Chair’s Report. Faculty Senate Chair Steven Kimbrough informed SEC members that all members of the Standing Faculty were invited to participate in the current meeting, given significant faculty interest in the subject matter. He also reported that Bill Braham, Professor of Architecture, will chair the Senate Ad Hoc Committee on the Institutional Response to the Climate Emergency (“CIRCE”). A full membership roster will be announced at a later time.

Past Chair’s Report. A report was not offered.

Panel Discussion on Penn Climate and Sustainability Action Plan 3.0 (“CSAP 3.0”). Bill Braham, Professor of Architecture, reported on the “Climate Action Plan for UPenn’s Main Campus.” Prof. Braham explained his longstanding consulting relationship with Facilities and Real Estate Services (FRES) in which his Center for Environmental Building and Design (CEBD) provides the analysis for the three Carbon Action Plans and building energy reduction projects. Prof. Braham also co-chairs the Utilities Subcommittee of the Environmental Sustainability Advisory Committee (ESAC), which advises FRES on the development of the Carbon Action Plans. Prof. Braham supplemented the information in CSAP 3.0 by presenting a planning document in the form of a “waterfall” diagram that illustrates Penn’s carbon footprint and the strategies being used to achieve net zero carbon by 2042. (See next pages for diagram and supporting materials.) Since 2009, Penn’s main campus has reduced its carbon emissions by 28.9%. With the recently approved Solar Power Purchase (PPA) agreement, CSAP 3.0 is projected to reduce campus emissions 55.5% by 2024. That plan also includes industry-wide enhancements to a “cleaner” electric grid, a program to renovate Penn’s “Top 30” buildings, “continuous recommissioning” and “enhanced recommissioning” strategies for other campus buildings, and some carbon offsets purchased by Penn’s steam supplier. Buildings that are the greatest consumers of energy on campus (e.g., laboratories) are prioritized for recommissioning in order to have the greatest impact. Air travel, another major source of carbon emissions, requires attention from faculty and staff as to how to affect change without a clear and evident solution. Both FRES and CIRCE will consider options for incentives and alternatives.

Vice Provost for Research Dawn Bonnell reported on the “Environmental Innovations Initiative,” which was announced on December 4, and on Penn scholars’ significant impact on climate change. The Initiative will begin with a series of listening tours and town halls and will consult with experts at Penn’s peer institutions before formalizing a structure for the Initiative. An animal nutrition program in the Vet School has been adopted by regional farmers and has led to a measurable reduction of nitrogen and phosphorous runoff in the Chesapeake Watershed. Also, the Penn Institute for Urban Research and the Perry World House are inviting visiting scholars to launch a city climate resiliency initiative that will provide mayors of “low income cities” a support structure and knowledge to help them create climate resilient environments.

Vice President of FRES Anne Papageorge and Vice President for Business Services Division Marie Witt reported on the “Penn Climate and Sustainability Action Plan 3.0.” Ms. Papageorge summarized progress on the Climate Action Plan 2.0, which concluded in 2019. The Penn Sustainability Course Inventory has expanded from 124 to 401 courses. Building-related carbon
emissions have decreased by nearly 30%, notwithstanding campus growth of over 600,000 square feet. Twenty-five main campus buildings and major interior renovations are LEED-certified. Over 50% of Construction and Demolition waste is diverted from the landfill as part of LEED. CSAP 3.0 (2019-2024) sets forth goals across seven areas: academics, utilities and operations, physical environment, waste minimization and recycling, purchasing, transportation, and outreach and engagement. Penn has engaged in a 25-year contract to invest in the building of two new solar farms, the most significant commitment of this kind amongst Penn’s peers.

A robust discussion ensued. Several faculty members encouraged a reframing of reporting on progress and policies in this area to ensure that perspectives on justice, human rights, and anxieties are heard. For example, future sustainability initiatives could engage students and faculty in understanding the financial, environmental, and ethical tradeoffs and decision points underlying each component of the Action Plan. Faculty members also voiced concerns that sustainability and climate action at Penn is under the domain of FRES given that the issues are broader than facilities or real estate.
2019: Carbon Action Plan 3.0
1- Overview

This waterfall diagram is designed to show the progress the University of Pennsylvania has made towards its goal of carbon neutrality by 2042 along with the anticipated effects of current programs and initiatives on future carbon emissions. Its purpose is not to chart the path to neutrality, but rather to show what the likely impact of the initiatives currently underway or being planned will be on the carbon footprint. Perhaps more importantly, it shows what parts of our carbon footprint are likely to remain in 2042 despite these efforts. The carbon remaining in the projected FY42 footprint is not truly an indicator that the university will be unable to meet its neutrality goals by 2042, but rather should serve as an inventory of what should be focused on in future 5 year plans. The details of what remains in this last column are discussed in the conclusions.

The figures depicted in the waterfall diagram were developed from the work and research conducted during CAP1 and CAP2, which were the first two 5-year phases of the 2042 carbon neutrality goal representing fiscal years 2009 to 2019. As CAP2 concludes and the next 5 year plan is being developed, the waterfall diagram was conceived of showing the University’s past, current, and future efforts to reduce its carbon footprint. As such, the diagram is divided into 3 sections representing the actual effects of past efforts (FY09-19), the probable effects of the efforts planned for the next 5 year plan (FY19-24), and the probable impacts of any actions planned that will take effect beyond the next 5 year plan (FY24-42).

The basis of the waterfall diagram is the carbon footprint that is annually prepared according to the methods found in the WRI GHG Protocol. The carbon footprint accounts for all the greenhouse gasses the university is responsible for emitting and details many different categories falling into three scopes. The majority of the GHGs in the UPenn carbon footprint come from three sources: electricity, steam, and air travel, which combined account for more than 90% of emissions. The waterfall diagram begins with the carbon footprint from 2009, showing these three categories and the remainder as a single value. The total carbon dioxide equivalent level from that year serves as the baseline by which all future changes to the carbon footprint are measured.

Three additional full year footprints appear on the waterfall diagram: FY19, FY24 and FY42; all of which are projections based on University efforts that have already been completed or have already been committed to or seriously explored. The projections additionally consider the impact that future growth of the University might have on the footprint and how changes to the electrical supply might lower emissions independent of University action. The projected footprints for these years serve as indicators for each of the sections of time described above, with the overall reduction compared against the FY09 baseline serving as the metric to gauge progress towards the goal of neutrality.
Between the full year footprints (FY09, FY19, FY24, and FY42) are additional columns showing changes in the footprint during this time frame. Each section has a column showing the increase that should occur due to growth in campus population and square-footage. Each section also has a column that shows the projected change in carbon due to changes in the supply of energy purchased by the University. The additional columns in each section detail the effects of actions that were, or will be, taken by the University of Pennsylvania. These include the impacts of renovations, recommissioning, changes in electric supply, and other programs/initiatives. The details of these columns are discussed in detail in the sections below.

2- Fiscal Years 2009-2019

The first section of the waterfall diagram details the largely completed period of time beginning in FY09 and ending in FY19, which as of this draft is nearly complete. As a result the figures presented in this section are largely based on actual reported data rather than projections, though some assumptions were made. One difference in this section compared to the other two is that the impacts of the individual efforts were not broken out, instead only the net impact of all the efforts was presented. Insufficient data existed to properly assign specific reductions to individual projects, largely due to the lack of before and after meter data at the building level for most of this period.

2.1- Baseline Carbon Footprint, FY09: Measured according to WRI’s GHG Protocol, this is the carbon footprint calculated by the UPenn Carbon Calculator and reported both internally and externally. The FY09 footprint largely exists unchanged from how it was calculated in that year. The one exception is for the carbon attributed to air travel, which was under reported in this year. To account for the current improved reporting of air travel, the FY09 level is held constant with the FY17 level, when reporting stabilized.

2.2- Campus Growth: This section represents how much the carbon footprint should have increased from FY09 to FY19 if it were proportional to increases in campus population and square footage of the Penn campus. This was estimated to be 7.6% during this time period.

2.3- Steam Chiller Added: The effect of summer steam chiller usage is uncertain and emissions factors for the summer vs remainder of the year are still being determined. Until a new value is decided on, the old 0.0498 MTCDE/mmBtu annul emissions factor is being used. This results in a new category of emissions being added when the steam driven chillers started to be used, which is represented by this category. This addition was accompanied by an assumed reduction in electrical consumption at the chiller, which is described in section 2.5.

2.4- Change in Electric & Steam Supply Emissions Factor: During this time period there were substantial reductions in the emissions factors associated with both the electricity purchased from the grid and the steam purchased from Veolia. The electric emissions factor dropped by nearly 31% and the steam emissions factor dropped by more than 22%. As a result, the two largest portions of the carbon footprint reduced significantly without any action required.
2.5- Reductions to Date: It was not possible to exactly calculate the impacts of the various initiative undertaken during this time period, but it is possible to deduce what they must have been. Given the starting point of the FY09 Baseline, the ending point of the Projected FY19 Footprint, and the calculated impacts of growth, changing emissions factors, and summer steam, then the reduction can be calculated as the difference between the Baseline and FY19 and the sum of the other three factors (growth, EFs, and summer steam). This was calculated for all 4 major categories of emissions.

[ex: Calculated Reduction = (FY19 – FY09) + Growth + Summer Steam – EF Reductions]

2.6- Carbon Footprint, FY19: This is the most recently completed carbon footprint. indicates that the carbon footprint will have reduced by nearly 28.9% between FY09 and FY19. Roughly two-thirds of this reduction is due to the reduced carbon content of our energy supply while the remainder can be attributed to reduced energy consumption and other actions directly taken to mitigate emissions. Roughly one third of the total reductions were mitigated by increases due to campus growth and the switch to summer steam, however, the summer steam was offset through a registered carbon offset program.

3- Fiscal Years 2019-2024

This section represents the time period that will be covered by the upcoming 5 year plan (CAP3 / CLASP). It begins with the FY19 Footprint and ends with the FY24 projected footprint. Unlike the previous section, which was largely based on historical data, the elements of this section are less certain and are reliant on the specific form the actions will take. The reductions associated with specific actions are drawn from comparable past projects and regional benchmarks for building performance.

3.1- Campus Growth: An annual growth rate of 1.5% has been observed across many metrics (square footage, campus personnel, student population) over the last ten years. This rate was applied to all categories compounded across 5 years.

3.2- Change in Electric Supply Emissions Factor: The electrical grid has decarbonized at an average annual rate of 3.5% over the last 10 years. This is assumed to continue and is compounded across 5 years.

3.3- Renovation of 30% of Campus: This is a continuation of an initiative begun in CAP2 whereby it was stated that the 30% of the campus with the greatest potential for energy reductions (based on EUI vs regional benchmarks for each building type) would be substantially renovated by 2042. This work is assumed to be spread evenly across the 30 year span since it was begin and the total anticipated energy savings anticipated from this effort is assumed to be accrued evenly across that time. Thus this portion represents roughly 5% of the campus being renovated to a performance level equal to the best performing quartile of buildings of that type.

3.4- Continuous Recommissioning: Recommissioning is the process of analyzing a buildings systems and then restoring them to optimal performance levels. It is assumed that over time all buildings will drift from
this optimal performance level as equipment degrades or fails and as the building itself ages. The continuous recommissioning project is an accelerated schedule of recommissioning campus buildings so that the average level of drift from the optimal performance levels is minimized. This minimizes the number of years that a building will be operating inefficiently over the lifetime of the building.

3.5- Enhanced Recommissioning: Is a new, aggressive form of recommissioning involving detailed energy and engineering analyses. It is currently being applied to some of the largest consumer buildings on campus and achieving HVAC energy reductions on the order of 30%. While more expensive and time consuming than traditional recommissioning, the impacts are similarly more impressive.

3.6- Purchase Renewable Electricity: This category assumes that the University will make a renewable energy purchase in an amount equal to 75% the current level of electrical consumption and that this energy will be carbon free, such as from solar or wind. While no specific commitment has been made to a renewable power purchase, it is being seriously considered at this level for the near future.

3.7- Projected Carbon Footprint, FY24: This is the projected FY24 Carbon Footprint based on the FY19 Footprint and the sum of the impacts of the items described within this section. It is estimated to be nearly 56% below FY09, nearly doubling the decrease from the previous 10 year period in 5 years, but a more than half of the decrease is only realized if the renewable power purchase is followed through. Growth and reductions in the emissions factor for electricity nearly cancel out. At this point, nearly 2/3 of the total remaining carbon is from steam and air travel, with the impact of electricity being greatly reduced due to the renewable energy purchase.

4- Fiscal Years 2024-2042

This section is the most uncertain and least complete. While it is possible significant events could change the projections for FY24, it is taken for granted that the projection for FY42 does not include all of the actions that will impact carbon emissions in this time period. This projection only includes the impact of actions that have already been committed to by the University, thus there is no category for enhanced recommissioning or additional renewable power purchases. Additionally, all projections regarding changes due to growth and decreasing emissions factors are ceased after 5 years as it become impossible to accurate predict these trends beyond this time frame.

4.1- Campus Growth: An annual growth rate of 1.5% has been observed across many metrics (square footage, campus personnel, student population) over the last ten years. This rate was applied to all categories compounded across 5 years.

4.2- Change in Electric Supply Emissions Factor: The electrical grid has decarbonized at an average annual rate of 3.5% over the last 10 years. This is assumed to continue and is compounded across 5 years.

4.3- Renovation of 30% of Campus: This is a continuation of the initiative begun in CAP2 and continued in CAP3 / CLASP whereby it was stated that the 30% of the campus with the greatest potential for energy reductions (based on EUI vs regional benchmarks for each building type) would be substantially renovated.
by 2042. This work is assumed to be spread evenly across the 30 year span since it was begin and the total anticipated energy savings anticipated from this effort is assumed to be accrued evenly across that time. Thus this portion represents roughly 18% of the campus being renovated to a performance level equal to the best performing quartile of buildings of that type.

4.4- Continuous Recommissioning: This is a continuation of the initiative begun in CAP2 and continued in CAP3 / CLASP. Recommissioning is the process of analyzing a buildings systems and then restoring them to optimal performance levels. It is assumed that over time all buildings will drift from this optimal performance level as equipment degrades or fails and as the building itself ages. The continuous recommissioning project is an accelerated schedule of recommissioning campus buildings so that the average level of drift from the optimal performance levels is minimized. This minimizes the number of years that a building will be operating inefficiently over the lifetime of the building.

4.5- Operational Changes: This is a catch all category that includes all of the energy saving / emission reducing strategies employed by the University such as: power down challenges, education & awareness campaigns, conversion to electric vehicles, use of occupancy sensors, etc. In absence of better data, this reduction was assumed to be 5% across the board by 2042.

4.6- Projected Carbon Footprint, FY42: This is the projected remaining carbon once all the projected increases and decreases that can CURRENTLY BE ANTICIPATED AND ESTIMATED have been added or subtracted from the last measured footprint (FY18 / FY19 Projected). At this juncture, it is estimated that current efforts will serve to negate slightly more than half of the FY09 carbon footprint. The current efforts are believed to be sufficient to nearly negate all emissions from electric consumption and to significantly reduce the emissions from steam use, substantial emissions still remain unaccounted for from steam and air travel which will make up more that 80% of the FY42 footprint. This indicates that future 5 year plans will need to think outside of the box to find plans to eliminate or offset this carbon, as current initiatives are unable to eliminate it.