in season, which efficiently provides heat while operating at a net zero fuel consumption.

Thermal energy demand for heating and cooling systems, unlike electrical energy demand, was considerably lower during the pandemic response period due to the limited campus population. Facilities HVAC team shifted to "holiday" schedule set temperatures for heating and cooling buildings: 65° days and 62° evenings. The power plant's three boilers, primary source of heat for central campus, produced 26% fewer therms in 2020 versus 2019, even though heating degree days were only 13% lower. Emissions were 21% lower than the previous few years. This can be attributed to reduced occupation and lightly-used buildings. An additional reason for the lower thermal energy footprint is that 2020 represents the first full year of completed distribution system efficiency improvements. It is not possible to measure the contribution of the improvements to overall thermal load as we do not meter thermal us in buildings like we do electric use.

The cogeneration plant operated throughout the year other than the usual 6-week summer shut down for scheduled maintenance. No significant impact is incurred from the shutdown.

Explanations Scope 2 Emissions: Purchased Electricity & Renewable Energy Sources

We purchase supplemental electricity from National Grid electric utility for several reasons: to supply buildings that are not connected to the co-gen, to supply demand that exceeds co-gen production capacity at a given time from connected buildings (demand gap), and to serve both segments when the co-gen is not operational. Electricity purchased in 2020 to supply buildings not connected to the co-gen was a significant 19.3% less than

2019 which was 3.4% more than that purchased in 2018. This decrease is largely due to lower occupancy in these buildings and therefore reduced demand for electricity during the pandemic. Electricity purchased to supplement the demand gap in buildings that are connected to the co-gen was 55.8% of total purchased electricity in 2020 compared to 57.7% in 2019. In our 'benchmark' year of 2014 when the co-gen operated consistently, demand- gap purchased electricity was 53% of total. As the co-gen operated through 2020, there is not a significant volume of purchased electricity in the third category, out of operation needs.

There are a number of other features that impact our Scope 2 emissions and deserve explanations of their own; Solar Flair LLC, SFASEC, SREC's and National Grid net metering.

Solar Flair: 2020 marked the sixth full year of our partnership with Solar Flair providing Clark solar energy "credits" through what is known as an Alternative Power Purchase Agreement. We calculate an equivalent kWh from the partnership's solar production financial incentives. (For a full explanation of Clark's arrangement with Solar Flair and National Grid, please see the Emissions Update 2014). Because Solar Flair's farms are operating at full build-out production capacity and we are receiving the full benefit, any additional decreases in Scope 2 emissions will require that Clark address energy efficiency, consumption practices, or additional renewable energy sources. We have maximized the benefits from the arrangement with Solar Flair.

In 2020, the solar production kWh equivalent accounted for 37.68% of Clark's total purchased electricity, compared to 55.28% in 2019, 31.7% in 2018, 59.3% in 2017. The variability is due to a combination of factors including weather and kWh market price, but primarily how much electricity we purchase versus make each year. We offset the kW equivalent as zero emissions from renewable resources in our Scope 2 emissions calculations.

Shaich Family Alumni and Student Engagement Center (SFASEC) Solar Array: SFASEC is an all-electric building (heating and cooling as well as lighting, equipment and appliances) and is not connected to the co-gen. The rooftop solar array was designed to supply 50% of the building's electricity demand. Solar energy produced by the SFASEC array directly offsets the building's electricity, so our total Scope 2 purchased electricity is reduced by the amount of kWh produced; however, there is demand in excess of on-site solar production for which we purchase electricity. Emissions from SFASEC's net purchased electricity are included in the 2020 total. In 2020, the solar array produced 41%, or 156,839 kW of the building' total electricity demand of 378.381 kWh. In 2019 the array supplied 30% of SFASEC's total annual electricity demand of 519,544 kWh, while in 2018 the array did indeed provide almost 50% of the building's needs.

Renewable Energy Certificates (SREC's): SFASEC's solar array generates not only power for the building's needs, but also solar carve-out renewable energy certificates (SREC's) under the Massachusetts Department of Energy Resources (DOER) Green Communities program. Each certificate represents the environmental attributes of one megawatt-hour (MWh) of energy generation and is made available for sale via the New England Power Pool energy credit market. Clark has a third-party vendor managing the sale of our SREC's. Due to the workings of the market and verification procedures, there is up to a six-month delay in receiving the credits for the sale of SREC's. In 2020 we claimed four fiscal quarters of applicable credits from June 2019 – June 2020 for a total of 145 MWh, equivalent to credits of $41,013.

While our net purchase of electricity and therefore Scope 2 emissions are obviously reduced by the amount of solar energy produced and used on-site, and the University receives only financial benefit

from the market activity, and the creation and sale of SREC's actually *adds* to our Scope 2 emissions consistent with the EPA's Renewable Energy Certificate methodology. When an SREC is purchased on the market, it offsets emissions produced by the buyer. When an SREC is sold, however, the producer takes on those equivalent emissions through the mechanism of the SREC. We have already received the double benefit of "free" solar power and payment; we cannot "double dip" by using a sold SREC as an offset.

Excess Production: Ideally the cogeneration engine runs consistently day and night at optimum load and produces an excess of electricity during lower demand periods. Since 2018 the University has been able to participate in net metering; selling and transferring the excess electric production to the utility's supply grid. With the installation of an electric boiler in 2019 to complement the gas-fired boilers, we can also choose to route the excess production there as needed during heating season. The electric boiler mitigates the consumption (and emissions) from natural gas in the plant overall and may be considered 'net zero' since the fuel has already been consumed by the co-gen. Regardless of destination, we include emissions from all production of electricity in our reporting. In 2020 excess production was 128,149 kWh, equivalent to 1.3% of the co-gen's total electricity production, or approximately 61 $MTCO_2e$.

Explanations: Scope 3 Emissions: Commute and Travel

Scope 3 decreased 68% in 2020 versus 2019, however this data point is entirely due to essentially eliminating two-thirds of employee commute in the University's pandemic response, which included remote work for most employees for most of the year. It is not indicative of any positive behavior change in commuting patterns. Because we do not track commuting or travel specifically, Scope 3 data is unavoidable based on a series of estimates and assumptions; 2020 is no exception and possibly even more of a 'guesstimate'. It is not possible to determine with accuracy the commuting pattern for 2020. In the pandemic response we did not record how many employees worked at home or what percent of the time they did so; we do not know who worked on campus when and for how long. Fortunately, SIMAP allowed for multiple period and classification entries due to the special conditions, and we estimated eight (8) distinct time periods with different staffing ratios based on a record of the campus's series of instructions to the campus community and separate requirements within departments (i.e. Facilities, ITS and Residence Life were on campus at intervals different from those of Philosophy). Scope 3 in normal conditions is challenging to measure and even harder in which to effect change. University-supported behavior-change solutions to the single-driver commute, such as offset incentives, carpooling and shuttle programs, or telecommuting, might reduce this emissions source. (Neither study abroad nor student commute are included in Clark's version of the greenhouse gas emissions inventory).

To calculate air travel emissions, we use SIMAP's built in calculator and expense data compiled from employee travel expense reports. (This year SIMAP introduced a feature that calculates MTCO2e directly from dollars expensed; previously we have had to determine both figures for mileage and carbon equivalents internally). Since we do not ask employees to distinguish between modes of travel, we assume that air travel is 50% of all international and 25% of all domestic travel expenses. Covid-19 restrictions on travel impacted employee air travel significantly in 2020: it was 67% below 2019. 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. As is the case with faculty and staff commute, in a normal year, air travel will not change significantly until alternative practices such as video conferencing, incentivized carbon offsets, etc. are institutionally supported and broadly applied.

Campus Energy Usage (Electrical and Thermal)

The Climate Action Plan's metrics are expressed in $MTCO_2e$, and this Update tracks consumption of fossil fuels that produce emissions. There is of course a direct relationship between fossil fuel combustion, $MTCO_2e$ ad energy use. While not a part of our Climate Action Plan per se, it is helpful to look at campus electrical and thermal energy usage over time to identify patterns and results of mitigation strategies or campus development. Technology-dependent strategies to reduce energy consumption (for example lighting efficiency, mechanical system upgrades) will reduce $MTCO_2e$. They may be offset by other non-technological and environmental increases such as a larger population or physical space footprint. Non-technological mitigation strategies (for example individual energy conservation practices or maximizing use of space) are harder to quantify than technology strategies but significant in managing Clark's energy consumption patterns as they will have a long term and aggregate effect. Smaller scale, incremental projects are always on-going, although there are no comprehensive reduction plans at this time.

Given the swings in population, space use and technology-based energy demand during Clark's pandemic response, 2020's campus energy use – electrical and thermal – is not a valuable contribution to patterns we have previously tracked. Previous Updates have also included data and charts showing per capita and per square foot energy use in therms. However, due to these same variations in campus population and use of space during much of 2020, the data are not representative of average conditions and therefore are not included in this year's Update.

Prior years data are more instructive. In 2019 campus electrical load was an increase of 4.38% over 2018, in turn a 7% increase over 2017, which was a 3% increase over 2016. The small but steady increase would be in keeping with increased population, additional personal and academic electronics use, and hotter summers requiring more air conditioning. That it is not larger is a testament to our energy management and efficiency upgrades.

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