Virginia Tech 2020 Climate Action Commitment Working Group

Final Technical Report
July 2020
Revised October 2020

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Part II: Progress in Climate Action since 2009 CAC and Comparison to Peers

Executive Summary

From January to June 2020, the Virginia Tech **Climate Action Commitment Working Group** executed its charge to evaluate the university's current position and our future role in addressing climate change. During this same period, a global pandemic has brought unprecedented hardship and suffering, particularly for the most vulnerable among us. Nevertheless, this unique time is engendering a tremendous spirit of innovation and collaboration. Around the world, people are coming together to address historic challenges. We are becoming bolder and more creative. And we are reimagining every aspect of our lives.

In this public health crisis, we are learning an important lesson: when experts testify to looming crises, when science speaks, society must take decisive action. People are learning to trust science and use it to guide action, shape responses, and inform policy-making. It has also exposed critical and uneven vulnerabilities in our economy and society, raising calls for recovery efforts to redress inequities. Similarly, our actions to combat climate change and strengthen our community's resilience must be guided by a just and equitable transition to sustainable new strategies, policies and practices. As a new world dawns, we must bounce "forward," not "back," to seize the promise and opportunities of this moment.

One such promise is the prospect of working together, creatively, urgently and with care, to address pressing challenges. Climate change is a slow-growing emergency compared to the lightning strike of Covid-19, but it will be more painful and longer lasting. This moment of pause gives governments, businesses, communities, and universities the opportunity to evaluate their current positions and their future roles. While the individual actions of any single institution may seem insignificant for the magnitude of the problem, the world cannot be saved without our collective action.

In late 2019—prompted by the demands of students and other community members involved in Climate Strikes and resolutions from the Faculty and Staff Senates, Student Government Association, and Graduate Student Assembly—President Tim Sands and Senior Vice President Dwayne Pinkney established a Climate Action Commitment Working Group (WG) comprised of 26 faculty, students, staff, and community members. In announcing the creation of the WG, President Sands stated that: "climate change presents one of the world's most pressing problems…and Virginia Tech has a duty to respond." **The Group was charged to assess the university's progress in implementing the 2009/2013 VT Climate Action Commitment, compare our experience to peer institutions, and develop a new Commitment.**

Virginia Tech, like other universities, is facing both short-term fiscal challenges and long-term uncertainties in these challenging times. Nonetheless, the university remains committed to taking bold action to do its part to address the climate emergency.

ES.1 Working Group Process

In order to engage a broad range of expertise and perspectives from across the university and wider community and conduct an ambitious work program, the Group established 12 subcommittees including a total of 130 faculty, students, community members, and staff to

investigate and discuss specific issues relevant to the Commitment. Most of the subcommittees met weekly from early February through the end of May. The subcommittees included:

- Agriculture, Forestry, and Land Use
- Budget and Finance
- Buildings Opportunities
- Climate Justice
- Community Engagement
- Energy Opportunities
- Greenhouse Gas (GHG) Inventory
- Peer Institutions Comparison
- Renewables Opportunities
- Structuring Sustainable Choices
- Transportation Opportunities
- Waste-Recycling-Composting and Procurement

The Working Group (WG) developed several mechanisms to expand community involvement in the process, including a website and email address for comment and two online surveys. Plans for face-to-face town hall meetings and conference sessions had to be reimagined when the university shut down after spring break. In place of the in-person events, the WG hosted 12 Zoom Convening sessions in April, attended by over 220 participants who provided excellent feedback. In anticipation of the Convening sessions, the WG and its subcommittees also developed ten creative videos that describe the CAC proposals (See: https://svpoa.vt.edu/index/VTCACRevision.html).

Our work has focused on developing effective strategies the university can advance to achieve meaningful climate action. Throughout the multitude of WG, subcommittee, and community zoom meetings, our discussions have also reflected on the important opportunity for Virginia Tech to reinvent itself, not only in its commitment to climate action, but also in its responsiveness to the needs of the world around us, in the spirit of *Ut Prosim*.

Our recommended climate action commitment is bold, aggressive, and comprehensive. Its goals range from necessary upgrades to the campus physical plant to reduce GHG emissions, to integrating those improvements into the educational mission through a Climate Action Living Laboratory, to engaging everyone in creating a culture of sustainability—all to position Virginia Tech as a leader as the clean energy economy evolves in the Commonwealth and the world.

ES.2 Progress Implementing 2009 VT Climate Action Commitment

Virginia Tech has made considerable progress in implementing its 2009/2013 Climate Action Commitment (2009 VT CAC) over the past decade, and our assessment of progress is presented in chapters 6 and 7. The 2009 VT CAC & Sustainability Plan was a cutting-edge effort for its time, but a decade later it fails to prescribe what climate scientists recognize as necessary actions and also falls short of many peer universities' recent initiatives.

In many respects, however, we have been forging ahead beyond the 2009/2013 CAC. Virginia Tech is a recognized leader in campus sustainability with a Sustainability Tracking and Rating System (STARS) Gold score that is highest among Virginia and ACC peer institutions. VT has won numerous awards and recognitions since 2010, including Princeton Review's top 50 Green Colleges (#14 in 2019), the Governor's Environmental Excellence Award (7 times), Best Workplaces for Commuters (every year, gold in 2019-20), Bicycle Friendly Campus (every year, silver level in 2019), Tree Campus USA certification (every year), and many others.

We have reduced greenhouse gas (GHG) emissions by 24% from 2006 to 2019, despite 22% growth in campus building size and enrollment. This reduction is faster than the 2009 CAC targeted trajectory. It resulted from investments in energy efficiency in existing and new buildings, and most importantly conversion to natural gas in the steam plant, which was enabled by a new gas pipeline. We now have 36 LEED certified buildings constructed or in process, amounting to 30% of campus space, and in 2015-2020 we invested $14 million in energy efficiency improvements, resulting in energy and dollar savings with a 5-year payback.

We have done much to develop alternative transportation choices, including dual use trails, bike share, ride share, and car share programs. We have record ridership on our partner Blacksburg Transit and innovative plans for campus mobility. We have a functional, although fragmented, waste management program with an 80% waste diversion rate (waste diverted from landfill) and 40% recycling rate, although shy of the 50% by 2020 goal of the 2013 VT CAC. In April 2020, our Procurement Department unveiled a Sustainable Procurement Policy; and in May, Facilities produced new Design and Construction Building Standards, both reflecting the ideals of the VT Climate Action Commitment.

We have an enviable array of sustainability-related academic programs, majors, coursework, and research, including in green engineering, natural resources, agriculture, power and energy systems, environmental policy, and smart and sustainable cities. In the STARS rating system, VT scores 89% of possible points in academic categories. It also scores 95% of possible points in campus engagement. We have a rich campus life for students with a wide array of opportunities, including strong environmental student organizations. Indeed, these student groups have energized the university community to move forward on climate action, both in 2008 and in 2019.

Our Facilities Department has embraced sustainability and climate action as part of its mission, and our Office of Sustainability is second to none, even with limited staff. We have the highly unique and valuable Virginia Tech Electric Service (VTES), a university-owned electric energy utility system, which serves not only the campus but also 6000 Blacksburg customers.

In other areas, however, we are falling behind. Although the 2009/2013 VT CAC was a leading effort for its time, from the perspective of 2020, it is limited in both scope and ambition. It did not include several sources of campus GHG, such as agriculture, business travel, and leased building space, the latter amounting to 13% of operational square footage. It did not even mention renewable energy nor the human cost of climate change. Furthermore, its overall goal of an 80% reduction in GHG from 1990 levels by 2050, while a typical goal for its time, is not aggressive enough compared to the contemporary needs for climate action and the national movement of our peer institutions.

ES.3 The Virginia Tech 2020 Climate Action Commitment

The major product of the Working Group is a new Climate Action Commitment. It aims to be bold and comprehensive, but also to be visionary and pragmatic for a leading academic institution. Goals 1-9 target physical means to achieve carbon neutrality by 2030, goals 10-14 address education, culture, social equity, and engaged implementation, and goal 15 sets a longer-range goal

of a fossil-fuel-fee campus. The Group also developed a set of potential pathways to achieve each goal. The table below lists the goals, and they are presented with summary pathways. More detailed pathways are outlined in chapter 2.

Vision of the Virginia Tech 2020 Climate Action Commitment:

> ***In the spirit of Ut Prosim, Virginia Tech will be a leader in climate action in service to our community, the Commonwealth, and the world.***

Mission of the Virginia Tech 2020 Climate Action Commitment**:**

President Tim Sands: "climate change presents one of the world's most pressing problems…and Virginia Tech has a duty to respond."

> ***The mission of the Virginia Tech 2020 Climate Action Commitment is to achieve carbon neutrality by changing our physical infrastructure, collective and individual behaviors, and educational mission; to engage everyone in creating a culture of sustainability; and to achieve these objectives through just and equitable means.***

Virginia Tech 2020 Climate Action Commitment

The 2020 CAC update process yielded the following 15 goals, which are expanded upon below.

1. Carbon neutral Virginia Tech campus by 2030
2. 100% renewable electricity by 2030
3. Complete the total conversion of steam plant fuel to natural gas by 2025, plan for a full transition to renewable steam plant fuel after 2025, and continue to improve the efficiency of campus energy systems
4. Reduce building energy consumption to enable carbon neutrality by 2030
5. Operations of new buildings initiated by 2030 will be carbon neutral
6. Agricultural, forestry, and land use operations will be carbon neutral by 2030
7. Virginia Tech to become a Zero-Waste Campus by 2030
8. Establish the Sustainable Procurement Policy and Procedures by 2022
9. Reduce single-occupancy-vehicle commuting to campus by 20% by 2025 and reduce transportation-related GHG emissions by 40% by 2030
10. Integrate the CAC into Virginia Tech's educational mission through the Climate Action Living Laboratory beginning in 2021
11. Establish climate justice as a core value of the VT Climate Action Commitment
12. Diminish barriers to sustainable behaviors through institutional change, education and social marketing
13. Implement the VT Climate Action Commitment at a high level of university administration and governance; by integrating goals for facilities, education, and campus culture; and with stakeholder engagement for evaluation of goals and progress
14. Develop innovative budgeting and financing mechanisms to generate funding and staffing to achieve Climate Action Commitment goals
15. Develop Pathways after 2030 to eliminate fossil fuels and carbon offsets by 2050

VT 2020 Climate Action Commitment Summary Goals and Pathways

Goal 1. Carbon Neutral Virginia Tech Campus by 2030

Carbon neutral = net-zero emissions of CO_2, CH_4, and NO_2 from VT operations at Blacksburg campus based on the geographic and GHG scope of the 2020 CAC.

Potential Pathways:

- **100% renewable electricity** by 2030 can reduce emissions by 50% below 2019 levels
- **Total conversion of steam plant to natural gas** by 2025 can reduce GHG by 10% below 2019
- **Reduction of energy use** in existing and new buildings can result in further emissions reductions of 10%, despite campus growth
- **Reduction of GHG** from waste/recycling, transportation, and agriculture, forestry, and land use described below can reduce emissions by 10%
- In 2030, remaining emissions can be negated by **carbon offsets**

Goal 2. 100% Renewable Electricity by 2030

Potential Pathways:

- **2020: achieve 30% renewable electricity** via purchase 20% renewable energy certificates (RECs) from APCO + APCO 10% renewable portfolio
- **2020-2030: Achieve 100% renewable electricity by 2030** via combination of VT rooftops/lands (15 MW), 3rd party owned PPA, and APCO owned SWVA PPA capacity (130 MW+15 MW=145 MW) to serve campus (95 MW) and town customers (50 MW) for 60% of needs plus 30% APCO renewable portfolio and 10% RECs to cover steam plant cogeneration
- Integrate solar development into the **Climate Action Living Laboratory** (CALL) of academic instruction and research, including dual-use solar-farm production agrivoltaics; a 10-MW storage testbed/showcase project for smart micro-grid reliability and resilience research through Virginia Tech Electric Service and the VT Power & Energy Center; and other instruction/research initiatives
- As with all components of this CAC, full **lifecycle analysis** of renewables procurement should include the environmental and social justice costs and benefits of procured systems
- The **siting** of renewable energy systems should employ best practices in public engagement to identify the most appropriate locations

Goal 3. Complete the total conversion of steam plant fuel to natural gas by 2025, plan for a full transition to renewable steam plant fuel after 2025, and continue to improve the efficiency of campus energy systems

Potential pathways:

- Addition of gas boiler #12 provides **natural gas thermal capacity for all steam plant demand**
- VT's new **natural gas service contract** signed in summer 2020 and effective until 2025, provides favorable price and reliability terms and prospects for renewable gas
- For **reliability and resilience**, a plan is needed for **backup fuel** (such as liquefied natural gas

(LNG), biochar, or other fuel) when natural gas is unavailable, and **boiler redundancy** (so-called "n+1") in case of a boiler outage at a critical time.

- **Improve chiller efficiency**: By 2023 the Chiller Plant Phase II capital project will reduce central chiller energy usage by 20% from 2020; future campus growth needs for chilled water will be met from central plants where possible.
- **Ten-year 2021-30 Energy Management Plan** will improve efficiency of stand-alone chilled water plants
- Establish an online Climate Action Living Laboratory (CALL) **Energy Dashboard** for faculty, staff, and students to access and analyze campus facilities energy use data for instruction and research
- Beginning with the CAC 2025 revision, develop a **plan for full transition to renewable energy for campus heating systems**. To promote zero emissions energy options in the plan, refine GHG inventory estimates of methane leakage from VT natural gas sources and include those **estimates of methane leakage in the carbon neutral goal for 2035**.

Goal 4. Reduce Building Energy Consumption to Enable Carbon Neutrality by 2030

a. **By the end of 2022, reduce electricity consumption (kWh) by 10% and electricity intensity (kWh/gsf) by 20% below 2006 levels**
b. **By 2030, employ energy management retrofits to reduce total energy consumption in all buildings by 10% and energy use intensity (Btu+kWh/gsf) by 20% below 2020 levels**

Potential pathways:

- Implement an **aggressive 2021-30 ten-year energy management plan** updated annually to reduce total energy consumption in all buildings including auxiliaries by 10%
- For **leased buildings** owned by the VT Foundation, work with the Foundation to develop financial arrangements to improve efficiency and reduce emissions
- By 2021, develop a campus-wide **Climate Action Living Laboratory Green Lab program** based on a pilot test-bed Green Lab to reduce energy, emissions, and materials in our most energy-intensive facilities
- **Reduce building energy and GHG emissions by smart operations**, such as demand response, digital controls, thermostat settings, occupant behavior, and innovative space scheduling, especially in summer
- Achieving these goals will require sufficient **staffing in energy management**

Goal 5. Operations of New Buildings Initiated by 2030 will be Carbon Neutral

a. **New building efficiency will conform to latest adopted LEED-Silver standards and ASHRAE 90.1 energy performance standards + 10%**
b. **By 2022, reduce total energy use intensity (EUI) in newly initiated buildings by 20% compared to 2020 existing buildings**
c. **By 2026, build a signature zero-net-energy (ZNE) building on campus as a showcase and learning model for the Climate Action Living Laboratory**
d. **By 2028, newly initiated buildings' efficiency improvements will reduce total energy use intensity (EUI) in new buildings by 40% compared to 2020 existing buildings**

Potential pathways:

- In 2021, identify candidate new buildings for a **showcase zero-net-energy (ZNE) building** and

begin fundraising to attract donors to help fund the project to be completed by 2026

- Electricity currently contributes 50% of total CO_2 emissions. **100% renewable electricity** by 2030 will reduce building CO_2 emissions by more than 50%
- By 2030, all newly initiated building design will have **carbon neutral** operations through 100% renewable electricity, improved energy efficiency, and carbon offsets
- **Post-occupancy evaluation** (POE) should become standard practice to fine tune building operations and engage occupants to better serve users and reduce emissions
- New buildings offer opportunities for campus **Climate Action Living Laboratory** research and instruction by faculty and students through field testing and use of emerging technologies, monitoring energy use, air quality, and occupant perceptions, and other projects
- Achieving these goals will require **sufficient engineering and design staffing**

Goal 6. Agricultural, Forestry, and Land Use Operations Carbon Neutral by 2030

Potential pathways:

- Develop the **University Compost Facility at Kentland** to provide benefits to campus organic waste management, help reduce animal waste GHG emissions, support soil health, and reduce need for new land for future land application of animal wastes
- **Adopt Campus Tree Policy** to increase canopy cover from 16% to 25% and manage VT trees, forests and woodlands to increase carbon sequestration and provide additional environmental benefits
- **Reduce agricultural and forestry net GHG emissions** through more efficient operations, reduced animal enteric fermentation emissions, improved energy and fuel efficiency, possibly an anaerobic digester to produce usable methane, and other means
- **Use VT agricultural lands to develop solar farms** toward renewables goal, including co-use solar and farmland agrivoltaics for Climate Action Living Laboratory instruction and research
- In 2030, **offset any remaining net GHG emissions** from agricultural/forestry operations with solar production from VT agricultural land and/or by purchasing carbon offsets

Goal 7. Virginia Tech to become a Zero-Waste Campus by 2030

a. **Increase landfill waste diversion rate to 85% by 2025**
b. **Increase waste recycling rate to 55% by 2025**
c. **Reduce waste to landfill per capita by 25% by 2025**

Potential Pathways:

- **Hire a zero-waste consultant** to conduct a waste audit study and plan to evaluate organization, procedures, and staffing to enhance campus waste management
- Based on consultant recommendations, consider hiring a **campus waste manager**
- Engage personnel involved in campus waste management on a **Waste/Recycling Council** to help streamline operations and reduce redundancies
- Develop **University Compost Facility at Kentland** to process campus organic waste from dining halls and athletics, veterinary and agriculture animal waste, yard trimmings, wood waste, non-recyclable soiled paper, and other compostables
- **Engage faculty, students, and staff** in greater use of recycling/compost behavior using social marketing and media, incentives, and innovative approaches to advance Circular Economy and

Pollution Prevention (P2) principles as part of the Climate Action Living Laboratory
- Evaluate and improve as needed the management of **specialty wastes**, such as e-waste, laboratory waste, construction debris, and wastes from major sporting and other events

Goal 8. Establish the Sustainability Procurement Policy and Procedures by 2022

Potential Pathway:
- On a pilot basis, adopt, implement, and evaluate the 2020 Sustainable Procurement Policy
- In 2022, the Energy & Sustainability Committee will assess the pilot project and work with the Procurement Department to formulate the Sustainability Procurement Policy v.2

Goal 9. Reduce Single-Occupancy Vehicle (SOV) Commuting to Campus by 20% by 2025 and Reduce Transportation-Related GHG Emissions by 40% by 2030

Potential Pathways:
- **Promote walking/biking/transit as the preferred means of commuting to campus:** use parking policies, alternative transportation programs, campus mobility planning in collaboration with Town of Blacksburg, and encourage Blacksburg Transit (BT) programs to improve the safety and convenience of and promote walking/biking/transit
- **Promote sustainable mobility choices** through good marketing including social media, parking permit literature, gaming, university promotion literature/website, and student orientation
- **Promote non-commuting work and learning opportunities** such as telecommuting, innovative on-line instruction, Internet conferencing, and other means
- **Improve infrastructure and traffic management to improve mobility choices and safety** by reducing speed limits, improved bike/ped path lighting, limiting/restricting vehicles in core campus, implementing current transportation plans, and coordinating with Town of Blacksburg plans
- **Improve vehicle efficiency and promote low-carbon emissions vehicles** through Motor Pool purchases and development of electric vehicle charging stations on campus
- **Promote social equity in mobility and parking policies** by developing effective and efficient commuting options for lower wage employees who cannot afford to live in Blacksburg, sliding-scale parking fees based on salary/wage, and collaboration with the Town to provide affordable workforce housing proximate to campus
- **Reduce and negate business travel GHG emissions with carbon offsets**
- **Establish an alternative mobility subcommittee of the Transportation and Parking Committee** to recommend strategies to increase the non-SOV mode share on campus

Goal 10. Integrate the CAC into Virginia Tech's Educational Mission through the Climate Action Living Laboratory (CALL) beginning 2021

Potential Pathways:
- Recognize the excellent **opportunities for student learning, faculty and student technical research, and staff development**. Benefits include learning from and innovating creative solutions in-house for VT's climate initiatives and better engaging the entire university both in

Blacksburg and other Virginia Tech locations in our quest for sustainable and just climate action

- Establish the **Climate Action Living Laboratory (CALL)** in the new University Office for Climate Action & Sustainability (OCAS) to enhance offerings and build bridges between facilities and academic departments, facilitating and supporting opportunities
- Alter norms and incentives to overcome traditional barriers and nurture cooperation between academic units (research and teaching) and operations units such as Facilities and auxiliary units including dining, residence and athletics. **Greater collaboration** between university units will help implement the CAC and integrate physical plant climate action with academics and campus life
- Integrate Climate Action Living Laboratory **(CALL) initiatives in other goals/pathways** for renewables (2), energy materials, devices and systems (3), buildings (4, 5), agriculture (6), waste (7), transportation (9), climate justice (11), sustainable behaviors (12), and community engagement (13)
- Engage the university's **land grant Extension and Outreach programs** to reflect the principles of the CAC and help implement them throughout the Commonwealth
- Integrate the physical infrastructure elements of the CAC into the fabric of the university's educational and research programs to expand **funding opportunities for campus innovation** from state and federal sources as well as foundations

Goal 11. Establish Climate Justice as a Core Value of the Climate Action Commitment

Potential Pathways:

- Encourage an **accelerated transition to carbon-neutral status** as a climate-justice imperative
- Ensure that the **social impacts** of Virginia Tech's climate mitigation choices (e.g. energy, land use, and waste) are identified and addressed to the greatest extent possible
- Establish a **Climate Justice Subcommittee** of the revised Climate Action, Sustainability, and Energy (CASE) Committee by 2021 with representation from students, faculty, and community members from frontline groups
- Ensure that VT climate action implementation **plans recognize and assist vulnerable or frontline groups adversely affected by those plans**, including low-wage VT employees, tuition-paying students, VTES town ratepayers, historically marginalized people of color and Indigenous communities, coalfield communities, and others
- **Establish education, research, and outreach programs to assist vulnerable and historically marginalized groups** mitigate and adapt to climate change and thrive in the new energy economy. These efforts should specifically target Virginia Tribes, African Americans in the New River Valley, coalfield communities in southwest Virginia, and coastal Virginia communities threatened by climate-related hazards

Goal 12. Diminish Barriers to Sustainable Behaviors through Institutional Change, Education and Social Marketing

Potential Pathways:

- **Identify structural, social and institutional barriers** to sustainable behaviors

- **Implement infrastructural changes**—from waste management to transportation to building operation—to make sustainable choices easier
- Develop **educational programs** to foster pro-environmental behavior change
- **Design and implement choice architecture or "nudges"** to promote sustainable behavior, while allowing for individual choice, using social media, gaming, and other means
- **Develop a shared toolkit of best practices** in social marketing, rooted in behavioral sciences, for campus groups initiating sustainability initiatives
- **Nurture cross-campus partnerships** to coordinate climate action and enhance sustainability initiatives

Goal 13. Implement the VT Climate Action Commitment
…at a high level of university administration and governance;
…by integrating CAC goals for facilities, education, and campus culture;
…with ongoing stakeholder engagement for evaluation of goals and progress

Potential Pathways:

- **Governance:** By fall 2021, restructure the university Energy and Sustainability Committee (E&SC), renaming it the **Climate Action, Sustainability, Energy (CASE) Committee**, and revising its charge, membership, and reporting, to oversee the implementation and review of the CAC goals and progress involving student, faculty, and staff stakeholders
- **Implementation/operations:** Appoint a new university **Chief Climate Action and Sustainability Officer** (CCASO) to direct a reconstituted **University Office of Climate Action and Sustainability** (OCAS) to oversee CAC implementation and other campus sustainability initiatives. The CCASO would jointly report to the Senior Vice President and Chief Business Officer and to the Executive Vice President and Provost. The CCASO would chair the CASE Committee. The Facilities Division would, in parallel, appoint a director of strategic success to oversee a range of strategic Facilities issues including climate action and sustainability
- **Learning:** Establish the **Climate Action Living Laboratory (CALL)** in the new OCAS to enhance offerings and build bridges between facilities and academic departments, facilitating and supporting opportunities (Goal 10)
- **Duties of Operations and Governance units:**
    - Collect data relevant to the CAC including GHG inventory and prepare an **Annual Report** of CAC Progress each fall semester for the previous fiscal year
    - Establish mechanisms to **engage and educate** the Virginia Tech community on the CAC and climate action
    - Establish ad hoc committees to develop instructional, research and outreach programming for the **Climate Action Living Laboratory (CALL)**
    - Evaluate CAC goals according to best practices in light of new information and standards and direct **update of the CAC on a five-year cycle**
    - **Broaden the geographic scope** of the CAC to all Virginia Tech properties in future iterations to include the entire University
    - **Advocate** for allocation and prioritization of resources to support the CAC
- **Annual review:** Conduct an in-depth annual review of the CAC goals and implementation progress that involves student, staff, faculty, and community stakeholders. The results of this review will be shared publicly in an accessible and easy-to-read format

Goal 14. Develop Innovative Budgeting and Financing Mechanisms to Generate Funding and Staffing to Achieve Climate Action Commitment Goals

Potential Pathways:

- Strategically invest university E&G and Auxiliary funds to implement the **10-year Energy Management Plan** at a level of $5 million/year in energy efficiency projects with a cumulative 8-year financial payback or 12% return on investment
- Major investment is needed to implement the **pathways for renewable electricity** both on VT buildings/lands and in the SWVA region, including the following options:
    - **VT owned** and developed projects on VT buildings/land, and
    - **Utility or 3rd party owned** and developed projects on VT buildings/land and in SWVA with VT power purchase agreement (PPA)

  The first option requires major VT capital investment but provides greater long-term return and control, while the second requires no VT capital but provides less long-term financial return. A combination of the two options may be used to meet the CAC renewables goal
- As a unique **power utility, VTES** has opportunities for investment in renewable energy serving both campus and its town customers
- The **Virginia Tech Foundation** helps the university achieve its goals and may be a valuable partner in implementing the CAC:
    - As owner of most of the **leased academic space** off campus, the Foundation has already agreed to provide funding for an energy efficiency retrofit pilot project in Corporate Research Center buildings on a revenue neutral basis
    - **Campus solar development** provides another opportunity for Foundation investment with appropriate return on that investment
- **Additional sources of funds** to implement the CAC include, federal and state grants, research funding in connection with the Living Laboratory, advancement donations, philanthropic organizations and foundations, and low interest revenue bonds by VTES and Auxiliaries.
- In addition to project funding, implementation of the CAC will require **upgrading the staff** to rise to the needs of the commitment, especially in energy management, energy and utility systems, building analysis and design, waste management, university compost facility operation, and campus sustainability

Goal 15. Develop Pathways After 2030 to Eliminate Fossil Fuels and Offsets by 2050

Potential Pathways:

- A long-term **Utilities Master Plan** should fully incorporate the goals of this Climate Action Commitment
- It is difficult to anticipate how technology, the economy, and public policy will evolve in the next 10-30 years, necessitating revisions along the way:
    - **2025: 5-year CAC revision** review explore options for 2030-2040 timeframe
    - **2030: 5-year CAC revision** review explore options for 2040-2050 timeframe
- Beginning with the CAC 2025 revision, develop a **plan for full transition to renewable energy for campus heating systems**. To promote zero emissions energy options in the plan, such as green hydrogen, hot water heating with geothermal heat pumps, refine GHG inventory estimates of methane leakage from VT natural gas sources and include those **estimates of methane leakage in the carbon neutral goal for 2035**.

ES.4 Implementation Milestones

The 15 goals and pathways include many target dates for actions or achievement as part of their implementation. They are summarized in the table below, with date, relevant goal number and action milestone.

VT 2020 CAC Implementation Milestones

Date	Goal	Milestone
2020	2	30% Renewable Electricity
		BOV approves VT 2020 CAC
2021	13	E&SC renamed Climate Action, Sustainability & Energy (CASE) Committee
	11	Operation plan for Climate Action Living Laboratory (CALL)
	5	Candidate identified for Zero-Net-Energy new building to be built by 2026
	3,4	1st year of 10-year 2021-2030 Energy Management Plan
	2	Fishburn Forest student-led wind assessment
2022	2	2.3 MW solar PV on VT rooftop and land
	2	VTES Solarize program for Town customers, 250 kW net metered
	4	Electricity use 10% below 2006 (Governor's E.O. 43)
	5	Newly initiated buildings EUI 20% below 2020 existing average
	8	Sustainable Procurement Policy v.2
2023	14	VT Foundation energy efficiency plan for leased buildings (CRC)
	2	VTES Community Solar project for Town customers 0.5-1 MW
2024	3	Chiller Phase II Upgrade complete
2025	3	Total conversion to natural gas in steam plant; plan for transition to renewable fuel
	15	5-year CAC update: Explore options for 2030-2040
	7	Recycling rate 55%; Waste diversion rate 85%; reduce trash to landfill/capita by 25%
	9	Reduce Single-occupancy-vehicle commuting by 20%
	2	10 MW solar PV on VT lands
	3	Explore geothermal heat pump hot water heating options for new districts
2026	5	Signature Zero-Net-Energy (ZNE) building on campus
2027	2	10 MW battery storage for VT Smart Grid research by VT PEC-VTES partnership
	2	35 MW solar PPA with Apco/3rd party
2028	5	Newly initiated buildings EUI 40% below 2020 existing average
2029	2	100 MW solar PPA with Apco/3rd party
2030	15	5-year CAC update: Explore options for 2040-2050
	1	Carbon neutral campus operations
	2	100% Renewable Electricity
	4	Total building energy use down 10%, EUI down 20% below 2020
	5	Newly initiated buildings carbon neutral operations
	6	Carbon neutral agriculture/forestry operations
	7	Zero Waste campus
	9	Transportation emissions reduced 40% from 2020
2050	15	Fossil fuel free campus

ES.5 Costs and Benefits of VT 2020 CAC Goals and Pathways

The Working Group assessed the impacts of the 2020 VT CAC goals and pathways including GHG emissions, fiscal costs and benefits, and implications for Virginia Tech's educational mission, operations, policies and governance, and culture. These implications are far-reaching and are presented in chapter 3.

Major benefits are reduction of GHG and enhanced university reputation, culture, and educational programs linked to campus climate action and sustainability. To implement the CAC goals, there will be costs and benefits for the university:

- Some initiatives (e.g., upgrades to the steam plant) are part of the cost of doing business, and the added costs to incorporate climate action goals may be small.
- Others, such as energy efficiency retrofits, have a positive return on investment.
- Others, including solar electric projects, will require major investment; however, creative power purchase agreements can reduce capital cost and achieve cost-effective results.
- Finally, some projects (e.g., the proposed University Compost Facility at Kentland) require capital and operating expenditures but provide substantial operational and educational benefits

Effective CAC implementation will require changes in operations and governance. Goal 13 recommends establishing a University Office for Climate Action & Sustainability (OCAS) directed by a Chief Climate Action & Sustainability Officer that reports jointly to the Senior Vice President and Chief Business Officer and the Executive Vice President and Provost. These arrangements are described in chapter 4.

ES.6 Immediate Near-Term Initiatives (2020-2022)

Although the 2020 VT Climate Action Commitment focuses on 2030 as the target date for its goals, the pathway to those goals begins the day the CAC is officially adopted by the University, if not before. The Working Group has identified a number of initiatives and projects that can and should be acted on in the short term from now until 2022 with full understanding of the current budget constraints of the university. The "shovel ready" initiatives aim to get a jump start on necessary action and to demonstrate the university's commitment. They are listed below sorted by (a) low-cost/no-cost/revenue-neutral initiatives, (b) ongoing and budgeted projects, and (c) new priorities in need of funding and/or approval. These initiatives are described in chapter 9.

a. Low/no cost/revenue neutral project/policy/planning initiatives

- Establish framework for Climate Action Living Laboratory (CALL) through Provost's Office, College Deans, and Facilities Department
- Restructure the Energy & Sustainability Committee to oversee 2020 VT CAC, renaming it the Climate Action, Sustainability, and Energy (CASE) Committee
- Establish an alternative mobility subcommittee of the Transportation and Parking Committee
- Develop plan for steam plant resilience/redundancy for total conversion to natural gas by 2025
- Develop Utility Master Plan
- Develop Campus Energy Dashboard

- Initiate Student Project for Fishburn Wind Energy Assessment
- Promote partnership between Virginia Tech Electric Service and the VT Power and Energy Center as part of Climate Action Living Laboratory
- Initiate partnership with APCO on renewable electricity development
- Initiate community relations with VTES Town customers
- Identify candidates for a zero net energy building on campus and develop fundraising plan
- Engage VT Foundation in energy efficiency retrofit plan for leased buildings
- Adopt Campus Tree Policy
- Seek external funding for agrivoltaics test array at Catawba Sustainability Center
- Implement and evaluate Sustainable Procurement Policy

b. Ongoing budgeted projects

- Implement ongoing steam plant and chiller upgrade projects
- Evaluate new natural gas contract on implications for CAC goals and pathways
- 2020 RECs for 30% renewable electricity, continue through 2022 as needed
- Implement Design & Construction Standards in light of CAC Goals
- Fill the VT Energy Manager Position and supplement staff as needed
- Implement budgeted projects in Parking & Transportation Plan

c. New priority projects in need of funding/approval

- Establish the University Office of Climate Action & Sustainability (OCAS) and appoint a university Chief Climate Action & Sustainability Officer (CCASO)
- Develop University Compost Facility at Kentland
- Initiate 10-year energy management plan, 2021-2030, and develop first year projects
- Develop solar projects on campus: 2.3 MW by 2022: Sterrett and other rooftop projects
- Implement Zero-waste management consultant study
- Implement a Green Lab Program
- Dedicate consistent, annual funds to maintain existing trails, sidewalks, bicycle infrastructure
- Implement transportation infrastructure plans (e.g., MMTF)

ES.6 Community Engagement

Engaging the university community in the CAC update was part of our charge and a critical part of our effort. The process overall--with its robust network of subcommittees--may be considered a true 'collaborative' enterprise, with over 120 students, staff, faculty, and community members involved. In terms of wider outreach, the Engagement Subcommittee originally planned on holding a major half-day town hall event on campus. Unfortunately, COVID-19 made that impossible. The group responded by deploying a range of 'physically distanced' engagement activities:

- Dedicated website portal introducing the CAC process and sharing committee materials https://svpoa.vt.edu/index/VTCACRevision.html
- Dedicated email address for the initiative
- A series of 10 videos sharing progress of the Working Group and the subcommittees
- A survey distributed widely throughout the community with 242 respondents
- A series of 12 hour-long Zoom "convenings," attended by at least 226 participants

Each of these streams of engagement is detailed in Chapter 5, and insights and information collected through them is summarized. **Key findings from these various engagement efforts include**:

- The vast majority of participants/respondents believe that **climate change is a serious threat**, and thus support aggressive action on the part of the university. In fact, many feel that VT is not doing enough
- The importance of **setting ambitious goals and sticking to them** was emphasized
- Emphasis was placed on **systemic or "upstream" solutions** rather than placing the onus on behavior change of individuals, given that many of the barriers to action are infrastructural and institutional (e.g., poor cycling infrastructure)
- The above notwithstanding, many did see **individual actions as important** and needing of attention. Creative ideas emerged around how to, for example, 'gamify' desired actions
- **Key champions** are important for propelling further action, including potentially a higher-level champion within university administration. This may be partnered with a **stronger Office of Sustainability**
- There is strong support for taking a more holistic view of **understanding our greenhouse gas emissions**, accounting for emissions associated with community behaviors like commuting
- There is **broad support for key actions proposed** through the CAC update process, including:
    - A shift to **carbon neutrality and 100% renewable energy, including** integrating renewable energy infrastructure into campus design
    - **Alternative transportation** and reductions in private automobile usage, including a ban on freshmen car parking permits
    - **Improved waste management**, including a new compost facility, and reductions at the source through purchasing decisions that minimize waste and promote sustainability
    - The creation of a **'living laboratory'** to foster partnerships between campus operations, local partners, and the academic (teaching and research) enterprise.
    - A **'green lab' system**, and similar programs to promote sustainable behaviors within work and student life spaces
    - Optimize **building design**, including with energy, water, and waste monitoring
    - The need to account for **climate justice** in any and all actions taken
    - **Stronger partnerships** with other institutions, including the Town of Blacksburg
    - There is a strong desire to see **engagement continue as the university shifts to implementation**

ES.8 Comparison with Peer Universities

One of the Working Group's deliverables is a comparison of Virginia Tech progress in climate action to peer universities, and this is presented in chapter 8. There are three good reasons for this:

1. To offer an evaluative reference point (i.e., to see how we are doing),
2. To adopt effective plans and avoid ineffective ones (i.e., to borrow good ideas), and
3. To demonstrate that what we're proposing is feasible and in line with similar universities (i.e., to show it is not far-fetched to have a bold and aggressive climate action plan)

Knowing that our perspective is comprehensive and that other universities have different strengths in different areas, we decided to have our specialty subcommittees select the peer and exemplary universities to assess in their specialty area. Those areas include:

- Carbon neutrality and GHG inventory
- Renewable Energy
- Buildings
- Energy Systems
- Transportation
- Waste-Recycling-Composting
- Agriculture, Forestry, Land Use
- Climate Justice
- Community Engagement
- Budget and Finance

In most areas we selected 3-8 universities that we consider to be peers or to be exemplary in that area. Some are from Virginia, some are Land Grants, some are from the Atlantic Coast Conference, some are far away, but all offer good examples and benchmark our progress to-date and our aspirations for our 2020 Climate Action Commitment.

All in all, our peer reviews told us that, while our 2009 Climate Action Commitment was right for its time and has led to improved energy efficiency and reductions in GHG emissions, it now lags behind the actions of many of our peers. This deficiency is most notable in the quest for carbon neutrality, for renewable energy, for zero waste, for zero-net-energy buildings, for alternative transportation, and for community engagement to advance climate action and sustainable behavior.

Many of our related programs do standup well in comparison to others, but if Virginia Tech is to regain its leadership role in climate action and sustainability, we need to move to a new Climate Action Commitment that is right for *this* time. Of course, that is what we have set out to do, and we believe that we have found the right balance of aggressive, yet pragmatic, climate action. Our goals are for carbon neutrality by 2030, 100% renewable electricity by 2030, investment in energy efficiency in existing and new buildings, carbon neutral agriculture, a zero-waste campus, sustainable procurement practices, sustainable mobility, climate justice as a core value, community engagement, and the establishment of a Climate Action Living Laboratory that will integrate these goals into the fabric of the university.

Relative to the peer and exemplary universities reviewed in this analysis, this 2020 VT Climate Action Commitment sets the stage for Virginia Tech to shine as an exemplar and leader in university climate action. Beyond our climate neutrality and zero-waste campus goals, **six areas of the 2020 CAC stand Virginia Tech above the rest:**

1. The detail and **specificity of the pathways** developed to achieve the CAC goals
2. Our own **unique utility VTES** leading our way to 100% renewable electricity, while most other universities are totally dependent on private utilities and companies
3. Using our considerable **land resources** not only to manage our agricultural climate impacts, but also to sequester carbon and develop renewable energy
4. Incorporating in our carbon neutral goal **scope 3 GHG emissions relating to behavior** (e.g., commuting, waste/recycling, water/wastewater, business travel), while most others include just scope 1 & 2
5. Integrating our physical climate action into the **university's educational mission** through the Climate Action Living Laboratory (CALL).
6. Specifically addressing **community engagement, sustainable behaviors, and social equity and justice** as core elements of our climate action.

1. Introduction

1.1 Seize the Moment

From January to June 2020, the Virginia Tech **Climate Action Commitment Working Group** executed its charge to evaluate the university's current position and our future role in addressing climate change. During this same period, a global pandemic has brought unprecedented hardship and suffering, particularly for the most vulnerable among us. Yet, this unique time is engendering a tremendous spirit of innovation and collaboration. Around the world, people are coming together to address historic challenges. We are becoming bolder and more creative. And we are reimagining every aspect of our lives.

In this public health crisis, we are learning an important lesson: when experts testify to looming crises, when science speaks, society must take decisive action. People are learning to trust science and use it to guide action, shape responses, and inform policy-making. It has also exposed critical and uneven vulnerabilities in our economy and society, raising calls for recovery efforts to redress inequities. Similarly, our actions to combat climate change and strengthen our community's resilience must be guided by a just and equitable transition to sustainable new strategies, policies and practices. As a new world dawns, we must bounce "forward," not "back," to seize the hope and promise of this moment.

One such promise is the prospect of working together, creatively, urgently, and with care, to address pressing challenges. Climate change is a slow-growing emergency compared to the lightning strike of Covid-19, but it will be more painful and longer lasting. This moment of pause gives governments, businesses, communities, and universities the opportunity to evaluate their current positions and future roles. While the individual actions of any single institution may seem insignificant for the magnitude of the problem, the world cannot be saved without their collective action.

The Working Group of 26 faculty, students, staff, and community members was established by President Tim Sands and Senior Vice President Dwayne Pinkney because, as they said, "climate change presents one of the world's most pressing problems…and Virginia Tech has a duty to respond." Virginia Tech, like other universities, is facing both short-term fiscal challenges and long-term uncertainties in these challenging and tumultuous times. Nonetheless, the university remains committed to taking bold action to do its part to address the climate emergency. The Group was charged to assess the university's progress in implementing the 2009/2013 VT Climate Action Commitment, compare our experience to peer institutions, and develop our new Commitment.

Our work focused on the smart ways the university can advance genuine climate action. Furthermore, through the multitude of working group, subcommittee, and community zoom meetings, our discussion has also reflected on the opportunity for Virginia Tech to reinvent itself, not only in its commitment to climate action, but also in its responsiveness to the needs of the world around us, in the spirit of *Ut Prosim*.

Universities play important roles in the U.S. and around the world. They aim to create innovative, sustainable, inclusive, and just communities as models for the future. They are societies' laboratories of change. Virginia Tech is not alone in this quest. We already lead our peer universities in some respects, but we have fallen behind in many others. Our 2009 VT Climate Action Commitment & Sustainability Plan was a leading effort for its time, but a decade later it falls short of both necessary action and the recent initiatives of many peer universities.

This recommended 2020 Climate Action Commitment is bold, aggressive, and comprehensive. Its goals are many and range from necessary upgrades to the campus physical plant to reduce GHG emissions, to integrating these improvements into the educational mission through a Climate Action Living Laboratory, to engaging everyone in creating a culture of sustainability—all to position Virginia Tech as a leader, as the Commonwealth and the world evolve to the clean energy economy.

1.2 The Charge to the Climate Action Commitment Working Group

During fall semester 2019, Virginia Tech students involved in Climate Strikes met with President Tim Sands with a series of climate action demands. The Faculty and Staff Senates, SGA, and GSA all passed resolutions calling for climate action (see Appendix B). In November 2019, President Sands issued a statement that Virginia Tech has a duty to respond to the pressing problem of climate change. He called on Senior Vice President Dwayne Pinkney to establish a working group of faculty, students, and staff to develop a new Climate Action Commitment, revising the original commitment endorsed by the Board of Visitors in 2009 and updated in 2013.

In December 2019, Dr. Pinkney formed the Climate Action Commitment (CAC) Working Group of ten faculty, ten students, and six staff and community representatives, and charged the Group to develop two deliverables:

a. A summary of the university's progress on sustainability since the original 2009/2013 CAC
b. A proposed revision to the CAC

The summary of progress was to outline the structure, partnerships, and arrangements developed to address sustainability; include high-level data summarizing progress; and compare our achievements to peer institutions. The revised CAC should consider updates to vision, mission and definitions; outline clear, measurable, and realistic goals; consider long-term impact of goals on university policies, operations, and budget; identify metrics and elements for determining progress meeting the goals; and follow university format (see charge letter in Appendix B).

President Sands requested the Group complete its work by May so governance approvals can occur during fall 2020. The charge to the committee asked for an Interim Report by March 1 and the final reports by May 7, 2020. The Interim Report was delivered in March. However, the Covid-19 pandemic shutdown delayed the final reports until the end of June. We are pleased to herewith submit the final report and look forward to thoughtful deliberation as it passes through governance and is ultimately implemented.

1.3 VT CAC Working Group Process

The Working Group could not convene until the start of spring semester (January 21st, 2020). Because of the short timeline, the Group was very busy. In order to engage a broad range of expertise and perspectives from the university community, the Group established 12 subcommittees that involved over 130 faculty, students, and staff members in the investigation and discussion of specific issues relevant to the Commitment. The membership of the Working Group and the subcommittees as well as the executive summaries of the 12 subcommittee reports are provided in the Appendices. Most of the subcommittees met weekly from February through May. The subcommittees include:

- Agriculture, Forestry, Land Use GHG
- Budget and Finance
- Buildings Opportunities
- Climate Justice
- Community Engagement
- Energy Opportunities
- Greenhouse Gas Inventory
- Peer Institutions Comparison
- Renewables Opportunities
- Structuring Sustainable Choices
- Transportation Opportunities
- Waste-Recycling-Composting and Procurement

The subcommittees provided an opportunity to involve a wide range of university stakeholders in the process. They have brought expertise and knowledge necessary to analyze the opportunities and constraints involved in our needed climate action. In addition, these many subcommittee members broadened the campus participation in our effort and with that, broader support for our results. Among the participants were 35 staff members who provided needed data and reality checks. Each subcommittee prepared its own report for the Working Group; these subcommittee reports are provided in Volume II to this report.

In addition to the subcommittees, the Working Group, through its Community Engagement Subcommittee, developed several mechanisms for communication and involvement in the process. The Group used a website and email address for comment and two online surveys. Plans for face-to-face town hall meetings and conference sessions had to be abandoned when the university shut down after spring break. In response, the Group hosted 12 Zoom Convening sessions in April that involved 226 participants and provided excellent feedback. In anticipation of the Convening sessions the Group and its subcommittees developed ten creative videos that described the CAC recommendations. See website:
https://svpoa.vt.edu/index/VTCACRevision.html

1.4 Roadmap to the 2020 VT CAC Working Group Report

This report is divided into two main parts with a total of eight chapters and two appendices:

Part I: The Virginia Tech 2020 Climate Action Commitment

- *Chapter 2* presents the 2020 Virginia Tech Climate Action Commitment including goals and detailed pathways to achieve them.
- *Chapter 3* explores a range of implications of the 2020 CAC for Virginia Tech including impacts on GHG emissions, budget and finance, operations and staffing, the educational mission, policies and governance, and university culture.
- *Chapter 4* discusses implementation of the CAC including major changes in operations and governance, staffing, procedures for annual GHG inventories, engaging the campus community, an annual review report of progress, and a five-year cycle for updating the CAC.
- *Chapter 5* focuses on the process and results of our community engagement process

Part II: Progress Implementing the 2009 VT CAC and Comparison to Peers

- *Chapters 6* and *7* provide a summary of progress we have made in the eleven years since the 2009 Climate Action Commitment was adopted as well as a critique of that progress.
- *Chapter 8* reviews related experience at peer and exemplary universities to see how we stand, steal good ideas, and show that we are not far-fetched with our recommendations.
- *Chapter 9* provides a short conclusion and describes a couple dozen initiatives, policies, and projects that are "shovel ready" for immediate action from now to 2022.

Appendix A provides information on the Working Group, its charge, its subcommittees, Climate Strike student demands, and the Faculty Senate climate action resolution.

Appendix B provides the executive summaries of the 12 subcommittees' reports.

The full subcommittee reports are given in the separate Volume II report of the Working Group. In addition, a series of slide decks presenting most of the Working Group's results is available on-line.

2. Virginia Tech 2020 Climate Action Commitment

2.1 Factors, Criteria, and Process for Developing Goals and Pathways

2.1.1 Factors Determining Effective Implementation of VT 2020 Climate Action Commitment

Before considering elements of the VT 2020 Climate Action Commitment, it must be noted that several factors will affect the potential achievement and beneficial consequences of the CAC. Implementation depends on internal commitments and external influences. Successful achievement must consider implications for students, faculty and staff and community.

Among **internal commitments** are those of the VT administration, staff, faculty, students, alumni, and donors. Their commitment will determine the university's sustainability culture and advocacy, including voices for change as well as behavior that affects sustainability choices. To a major extent the achievement of CAC goals will depend on financial investment from diverse sources including E&G and auxiliary funds, VT Foundation investments, external grants, and private donors. The university community has many funding priorities, especially as it recovers from Covid-19, and the climate commitment must compete with other needs including safety and security, academic excellence, quality student experience, affordable tuition and fees, and competitive faculty salaries.

Among **external influences**, state policy and funding, utility providers' climate commitments, terms and conditions of utility contracts, as well as federal and international climate commitments will all affect the context in which VT operates. Already 2020 state Governor and General Assembly action is providing mandates and goals that will facilitate VT's 2020 Climate Action Commitment.

The climate commitment and its implementation must consider not only GHG reduction and cost-effectiveness, but also benefits for VT's educational mission, culture, and reputation. Moreover, climate actions need to consider **social equity implications** for students, employees, and the larger community. These implications involve sources of energy; upstream and downstream social impacts; student fees; staff wages; affordable options for housing, transportation, and utilities; among others.

2.1.2 Process and Criteria for Developing and Evaluating Climate Action Goals

The Climate Action goals and pathways presented in this chapter are the heart of the matter. They were developed through a process of deliberation in each subcommittee and within the Working Group. A set of preliminary goals and pathways was developed for the Interim Report. They underwent revision through weekly subcommittee discussions and were presented in the 12 Zoom public convening sessions. Based on public comments, the goals and pathways were finalized in the subcommittee reports in summary form (presented in the Executive Summary) and in expanded form (presented below). The process of assessment was generally based on the following set of criteria:

- Relative **contribution expected to reduce greenhouse gas emissions and achieve reduction goals**, and to achieve complementary sustainability objectives.
- Context of VT's mission as a leading institution in education, research and outreach.
- **Resource efficiency** or 'bang for the buck', acknowledging that we seek to achieve as much as possible in a resource constrained environment.
- **Ease of implementation**, given legal, institutional, political, and other constraints.
- **Palatability to the VT community** with the goal of fostering broad support for actions to ease implementation and minimize barriers.
- Wider societal **social justice** implications (positive and negative) associated with adoption and implementation.

2.2 Virginia Tech 2020 Climate Action Commitment

2.2.1 Climate Action Commitment Vision and Mission

Vision of the Virginia Tech 2020 Climate Action Commitment:

> ***In the spirit of Ut Prosim, Virginia Tech will be a leader in climate action in service to our community, the Commonwealth, and the world.***

Mission of the Virginia Tech 2020 Climate Action Commitment:

President Tim Sands: "climate change presents one of the world's most pressing problems…and Virginia Tech has a duty to respond."

> ***The mission of the Virginia Tech 2020 Climate Action Commitment is to achieve carbon neutrality by changing our physical infrastructure, collective and individual behaviors, and educational mission; to engage everyone in creating a culture of sustainability; and to achieve these objectives through just and equitable means.***

2.2.2 Virginia Tech 2020 CAC Expanded Goals and Pathways

The Executive Summary presented summary goals and pathways. This section provides more detailed information on the CAC goals and potential pathways to achieve them.

The 15 primary CAC goals:

1. Carbon neutral Virginia Tech campus by 2030
2. 100% renewable electricity by 2030
3. Complete the total conversion of steam plant fuel to natural gas by 2025, plan for a full transition to renewable steam plant fuel after 2025, and continue to improve the efficiency of campus energy systems
4. Reduce building energy consumption to enable carbon neutrality by 2030
5. Operations of new buildings initiated by 2030 will be carbon neutral
6. Agricultural, forestry, and land use operations will be carbon neutral by 2030
7. Virginia Tech to become a Zero-Waste Campus by 2030
8. Establish the Sustainable Procurement Policy and Procedures by 2022
9. Reduce single-occupancy-vehicle commuting to campus by 20% by 2025 and reduce transportation-related GHG emissions by 40% by 2030
10. Integrate the CAC into Virginia Tech's educational mission through the Climate Action Living Laboratory beginning in 2021
11. Establish climate justice as a core value of the VT Climate Action Commitment
12. Diminish barriers to sustainable behaviors through institutional change, education and social marketing
13. Implement the VT Climate Action Commitment at a high level of university administration and governance, by integrating goals for facilities, education, and campus culture, and with stakeholder engagement for evaluation of goals and progress
14. Develop innovative budgeting and financing mechanisms to generate funding and staffing to achieve Climate Action Commitment goals
15. Develop Pathways after 2030 to eliminate fossil fuels and carbon offsets by 2050

Expanded Goals and Pathways

The Working Group and subcommittees devoted significant attention to deliberating around not just what the updated CAC goals should be, but how they can be implemented in practice. This section further expands upon the goals outlined above and provides potential *pathways*.

Goal 1: Carbon Neutral Virginia Tech Campus by 2030

Carbon neutral is defined as net-zero emissions of CO_2, CH_4, and N_2O by VT operations on the Blacksburg campus based on the geographic and GHG scope of the 2020 CAC update.

The **geographic scope** includes all Virginia Tech owned lands and buildings on the main campus, buildings leased by university departments in Blacksburg, and agricultural/forestry operations and lands in the Blacksburg region.

The **GHG scope** includes:

- *Scope 1* emissions from campus fuel use and fugitive sources,
- *Scope 2* emissions related to purchased electricity (generation CO2 and N_2O, transmission/distribution losses), and
- Some *Scope 3* emissions related to campus behavior (commuter driving, transit bus fuel, waste/recycling/compost, water/wastewater, aviation fuel, and commercial business travel).

Other GHG Scope 3 emissions are not included in 2030 carbon neutral goal, but will be monitored as part of the annual GHG inventory. These include estimates of upstream leakage from natural gas extraction/distribution, upstream emissions from the production/ transport of dining hall food, and possibly other sources. By 2025, reduction targets will be established for these emissions as data sources are improved.

Emissions from other Virginia Tech locations across the state and in other countries are not included in the 2030 carbon neutral goal. By 2025, GHG inventory methods for the 2020 VT CAC should be applied to other VT operations in the Commonwealth, and each should establish GHG reduction targets, goals and pathways.

Potential Pathways:

1a. Goal 2—**100% renewable electricity** by 2030—can reduce emissions by 50% below 2019

1b. Goal 3—in the steam plant **total conversion to natural gas use by 2025 and transition to some renewable fuel by 2030**—can reduce GHG by at least 10% below 2019

1c. Goals 4 & 5—**reduction of energy use** in existing and new buildings—can result in further emissions reductions of 10% despite campus growth.

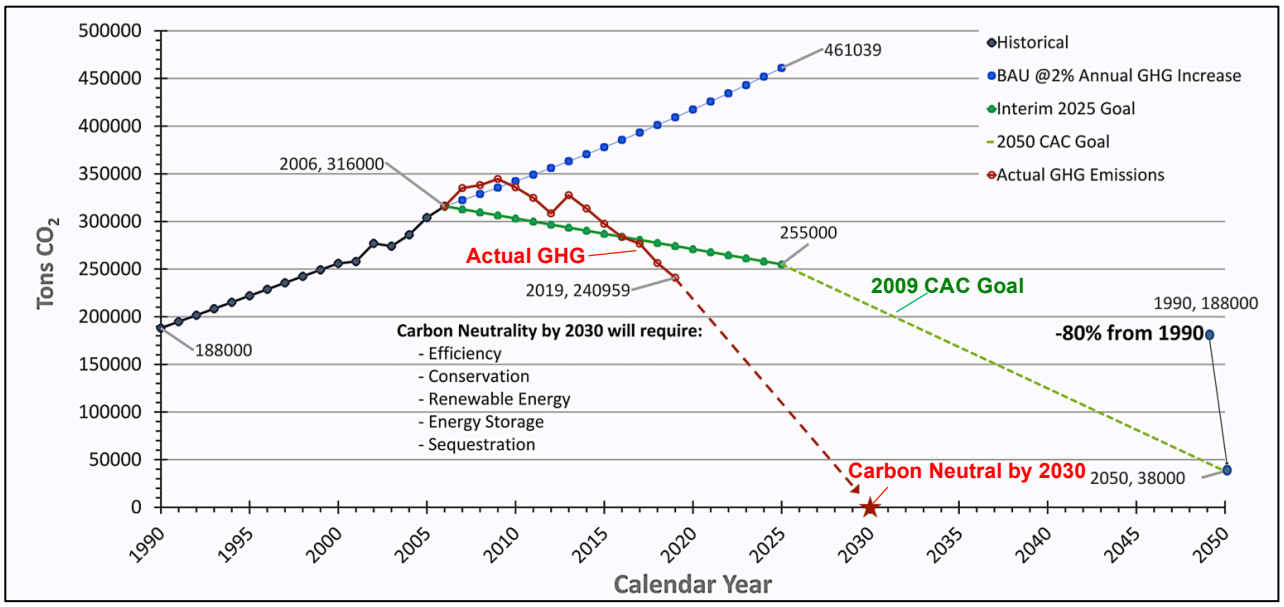
1d. Goals 6, 7, & 8— **reductions in GHG emissions from waste/recycling, transportation, and agriculture**, forestry, and land use—can reduce emissions by 10%.

1e. In 2030, remaining emissions can be negated by **carbon offsets**.

- Most universities use carbon offsets to reduce their GHG emissions and approach carbon neutrality.
- Purchase of carbon offsets can be costly. Current offset prices are $5-12/MT (metric ton) CO_2e. Carbon offsets to cover 2020 VT CAC GHG emissions of about 300,000 MT would be $1.5-3.6 million.

- There are better uses for this money, so every effort should be made to avoid the need for offsets by investing in energy efficiency and renewable energy. This investment not only reduces emissions and the need for offsets, but also provides long-term financial benefits.

Figure 2.1. Carbon Neutral by 2030. 2009 CAC GHG reduction goal (green line); actual GHG reduction progress (solid red line); needed reduction for carbon neutral by 2030 (dashed red line)



Goal 2: 100% Renewable Electricity by 2030

Virginia Tech is in the unique position of having its own electric utility - Virginia Tech Electric Service (VTES) - which dates back to the 1890s when it made Blacksburg the first town in SWVA with electric power, and the steam and power plant became the instructional tools for electrical and mechanical engineering departments.

Virginia Tech can achieve 100% renewable electricity through a combination of:

- Solar energy projects on campus building rooftops and VT lands. These can be VT owned or 3rd party owned with a VT power purchase agreement.
- Power purchase agreements (PPA) with utility or 3rd party-owned projects in Southwest Virginia
- Other PPAs or virtual PPAs.
- Appalachian Power increasing renewable portfolio, which is now 10% and by new state law must be 14% by 2025 and 30% by 2030.
- Renewable energy certificates (RECs) or purchased MWh credits from utility or 3rd parties.

Achieving 100% renewable electricity by 2030 assumes 60% VT owned or purchased renewable generation, plus 30% APCO renewable portfolio and 10% RECs to cover steam plant cogeneration. 60% generation requires 145 MW of solar capacity to serve campus (95 MW) and town customers (50 MW).

The pathways assume a combination of solar on VT buildings and land (15 MW), 3rd party owned PPA, and APCO owned SWVA PPA capacity (130 MW), for total 15 MW+130 MW = 145 MW. Capital costs of VT owned solar systems are assumed to be $2/W for <0.5 MW projects and $1.50/W for >1MW projects.

- Total capital cost for 15 MW on VT buildings/lands would be about $25-30 million.
- Total capital cost for 145 MW would be over $200 million.
- Best PPA contract rates on the market are 20-year, non-escalating ~7¢/kWh.

While utility/3rd party PPAs are assumed to be the preferred approach for off campus solar projects, on-campus projects can be either VT-owned or utility/3rd party owned with PPAs.

- The advantages of VT owned and managed renewable systems are greater control and possible greater long-term financial return; and disadvantages are high initial capital investment and ongoing operation/maintenance/decommissioning requirements.
- The advantages of PPAs are little or no initial capital costs and no operation/maintenance cost; and disadvantages are potentially higher electricity costs and less operational control.

Potential pathways (including timelines and different options):

2a. 2020: achieve 30% renewable electricity via purchase 20% renewable energy certificates (RECs) from APCO + APCO 10% renewable portfolio

2b. 2020-22: 2.35 MW on VT bldgs/land including "showcase" solar array perhaps on Old Southgate

- Option 1: VT finance and own: 2.3 MW @ $2/W=$4.6 million
- Option 2: 3rd party PPA: no upfront cost, pay per kWh; 25-year contract, 5 year buyback option
- Option 3: Sterrett 0.33 MW and 2nd building 0.67 MW through 3rd party PPA, learn from experience then VT finance and own remaining 1.3 MW ($2.6 million)

2c. Beginning 2021: Incorporate campus and region VT renewable electricity development by Virginia Tech Electric Service (VTES) into VT educational mission through **Climate Action Living Laboratory** with faculty, student, and staff instructional, research, and outreach opportunities.

2d. 2021: assess VT Fishburn Forest atop Price Mountain and other sites for cost-effective wind energy; engage students/faculty and partner with JMU to conduct a wind study.

2e. 2022-27: Continue to work with APCo to be a primary customer of their renewable capacity as they develop it to meet state requirements. APCO just completed an RfP solicitation for 250 MW of renewables in March and as this capacity is developed, VTES could contract for the output. Under the Virginia Clean Economy Act, APCO is required to achieve a 14% renewable portfolio by 2025, 20% by 2027, 30% by 2030, 65% by 2049, and 100% by 2050.

2f. 2022: VTES Solarize program to add 0.25 MW net-metered solar for town customers, doubling VTES current distributed capacity. Customers cover cost but VTES could facilitate/incentivize customers. RECs owned by customer, but VTES could buy their RECs.

2g. 2023: 0.5-1.0 MW community solar for VTES customers, possibly located on airport land off of Hubbard Dr. VTES would own RECs.

- Customers buy shares in 100 kWh blocks for $10/block (10¢/kWh) for 20 years.
- Production 500 kW = 500 kW*1,314 kWh/yr/kW = 670,000 kWh/yr (6,700 shares)
- Revenue = $67,000/yr * 20 yr = $1.34 million (present value = $1 million, 20 yr, 3%)
- Capital cost: 500 kW * $2/W = $1 million

2h. 2025: add 10 MW solar capacity on campus and on VT land in region in cooperation with APCo (still within 2027 contract). Use solar installations at Kentland Farm and Catawba Sustainability Center to study "agrivoltaics," or agricultural production on solar farms. 10 MW @ 6 ac/MW= 60 ac.

- Option 1: VT finance and own: 10 MW@ $1.50/W = $15 million
- Option 2: 3rd party PPA: no upfront cost, pay per kWh; 25-year contract, 5 year buyback option

2i. By 2027 (APCO contract renewal date), 50% renewable electricity via campus and VT land capacity (12 MW), APCo power purchase agreements (PPA) in southwest Virginia (including reclaimed mine land) (35 MW), APCo renewable portfolio (20%), and virtual PPA (VPPA) and/or RECs (10%) (e.g., 20% production (47 MW)) + 20% APCo portfolio + 10% purchased PPA/VPPA/RECs)

2j. By 2027 or earlier, add 10 MW **energy storage** to campus renewable capacity and use VTES as a testbed and showcase for innovative **VT Smart Grid** reliability and resilience research through a partnership between VTES and the VT ECE Power & Energy Center (PEC) using shared SCADA data and in collaboration with APCo for research and testing in real-life scenarios.

2k. By 2029 add 100 MW solar capacity via campus and VT land capacity (+3 MW, total 15 MW) and PPA with APCo and/or 3rd party in southwest Virginia (+95 MW, total 130 MW).

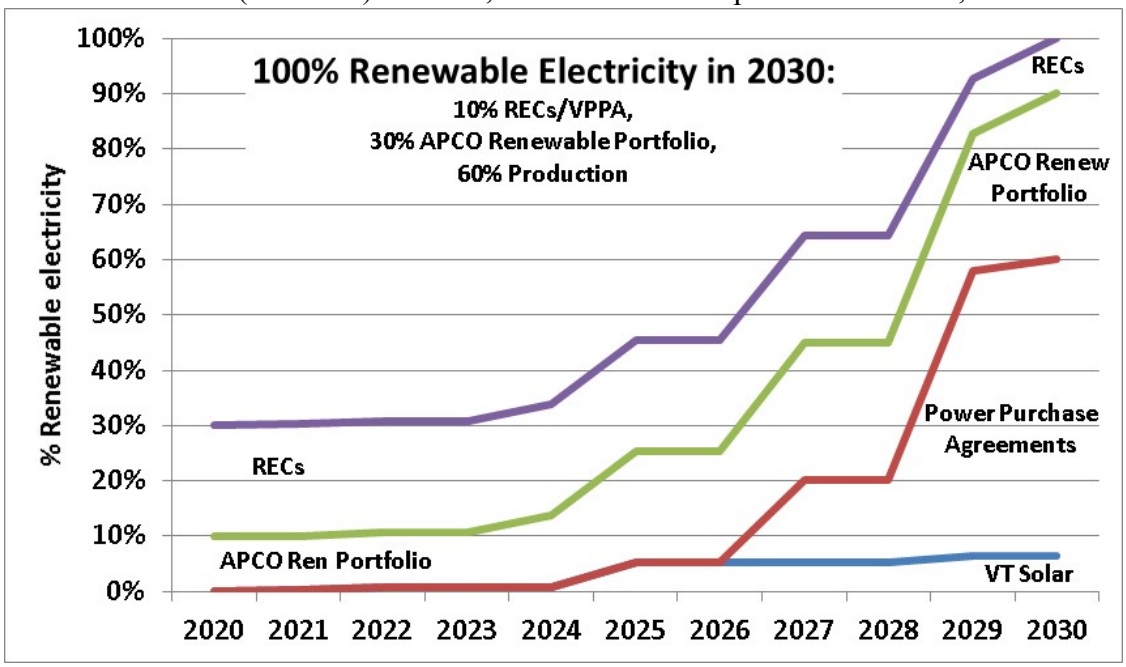
2l. By 2030, 100% renewable electricity with 60% renewable production (VT solar (15 MW) and APCo+3rd party PPA in southwest Virginia (130 MW), total 145 MW to serve campus (95 MW) and town customers (50 MW), 30% APCo renewable portfolio, and 10% VPPA and/or RECs

2m. As with all components of this CAC, full **lifecycle analysis** should include the environmental and social justice costs and benefits of procured systems, including sources and decommissioning of photovoltaic systems, requiring end-of-life recycling.

2n. Siting renewable energy systems should employ best practices of public engagement to identify most appropriate sites considering compatible uses and economic, environmental, social effects

2o. VT should **work closely with VDMME** (Virginia Department of Mines, Minerals, and Energy) to take advantage of state grant programs and compiance for agencies and universities in response to the Governor's Executive Order 43 and 2020 legislation

Figure 2.2. 100% Renewable Electricity by 2030. Shows pathway to 2030 with VT Solar on Campus (15 MW) + PPA in SWVA (130 MW) for 60%, APCO renewable portfolio for 30%, RECs for 10%



Goal 3. Complete the total conversion of steam plant fuel to natural gas by 2025, plan for a full transition to renewable steam plant fuel after 2025, and continue to improve the efficiency of campus energy systems

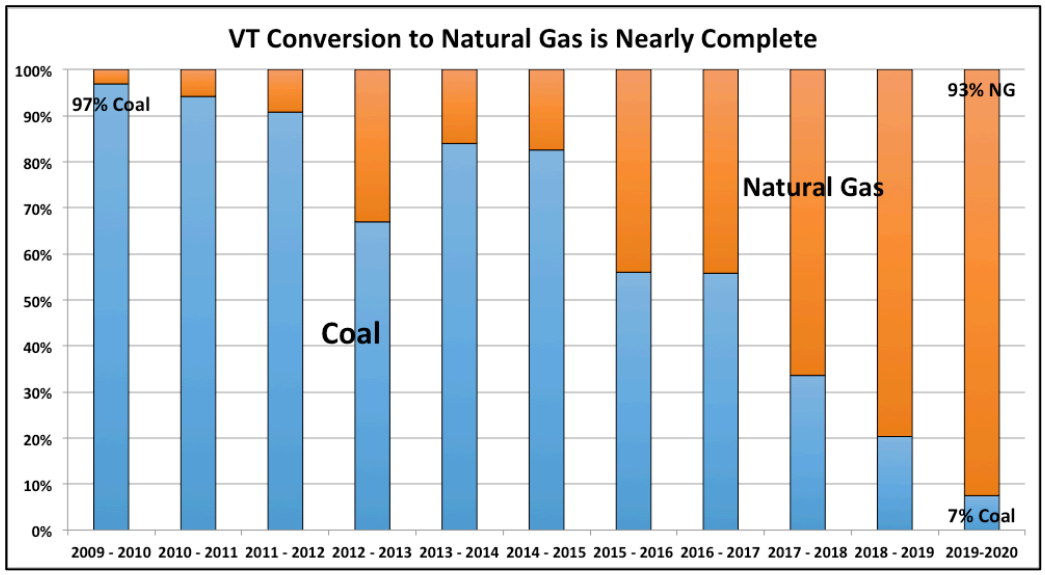
The **2015 natural gas pipeline** enabled the steam plant to drop from 97% reliance on coal fuel in 2009 to 7% in 2019. With the addition of gas boiler #12, we will have the natural gas thermal capacity to meet all steam plant demand.

For reliability and resilience in total conversion to natural gas, the steam plant will need:

- **Backup fuel** (such as liquefied natural gas (LNG), biochar, or other fuel) when natural gas is unavailable or the market is tight, and
- **Boiler redundancy** (so-called "n+1") in case of a boiler outage at a critical time. Converting a coal boiler to biochar or natural gas could provide this.
- Scheduled upgrades to the steam plant to provide resilience and reliability will incur necessary costs of doing business. Total conversion to natural gas reducing GHG emissions will be incorporated into those plans with limited increases in net costs.

VT's **natural gas service contract** will be renewed summer 2020 and the new contract will determine the conditions and need for backup, price terms, and possibility of some renewable gas.

Figure 2-3. Total conversion to natural gas in steam plant is nearly complete
From 2009-10 to 2019-20, natural gas from 3% to 93% of steam plant fuel



Potential pathways:

3a. Improve chiller efficiency:

- By 2023 the Chiller Plant Phase II project will reduce 2020 central chiller energy usage by 20%.
- The ten-year 2021-30 Energy Management Plan will improve efficiency of stand-alone chillers
- Future campus growth needs for chilled water will be met from central plants where possible.

3b. By 2022, develop a **plan for total conversion to natural gas while providing resilience backup fuel** in cold weather or interrupted natural gas supply. The backup fuel need will be affected by the terms of the 2020 natural gas contract. Options include:

- Liquefied natural gas (LNG) with storage at Old Southgate site where it can be tapped into the existing pipeline (cost ~$1 million) or better yet at the steam plant if coal storage and baghouse emission control can be removed.

- Renewable fuels, such as biogas and biochar, which is currently being applied to institutional uses in Virginia and Maryland.

3c. By 2022, develop a plan for **boiler n+1 resilience** backup, dependent on decision for back-up fuel

3d. Continue to explore **options for renewable gas** from service provider's contract as a means to reduce natural gas emissions and/or offset natural gas electricity from the steam plant cogeneration

3e. As part of the Climate Action Living Laboratory (CALL), engage faculty and students to develop an online **Energy Dashboard** for users to obtain and analyze energy use data for campus facilities

3f. Beginning with the CAC 2025 update, develop a **plan for full transition to renewable energy for campus heating systems**. To promote zero emissions energy options in the plan, refine GHG inventory estimates of methane leakage from VT natural gas sources and include those **estimates of methane leakage in the carbon neutral goal for 2035**.

- Explore geothermal and ground source heat pump systems and other non-fossil-fuel options for heating new districts of campus.
- New districts being considered on campus should evaluate hot water rather than steam heating systems. Understanding the extreme cost of extending steam tunnels, hot water systems sourced by the existing steam loop are already being explored for new districts.
- Conversion of steam to hot water central heating systems is being considered at other universities and offers the prospect of efficient geothermal and ground source heat pump heating and cooling systems in conjunction with renewable electricity.

Goal 4. Reduce Building Energy Consumption to Enable Carbon Neutrality By 2030

4.1. By the end of 2022 reduce electricity consumption (kWh) by 10% and electricity intensity (kWh/gsf) by 20% below 2006 levels

- This subgoal reflects the **Governor's E.O 43,** which requires that state agencies reduce their electricity consumption to10% below 2006 levels by 2022.
- From 2006 to 2019 the campus gross square feet (gsf) grew by 22% and electricity consumption grew by only 9% due to energy improvements, so electricity intensity (kWh/gsf) dropped by 14%
- To achieve this subgoal electricity consumption needs to be reduced by 15% from 2019 by the end of 2022, which will be a challenge. We are on track to achieve the electricity intensity subgoal.
- Means to achieve the 2022 subgoal include the current chiller upgrade (see Goal 3 pathway), this last year of the current 5-year energy plan, an aggressive start to the proposed 2021-30 energy plan, and energy conservation/demand response.

4.2. By 2030 employ energy management retrofit to reduce total energy consumption (Btu+kWh) in all buildings by 10% and EUI (Btu+kWh/gsf) by 20% below 2020.

- **All buildings** include campus academic (E&G) buildings (5.36 million ft^2), auxiliary buildings (e.g., dining and residence halls, athletics, 4.35 million ft^2), and off-campus buildings leased for VT operations (CAC geographic footprint includes 47 leased properties, 1.45 million ft^2, 70% owned by VT Foundation).

- Energy efficiency retrofits in the **2015-2020 Energy Management Plan** have reduced energy use in academic buildings financed with E&G funds. Other means of financing are needed for energy retrofits in auxiliary buildings and leased buildings.

Potential pathways:

4a. An **aggressive 2021-30 10-year energy management plan** updated annually can reduce total energy consumption in all buildings by 10% below 2020 levels. Auxiliary buildings need to be included, financed with internal funds or external energy performance contracting. Identified opportunities for 2021-30 energy management strategies include:
- Energy audits;
- Retrofit lighting, equipment replacement;
- Re-commissioning of lighting and mechanical systems;
- Optimizing chilled water plants,
- Studies and pilot projects for HVAC, lighting, and renewable energy; and
- Electricity demand management.

4b. For **buildings leased** for VT department use, special arrangements are needed to finance efficiency retrofits and reduce emissions. Most leased space is owned by the VT Foundation. The Foundation can invest in efficiency improvements in its buildings, and has indicated an interest in doing this on a revenue neutral basis, starting with a pilot program.

4c. Building energy and GHG emissions can be reduced by **smart operations**, such as demand response, digital controls, thermostat settings, occupant behavior, and innovative space scheduling especially in summer.

4d. As part of the **Climate Action Living Laboratory (CALL),**
- Engage faculty and students to develop an on-line **Energy Dashboard** for users to obtain and analyze energy use data for campus facilities. Dashboard kiosks in high-traffic individual buildings can raise campus awareness of energy and GHG emissions.
- By 2021, use a showcase and test-bed **Green Lab** to pilot a campus-wide Green Lab program to better design and manage research labs, our most energy-intensive buildings, with a goal of Green Lab certification of 80% of science and engineering labs by 2025.

4e. In addition to project funding, achieving these goals will require sufficient **staffing in energy management**.

Goal 5. Operations of new buildings initiated by 2030 will be Carbon Neutral

5.1 New building efficiency will conform to the latest adopted LEED-Silver standards and ASHRAE 90.1 energy performance standards + 10%

- The 2009/13 VT CAC called for new buildings to achieve LEED-Silver standard and exceed ASHRAE 90.1 energy performance standard by 10%. Since 2009, both LEED and ASHRAE standards have been upgraded significantly and far exceed their 2009 levels of efficiency. ASHRAE 90.1-2019 standards produce 37% energy savings compared to their 2004 standards.
- **ASHRAE standards are upgraded every three years and LEED standards have aligned themselves closely to ASHRAE standards over the years.** To be even considered for LEED v.4-Silver buildings must exceed ASHRAE by 5%; and to achieve half of the available energy

points, it must exceed it by 22%. Since LEED-Silver can be achieved without exceeding ASHRAE by more than 5%, our goal is to continue exceeding ASHRAE by 10%.

- Following **accepted industry-standards,** such as ASHRAE and LEED, align efficiency goals with building design and construction contracting, and ultimately improves implementation.
- ASHRAE also develops and upgrades a "stretch" standard 189.1, including guidelines for high performance green buildings, which can be used to inform VT design guidelines.

5.2 By 2022, reduce total energy use intensity (EUI) in newly initiated buildings by 20% compared to 2020 existing buildings.

- This interim sub-goal is intended to be applied as a benchmark for new building stock rather than a design tool for individual buildings. It can help **jump-start new-building energy analysis** and improvements. It will likely be easy to achieve, but the analytical exercise will be useful for Facilities staff training.
- Each project should determine the design EUI and then evaluate the actual EUI over time using metered data.

5.3 By 2026, build a signature zero-net-energy (ZNE) building on campus as a showcase and learning model.

- A **zero-net-energy (ZNE) building** has high energy efficiency and reduced annual consumption that can be supplied (offset) with site-produced renewable energy. Such a building still uses some conventional energy but balances that consumption with on-site net-metered solar electricity generation on an annual basis.
- A ZNE building on campus can serve as a **showcase for Virginia Tech leadership** and as an **educational model** for the Climate Action Living Laboratory. Virginia Tech has received international recognition for its ZNE design innovation through Solar Decathlon competitions.

5.4. By 2028, newly initiated building efficiency improvements will reduce total energy use intensity (EUI) in new buildings by 40% compared to 2020 existing buildings

- Like subgoal 5.2 this is intended to be a benchmark for new building stock rather than a design tool. Following continually revised **ASHRAE 90.1 and LEED-Silver** building energy standards, efficiency improvements can bring down total energy intensity in new construction by 40% by 2030 while providing necessary building performance.
- Each project should determine the design EUI and then evaluate the actual EUI over time using metered data.

Potential pathways:

5a. Electricity currently contributes 50% of total CO_2 emissions. 100% renewable electricity by 2030 will reduce new building CO_2 emissions by 50%.

5b. In 2020, identify candidate new building projects/needs for a **showcase ZNE building** and begin fundraising to attract donors to help fund the project.

5c. By 2030, all newly initiated construction will be **carbon neutral** through 100% renewable electricity, reduced energy consumption, on-site solar energy production, and carbon offsets..

5d. Capital budgets need to reflect these goals and incorporate the value of life-cycle energy and GHG savings.

5e. Post-occupancy evaluation (POE) should become standard practice to asses building operations to reduce energy & emissions, better serve users, and establish better thermal comfort set-points.

5f. As part of the **Climate Action Living Laboratory** new building budgets or supplements should include project design and operation elements, such as metering, that offer opportunities for research and instruction by faculty and students through use of emerging technologies, monitoring energy use, air quality, and occupant perceptions, and other projects.

5g. Achieving these goals will require sufficient **engineering and design staffing**.

Goal 6. Agricultural, forestry, and land use operations will be carbon neutral by 2030

Virginia Tech owns and manages **considerable land area** in the Blacksburg region and throughout the Commonwealth. In addition to main campus, VT owns and manages 3,500 acres of agricultural lands including the 1,950-acre Kentland Farm. In addition, there are about 1,300 acres of VT forested land in the area including the 1,150-acre Fishburn Forest on Price Mountain. The 377-acre Catawba Sustainability Center in Roanoke County is also part of our inventory.

Campus trees, including several old growth stands like Stadium Woods, play an important role in the campus environment with many benefits. Canopy cover is 16%.

Campus lands play an **historic and important part of the university**'s educational programs especially in agriculture and forestry, as well as the natural and physical sciences, engineering, and other disciplines. Incorporating these lands and operations in the Climate Action Commitment can enhance our Climate Action Living Laboratory.

Agricultural and forestry operations GHG emissions were not included in 2009/2013 CAC but are part of the 2020 VT CAC GHG inventory.

- In 2019 emissions totaled 11,297 MT CO_2e and came from animal enteric fermentation CH_4 (58%, 45% from dairy cows), manure management CH_4 (31%), land application of manure and fertilizer N_20 (6.5%), and equipment and vehicle fuel and electricity CO_2 (4.8%).
- Conservation tillage in VT cropland sequesters an estimated 1,271 MT and VT forested land has carbon sequestration benefit of 1,980 that is documented. Total net A/F/LU GHG emissions in 2019 are 8,046 MT CO_2e or about **3.3% of 2019 VT GHG emissions**.

Animal enteric fermentation emissions amount to 58% of total agriculture emissions and about 3% of total VT GHG. Animal scientists at Virginia Tech are investigating practices that reduce methane generation, such as increasing ruminant digestion efficiency by adjusting feed rations and provision of dietary additives that reduce metabolism of rumen CH_4-producing bacteria. Such scientific breakthroughs have the potential to reduce CH_4 emissions that currently comprise about 2% of VT GHG emissions.

Manure management CH_4 amounts to 31% of agricultural GHG emissions and 1.5% of total VT GHG. Two options for reducing GHG manure emissions that could be used in combination are composting and anaerobic digestion (AD) to produce usable methane.

- AD of VT livestock manure could produce about 200,000-220,000 m^3/year of CH_4 (7 billion Btu). If combusted for heat or a micro-turbine, this would offset the GHG emissions from the estimated 225,000 m^3 CH_4 from manure handling or 1.5% of VT GHG.

Composting would reduce GHG emissions not only from manure but also from campus dining hall and other compostable organic waste. The GHG reduction value of composting depends on its landscape application, from 0.036 to 4.58 $MTCO_2$ per MT compost. Based on an assumed reduction

of 0.42 MT CO_2e per MT of food composted, composting the current 550 MT of VT dining hall food waste would yield reduction of 230 MT CO_2e, 0.1% of VT GHG. If compost were applied to disturbed, marginal soils the estimated reduction could be as high as 1% of VT GHG.

Potential pathways:

6a. Develop the University Compost Facility at Kentland

Developing and operating the University Compost Facility at Kentland will provide significant benefits in management of campus organic wastes from dining halls, athletics, vet school, and campus tree trimmings. The Facility will also reduce net animal waste GHG emissions, support soil health, relieve the need to purchase new land for future land application of animal wastes, and support sustainable agriculture education and research. Capital cost is estimated at $1.8 million with net operating cost of about $200,000/year.

6b. Adopt a Campus Tree Policy to increase canopy cover from 16% to 25%

VT forest lands can be managed to increase carbon sequestration to offset some of the agricultural emissions. The current campus canopy cover of 16% can be increased to 25% through a Campus Tree Policy, which will also offer additional environmental and climate adaptation benefits.

6c. Reduce GHG emissions through ruminant research and improved efficiency of agricultural operations

- The source of most VT agriculture/forestry/land use emissions is animal enteric fermentation, especially from the dairy herd. Animal emissions of methane are a global problem, and animal science research can increase ruminant digestion efficiency via adjusting rations, additives that reduce metabolism of rumen CH_4-producing bacteria.
- Agricultural and forestry programs can reduce net GHG emissions through the compost facility and possibly anaerobic digestion with methane recovery, more efficient operations, improved energy and fuel efficiency, agrivoltaics solar production, and other means.

6d. Develop Solar Energy Projects on Virginia Tech Lands

- The 2020 VT CAC goal #2 is 100% renewable electricity by 2030 and it calls for at least 15 MW of solar capacity on Virginia Tech buildings and lands in the area. Land area on campus, Kentland Farm, Fishburn Forest, and Catawba Sustainability Center are prime candidates for solar development. 15 MW would require about 75-100 acres.
- Develop solar farms on VT agricultural land to provide "agrivoltaic" multiple use solar and usable grazing/cropland. These agrivoltaic farms would provide unique research and educational opportunities, part of the Climate Action Living Laboratory.

6e. Enhance Sustainable Agriculture Education in Climate Action Living Laboratory

- Expand climate sensitive and sustainable agriculture experiential education programs at Catawba Sustainability Center and Kentland's Homefield Farm
- The University Composting Facility at Kentland will provide a living learning laboratory for VT students and educational programming for waste management and composting professionals from Virginia and nearby states.

6f. In 2030, negate remaining net GHG emissions from agricultural/forestry operations

- In order to achieve zero net GHG emissions by 2030, credits developed by the agriculture and forestry sectors via solar agrivoltaic adoption, energy generated from anaerobic digestion of manure and other wastes, and C sequestration may need to be supplemented by purchasing carbon offsets.

Goal 7. Virginia Tech to become a Zero Waste Campus by 2030

As defined by industry, a **"Zero Waste Campus" has a 90% or greater Waste Diversion Rate** or waste kept out of landfills.

7.1. Increase waste diverted from landfill--including construction waste--to 85% by 2025

For CY 2019, Virginia Tech achieved an 80% waste diversion rate. For the past decade the rate has averaged 70%, with a low of 47% (2016), and a high of 84% (2011, 2012). The waste diversion rate includes recycled/reused construction waste from new construction and major renovations. In a robust construction year, the waste diversion rate will increase significantly. The university owned Quarry is currently producing about 1,000 to 2,000 tons/month of Hokie Stone scrap material or overburden, which is crushed into useful gravel and can be included in diverted waste.

7.2. Increase waste recycling rate to 55% by 2025

For Calendar Year (CY) 2019, Virginia Tech achieved a 39% recycle rate. The recycling rate has remained relatively constant at or near 40% for the past decade.
For CY 2019, Virginia Tech recycled a total of 2,000 tons of principal recyclable materials:

- 750 tons sent to MRSWA at a cost of $25,875 ($34.50 per ton) plus contractor cost for storage containers and collection and transport fees; and
- 566 tons of food waste for composting sent to ROF and of waste cooking oil collected on campus by Valley Protein, at a cost of $84,900 ($150 per ton) plus contractor cost for collection and transport of food waste to the ROF sledge container at Prices Fork Closed Landfill.
- 684 tons sent to a number of other organizations with varying costs

7.3. Reduce waste to landfill per capita by 25% by 2025

For CY 2019, Virginia Tech sent 4,000 tons of municipal solid waste through MRSWA to the NRRA local landfill or 0.1 tons or 200 pounds per capita (students + faculty + staff = 40,000). Goal 7.3 is 150 lb/capita by 2025. The 2019 trash disposal cost was $218,000 ($54.50 per ton) plus contractor cost for storage containers and collection and transport fees.

Pathways to Goals:

7a. To enhance campus waste management, **hire a zero-waste consultant** to conduct a waste audit study and plan to evaluate current organization, equipment, procedures, and staffing.

- A third-party zero-waste consultant is critically needed to objectively evaluate waste operations for E&G facilities, auxiliaries, and the athletic department to identify opportunities to streamline operations, maximize efficiencies, reduce costs, and recommend measures to achieve zero waste.

7b. Improve Oversight of Waste/Recycling/Compost

- Based on consultant recommendations, improve organization of waste management with one option being the **hiring of a waste manager** to manage all aspects of campus waste management and forming a Waste/Recycling Council of existing program personnel to coordinate waste management activities to help streamline operations and reduce redundancies.

7c. Develop University Compost Facility at Kentland to process campus organic food waste, veterinary and agricultural animal waste, yard trimmings and other compostables.

- For CY 2019, 566 tons of food waste for composting was sent from our 11 dining facilities to Royal Oak Farm (ROF) at a cost of $150 per ton. ROF is the nearest DEQ permitted composting facility. The university continues to produce 600 tons of food waste for composting.
- A University Compost Facility at Kentland would provide composting of not only dining hall waste but also other campus organic wastes from athletics, the vet school, residence halls, and campus tree and brush trimmings, and ultimately community organic waste. The capital cost of the facility is estimated at $1.4-1.8 million with net operating cost of $165,000 per year.

7d. Engage faculty, students, and staff in the Climate Action Living Laboratory to promote Pollution Prevention (P2) concepts of reduce/reuse/recycle to achieve principles of Circular Economy. Include P2 and Circular Economy activities in Sustainability Internships, learning living centers, student orientation programs, and recycling/composting programs.

7e. Promote **greater adoption of recycling, composting, and other best practices in waste management** through effective social marketing, social media, incentives, and innovative approaches. Include CAC sustainable choices Goal 12 pathways including web-based and smart-phone apps, student clubs, roundtables, 1st year experience app, and campaigns for Y-toss, green tailgating, and related programs.

7f. Evaluate and improve as needed management of specialty wastes, such as e-waste, construction debris, laboratory waste, and wastes from major sporting and other events.

- By 2021, use a showcase and test-bed **Green Lab** to pilot a campus-wide Green Lab program to better design and manage waste materials in research labs (see Goal 4 pathways).
- Expand programs for **reuse of materials**, such as Surplus, Hokie-Swap, Y-Toss
- Expand programs for Green Tailgating and related Athletics recycling/compost initiatives

Goal 8. Establish the Sustainability Procurement Policy and Procedures by 2022

In April 2020, the Virginia Tech Procurement Department developed a **Sustainable Procurement Policy** that aims "to make procurement decisions that embody the university's commitment to sustainability whenever possible." The Policy reflected the elements of the 2009/2013 VT Climate Action Commitment and Sustainability Plan. This Policy is a significant development by the University in procurement to reflect sustainability principles.

Because the 2009/2013 CAC and plan will be superseded by the 2020 VT CAC, we recommend the new Policy be piloted for two years and then be evaluated by the Energy & Sustainability Committee in 2022 for its conformance with the adopted 2020 VT CAC.

Potential Pathway:

8a. On a pilot basis, adopt, implement, and evaluate the 2020 Sustainable Procurement Policy for two years

8b. In 2022, the Energy & Sustainability Committee will assess the pilot project and work with the Procurement Department to formulate the Sustainability Procurement Policy.

Goal 9. Reduce Single-Occupancy Vehicle Commuting To Campus by 20% by 2025 and Reduce Transportation-Related GHG Emissions by 40% by 2030

Virginia Tech transportation-related GHG emissions for 2020 VT CAC include:

- Scope 1 GHG: fuel for fleet vehicles and other campus vehicles, aviation fuel for VT airplanes
- Scope 3 GHG: student, faculty, and staff commuting to campus; Blacksburg Transit (BT) fuel, and business air travel

The 2009 VT CAC&SP did not include BT or business air travel. 2019 transportation GHG emissions under that more limited scope were about 20,000 MT CO_2e, or 8.4% of total VT emissions. About 80% of transportation's share of emissions were from commuting, 13% from fleet vehicles, and 7% from aviation fuel.

The 2020 CAC addition of Blacksburg Transit fuel adds 3515 MT CO_2e or 1.4% of total VT emissions and business air travel adds 5000-7500 MT CO_2e or 2-3%. **Overall, transportation will account for about 12% of total VT emissions in 2020, under the expanded scope.**

Since the 2009 VT CAC&SP, Virginia Tech and the Town of Blacksburg have made considerable progress in developing alternative transportation choices, including:

- 50% increase in Blacksburg Transit ridership,
- BT has 9 hybrid-electric buses of its 53-bus fleet; BT has also ordered 5 electric buses
- 32% increase in campus bike racks (since 2013),
- 20 miles of campus shared-use paths,
- Roam NRV bike-share (since 2018 11,000 trips, 28,000 miles).
- Shuttles and bus service to Roanoke and Northern Virginia,
- Car- and ride-share programs, and
- Recognition by Best Workplaces for Commuters every year since 2009 (Best of the Best in 2014) and as a Bicycle Friendly University at bronze level 2012-18 and silver in 2019.

The 2016 Transportation Master Plan calls for further improvements in bike infrastructure and parking management, and the Beyond Boundaries 2047 Campus Plan includes the Infinite Loop to improve mobility and Green Links pedestrian-friendly routes.

However, there are also negative trends:

- Single occupancy vehicle (SOV) commuting increased by 10% from 2014 to 2018,
- There is an oversupply of parking (2000 spaces sit empty on any given day),
- Parking permit prices are cheap and provide no incentive for alternative commuting,
- Student orientation or employee onboarding don't include education on transportation options,
- VT is one of only a few universities that allow freshman to bring cars to campus, and
- University motor pool vehicles do not use alternative fuels.

Guiding principles in developing goals and pathways:

- Prioritize moving the most people over moving the most cars
- Emphasize safety
- Consider equity issues
- Emphasize collaboration with Town of Blacksburg
- Develop cost-effective solutions

Potential Pathways to achieving Transportation goals:

9a. Make walking/biking/transit the preferred means of commuting to campus

Use parking policies, alternative transportation programs, campus mobility planning in collaboration with Town of Blacksburg, and Blacksburg Transit (BT) programs to promote and improve the safety and convenience of walking/biking/transit as the preferred means of commuting to campus.

- In 2020, provide **better data** on student and staff commuting behavior and reasons for that behavior through surveys and other means to monitor progress.
- **Promote sustainable mobility choice through good social marketing** including social media, parking permit literature, university promotion literature/website, student orientation materials, and other means.
- **Follow other Virginia universities in restricting freshman vehicles** on campus to help students develop less car-dependent culture and behavior.
- **Enhance Blacksburg Transit** as a commuting choice through education, marketing, coordinating with other transit, development of the Multi-Modal facility, and other means.
- Upgrade VT's **Bike Friendly University from silver rating to gold**.
- **Parking demand management:**
  - Increase parking permit prices. For employees, implement on a sliding income-scale. Use additional revenue to fund sustainable transportation improvements.
  - Consider moving away from annual and toward automated daily fee parking permits so people have to think about paying for parking every time they drive to campus

9b. Promote non-commuting work and learning opportunities

- Based on experiences during the Covid-19 pandemic shutdown, promote teleworking, innovative online instruction, video conferencing, compressed workweek schedules, and other means to reduce travel demand.
- Work with Human Resources to identify opportunities and barriers to increasing teleworking.

9c. Improve infrastructure and traffic controls to improve mobility choices and safety

- Improve safety of vehicle, bicycle and pedestrian mobility on campus
  - Reduce the speed limit on all core campus streets to 15 miles per hour.
  - Improve lighting on walking and bicycle paths
  - Limit/restrict vehicles in the core of campus by gating streets at strategic locations (Drillfield Drive, Alumni Mall, Kent Street, West Campus Drive, and Stanger Street).
- Implement infrastructure recommendations in the Parking & Transportation Master Plan and Beyond Boundaries 2047: The Campus Plan.
  - Infinite Loop, Green Links, Expand Bike Lanes on Kent Street and Washington Street
  - Multi-modal Facility
- Coordinate with Town of Blacksburg transportation and corridor plans to improve connectivity between campus and town.

9d. Improve vehicle efficiency and promote low-carbon emissions vehicles

- Require University fleet vehicle purchases and encourage Blacksburg Transit to emphasize fuel efficiency, through zero-emission, hybrid, and electric vehicles.
- Although transportation emissions per vehicle-mile will naturally decline with improved vehicle efficiency and increased electric vehicle ownership, changes in commuting mode are necessary to achieve GHG reduction goals and a more livable and less car-oriented campus.
- Support electric vehicle use by installing a mix of charging station types in parking garages, at Fleet Services, and at other locations.

9e. Promote social equity in mobility and parking policy

- Develop effective and efficient commuting options for lower-wage employees who cannot afford to live in Blacksburg, including vanpools, park & ride, and other means.
- Implement sliding income-scale pricing for parking permits.
- Collaborate with the Town to provide affordable workforce housing proximate to campus.
- Build more residence halls on campus to free up more off-campus housing for staff.

9f. Reduce and negate business travel GHG emissions

- Encourage car sharing and transit use for business travel.
- By 2030, negate business airline travel emission with carbon offsets.

9g. Establish an Alternative Mobility Subcommittee of the Transportation and Parking Committee to recommend strategies to increase non-SOV mode share on campus.

Goal 10. Integrate the CAC into Virginia Tech's Educational Mission through the Climate Action Living Laboratory (CALL) beginning in 2021

The 2009/2013 VT Climate Action Commitment and Sustainability Plan highlighted sustainability related academic programs in goal #9. And Virginia Tech has scored well in the academic categories in AASHE's STARS rating system, scoring 90% of available points for undergraduate, graduate and research programs.

Since the 2009 VTCAC&SP, the Sustainability Office has implemented the Sustainability Internship program, whose interns work on campus projects and studies, and the Green RfP program for student initiated sustainability projects on campus, which the University Budget & Finance Office has funded with $1 million over ten years.

Although climate action and sustainability are addressed well in several academic departments, few of them rely on the campus as a learning laboratory. The VT 2020 CAC goals and pathways offer great **opportunities for student learning, faculty and student technical research, and staff development**. Benefits include learning from and innovating creative solutions in-house for VT's climate initiatives and better engaging the entire university both in Blacksburg and other Virginia Tech locations in our quest for sustainable climate action.

Potential Pathways:

10a. Establish the **Climate Action Living Laboratory (CALL)** in the new University Office for Climate Action & Sustainability (OCAS) (see Goal 13) to enhance offerings and build bridges between facilities and academic departments, facilitating and supporting opportunities.

10b. Alter norms and incentives to overcome traditional barriers and nurture cooperation between academic units (research and teaching) and operations units like Facilities and auxiliary units like dining and residence and athletics. **Greater collaboration** between university units will support the implementation of the CAC and integrate physical plant climate action with academics and campus life.

10c. Implement **Climate Action Living Laboratory** initiatives in other goals/pathways:

- **Goal 2: Renewables -** Incorporate campus and region VT **renewable electricity development** by Virginia Tech Electric Service (VTES) into VT educational mission through Virginia Tech

Living Learning Campus with faculty, student, and staff instructional, research, and outreach opportunities.

- **Goal 3: Energy -** Engage faculty and students to work with staff to develop an online **Energy Dashboard** for users to obtain and analyze energy use data for campus facilities
- **Goals 4, 5: Buildings -** As part of the **Campus Living Learning Laboratory:**
  - Provide building energy/emissions/solar production data through **energy dashboard kiosks** in high-traffic buildings to raise campus awareness of climate action.
  - By 2021, use a showcase and test-bed **Green Lab** to pilot a campus-wide Green Lab program as part of the national movement to better design and manage research labs, our most energy-intensive buildings.
- **Goal 6: Agriculture/Forestry/Land Use -** Sustainable Agriculture Educational Programs
  - Expand climate sensitive and sustainable agriculture experiential education programs at Catawba Sustainability Center and Kentland's Homefield Farm
  - The University Composting Facility at Kentland will provide a living learning laboratory for VT students and educational programming for waste management and composting professionals from Virginia and nearby states.
- **Goal 7: Waste/Recycling/Compost -** Engage faculty, students, and staff to promote Pollution Prevention (P2) concepts of reduce/reuse/recycle to achieve principles of Circular Economy, including activities in Sustainability Internships, living learning centers, student orientation programs, and recycling/composting programs.
- **Goal 11, 12, 13: Climate Justice, Sustainable Choices, and Community Engagement -** Engage faculty and students in social science studies and research related to sustainable behavior, justice issues, and involving the campus community in climate action.

10e. The university's **land grant Extension and Outreach programs** must also be engaged to reflect the principles of the CAC and help implement them throughout the Commonwealth.

10f. Integrating the physical infrastructure elements of the CAC into the fabric of the university's educational and research programs offers **funding opportunities for campus innovation** from foundation and state and federal sources.

Goal 11. Establish climate justice as a core value of the Climate Action Commitment

- Harlan, et al. (2015) **defines climate justice** in four parts:
  - Sharing benefits and burdens of climate action equitably
  - Engaging marginalized groups as participants in the climate action process
  - Maximizing opportunities in climate action for marginalized groups to survive and thrive
  - Repairing historic harms against marginalized groups in developing climate action
- The Governor's 2019 **E.O. 43 and the 2020 Clean Economy Act** require clean energy and climate goals be achieved in a just manner that advances energy- and social-equity and environmental justice.

Potential Pathways:

11a. Encourage an **accelerated transition to carbon-neutral** status as a climate-justice imperative.
- Assess the viability of renewable energy sources, such as geothermal, solar, and wind, for heating and cooling new buildings constructed on Virginia Tech's campus.
- Seek opportunities to transition the steam plant's primary fuel source away from natural gas to renewable energy sources.

11b. Ensure that the **social impacts** of Virginia Tech's climate mitigation choices (e.g. energy, land use, and waste) are identified and addressed to the greatest extent possible.
- Consider the lifecycle impacts of all renewable energy procured systems to ensure they are sourced ethically and sustainably, manufactured with high standards for worker safety, and include a decommissioning plan for responsible, end-of-useful-life recycling.
- For example, solar photovoltaic manufacturers should receive a score of 80 or higher on the Silicon Valley Toxics Coalition's annual Solar Scorecard.(http://www.solarscorecard.com/)

11c. By 2021 establish a **Climate Justice Subcommittee** to the revised Climate Action, Sustainability, and Energy (CASE) Committee with representation from students, faculty, staff, and community members possibly from frontline groups.

11d. Ensure that VT **climate action strategies recognize and assist vulnerable** and frontline groups adversely affected by those plans
- Groups potentially affected by VT CAC plans include low-wage VT employees, tuition-paying students, VTES town-resident customers, historically marginalized people of color and Indigenous communities, coalfield communities, and others.
  - Low-wage employees who cannot afford to live in Blacksburg should have access to affordable commuting options with low climate impact and local work-force housing.
  - VT CAC implementation should identify ways to mitigate potential increases in electricity costs for low-income VTES town customers and increases in tuition and fees for low-income students, should such increases result from the University's climate-action commitment.
  - VT CAC renewable energy development should work with coalfield communities to establish locations for utility- or 3rd party owned solar farms for VT power purchase agreements.
- Establish education, research, and outreach **programs to assist vulnerable and historically marginalized groups** in their efforts to mitigate and adapt to climate change and thrive in the new energy economy. These efforts should specifically target Virginia Tribes, African Americans in the New River Valley, coalfield communities in southwest Virginia, and coastal Virginia communities threatened by climate-related hazards.

Goal 12. Diminish Barriers to Sustainable Behaviors through Institutional Change, Education and Social Marketing

Most of the goals of this Climate Action Commitment deal with physical strategies for improving the efficiency of buildings and energy systems, replacing coal, adding renewable energy, building a compost system and mobility infrastructure. But becoming carbon neutral also depends on what people do, how much they recycle and compost, turn off the lights, bike to campus instead of drive, make choices that reduce GHG emissions. The extent to which our students, faculty and staff make sustainable choices that define our culture will say more about who we are and our commitment to climate action than the physical changes we make.

We intentionally include in our CAC GHG emissions inventory, against which we have set the carbon neutral by 2030 goal, those scope 3 sources that relate to people's behaviors: waste and water, commuting, and business travel. Sustainable choices are about structuring institutions and infrastructure to facilitate sustainable individual behaviors. By leveraging structural changes, incentives, disincentives, educational programs, and games and other innovative tools, these choices can and must be made much easier, cheaper, safer, and more enjoyable. The sustainable choices goal and pathways focus on how university units can 'nudge' community members towards adopting behaviors that will reduce our greenhouse gas emissions and create a more sustainable campus culture.

Potential Pathways:

12a. Identify structural, social and institutional barriers to sustainable behaviors

12b. Implement infrastructural changes—from waste management to transportation to building operation—to make sustainable choices easier

12c. Develop **educational programs** to foster pro-environmental behavior change
- Educate first-year students about sustainability and sustainable choices, beginning with campus tours and orientation and continuing through First Year Experience
- Find innovative ways to include learning-based opportunities for student climate action, awareness, and engagement.
- Support creative ways to integrate behavior change with research and educational programming, working through the proposed Climate Action Living Laboratory (CALL)

12d. Design and implement choice architecture or "nudges" to promote sustainable behavior, while allowing for individual choice

12e. Develop a shared toolkit of best practices in social marketing, rooted in behavioral sciences, for campus groups initiating sustainability initiatives

12f. Nurture cross-campus partnerships to coordinate climate action and enhance sustainability initiatives
- Create a structuring sustainable choices subcommittee of the new Climate Action, Energy, and Sustainability (CASE) committee (currently E&SC)
- Partner with Experience VT and Sustainability Managers to integrate sustainability into the new Experience VT app.
- Craft an ongoing university survey that enables university departments to submit their own university sustainability goals, aspirations, and current infrastructure challenges that may prevent their goals/aspirations from being achieved.

Goal 13. Implement the VT Climate Action Commitment

- **at a high level of university administration and governance;**
- **by integrating CAC goals for facilities, education, and campus culture;**
- **with stakeholder engagement for evaluation of goals and progress.**

Over the past decade, commitments at both the policy and operational levels have led to substantial progress on climate action and sustainability. However, the comprehensive nature of the VT 2020 CAC necessitates a broader approach than current policy and governance arrangements allow. Currently, the Office of Sustainability (OS) in the Division of Campus Planning, Infrastructure, and Facilities (DCPIF) has primary responsibility for injecting sustainability principles into operations and the Energy & Sustainability Committee (E&SC) is the primary governance unit responsible for proposing policy changes in the areas of environment, energy, and sustainability.

Both are positioned in the Facilities world, with the OS reporting to the Chief of Staff to the Chief Facilities Officer and the E&SC reporting to the Commission on University Support (CUS). Facilities continues to be a critical component of the VT 2020 CAC; goals 1-5, 7, 9 &15 are the most important actions proposed to reduce VT's GHG emissions and are all dependent on initiatives to be taken by Facilities departments. The DCPIF must play a critical role in CAC implementation.

However, the 2020 CAC goals go farther than the physical plant to address the university's educational mission, campus culture, social equity and justice, and engagement of all university departments, faculty, staff and students. Both the OS and the E&SC units have, in practice, engaged broader perspectives than Facilities; for example, with a limited staff the OS has operated effective student internship and student-initiated Green RfP programs, and the E&SC has a diverse membership of faculty, students, and Facilities staff. However, efforts to elevate sustainability, energy, and climate planning must be truly university-wide if the ambitious 2020 CAC goals are to be met.

This goal and the pathways laid out below suggest operational and governance structures that can elevate the university's commitment and better reflect the comprehensive nature of the 2020 CAC.

Potential Pathways:

13a. *Governance*: Restructure the Energy and Sustainability Committee (E&SC)

- Rename the E&SC the **Climate Action, Sustainability, and Energy (CASE) Committee**
- Revise the **reporting lines** of the CASE committee to include, in addition to the Commission on University Support (CUS), relevant commissions for student life, academics, faculty and staff.
- Modify the **membership** of the new CASE committee to include additional representation of the DPCPIF, the Provost's Office, Student Affairs, student life, student environmental organizations, and vulnerable frontline communities.
- Create **CASE subcommittees** (SC) that may include: CAC Implementation SC, GHG Inventory SC, Climate Action Living Laboratory (CALL) SC, Climate Justice SC, Engagement & Sustainable Choices SC, Education & Student Involvement SC, Town-Gown Sustainability SC. Subcommittees may include participation beyond formal CASE membership.
- Modify the existing **charge of the committee** to:

  "To review and provide guidance to all facets of University Administration on implementation opportunities relating to the university's Climate Action Commitment and the pursuit of environmental quality and social sustainability, through policy, infrastructural and operational changes, education, and broad engagement."

- During fall 2020, develop a formal proposal for the CASE committee through an ad hoc subcommittee of the current E&SC. The subcommittee may include some non-E&SC members involved in the VT CAC Working Group update process. The proposal developed should include a revised charge, membership, subcommittees, and reporting lines. It should be completed by December 2020 with the transition from the E&SC committee to the CASE committee occurring in fall 2021.

13b. ***Implementation/Operations*****:** Consider new options for the direction, responsibilities, staffing, location, and reporting lines of the operational **unit charged with implementing the CAC.**

- **Restructure the OS as a university wide unit,** renamed the **University Office for Climate Action and Sustainability (OCAS).** The OCAS would have primary responsibility for CAC implementation, with strong connections to Facilities units as well as to related activities in academics (including the goal 10's Climate Action Living Laboratory addressed below), student life and student affairs, and other units.
- Appoint a new University **Chief Climate Action and Sustainability Officer (CCASO)**. The CCASO would direct OCAS and chair the CASE Committee. The CCASO would report jointly to the Senior Vice President and Chief Business Officer and the Executive Vice President and Provost.
- In order to support the CCASO with CAC implementation in Facilities, a new director position would be created in the Division of Campus Planning, Infrastructure, and Facilities (DCPIF), who would oversee strategic facilities initiatives including climate action and sustainability.

13c. ***Learning:*** The 2020 CAC update process has strengthened relationships between employees in operational university units (including facilities, student life, and elsewhere), Town of Blacksburg and other local partners, and faculty and students on the 'academic side'. The next steps include:

- Increasing educational initiatives and research opportunities in the areas of climate, sustainability, and energy using CAC projects to test new technologies and ideas and provide students with invaluable hands-on learning opportunities.
- To this end, CAC Goal 10 recommends the creation of a **Climate Action Living Laboratory (CALL)** as a unit that can enhance offerings and build bridges between facilities and academic departments, facilitating and supporting opportunities. The CALL should be situated under the reorganized OCAS.

13d. ***Annual Review:*** Conduct an annual review of the CAC goals and implementation progress through a process that involves student, staff, faculty, and community stakeholders. The annual review process should include the following features:

- The GHG Inventory Subcommittee of the revised CASE Committee will be responsible for leading annual audits of the university's emissions portfolio.
- The results of this review will be shared publicly in accessible and easy-to-read formats, including through social media.
- There will be opportunities for stakeholders to critique and provide feedback, potentially through both a yearly community survey and yearly CASE Town Hall.

13d. Duties of Operations and Governance units:

- Collect data relevant to the CAC including GHG inventory and prepare an Annual Report of CAC Progress each fall semester for the previous fiscal year.
- Establish mechanisms to engage and educate the Virginia Tech community on the CAC and climate action

- Establish ad hoc committees to develop instructional, research and outreach programming for the Climate Action Living Laboratory (CALL)
- Evaluate CAC goals according to best practices in light of new information and standards and direct update of the CAC on a five-year cycle
- Broaden the geographic scope of the CAC to all Virginia Tech properties in future iterations to include the entire University
- Advocate for allocation and prioritization of resources to support the CAC

Goal 14. Develop innovative budgeting and financing mechanisms to generate funding and staffing to achieve Climate Action Commitment goals

Achieving the Climate Action Commitment will require financial and staffing resources. With limited resources especially as a result of the Covid-19 pandemic, CAC financial needs will be in competition with other needs and priorities of the university, including safety and security, academic excellence, quality student experience, affordable tuition and fees, and competitive faculty salaries.

Academic (E&G) funds may be used to fund projects to improve existing academic building efficiency. More creative funding mechanisms can address energy efficiency needs in auxiliary buildings not included in E&G funded efficiency improvements. Energy Performance Contracting through Virginia DMME may be an effective financing vehicle for these buildings. Also, these auxiliaries may have some bonding authority to generate investment funds for efficiency improvements. Savings in utility bills can repay capital and financing costs.

New building energy efficiency continues to be challenged by the separation of capital design/construction budgets and operating budgets. To advance life cycle cost analysis, future operating costs need to considered to justify upfront investment in efficiency.

Many VT operations are located in leased space in Blacksburg owned by the VT Foundation or others. We have included most of this space (1.45 million ft^2 in 45 properties, 13% of total VT space, about 70% Foundation owned) in our GHG emissions calculations. The university cannot directly reduce these emissions because it does not own the buildings. But the Foundation can improve the efficiency of its buildings that house VT operations. Lease terms could be revenue neutral for the Foundation in that the lease agreements cover the Foundation financing costs. The university pays the utility bills.

Potential Pathways:

14a. Strategically **invest university E&G and Auxiliary funds to implement the 10-year Energy Management Plan** targeting academic and auxiliary buildings at a level of $5 million/year in energy efficiency projects with a cumulative 8-year financial payback.

- The 2015-2020 Five-year Energy Management Plan invested nearly $3 million/year of academic (E&G) funds that resulted in efficiency improvements that averaged about a 5-year payback with energy cost savings. More creative funding mechanisms can address energy efficiency needs in auxiliary buildings (e.g., residence halls, dining halls, athletics). These buildings account for 45% for campus gross square footage.

14b. Major investment is needed to implement the **pathways for renewable electricity** both on VT buildings/lands and in the SWVA region. Options for development include:

1. **VT owned** and developed projects on VT buildings/land, and
2. **Utility or 3rd party owned** and developed projects on VT buildings/land and in SWVA with VT power purchase agreement (PPA).

Option (1) provides major VT capital investment but greater long-term return and control, while option (2) requires no VT capital but less long-term financial return. A combination of the two options may be necessary to meet the CAC renewables goals.

14c. The **Virginia Tech Foundation** helps the university achieve its goals and can be a valuable partner in adopting and implementing the CAC in the following ways:

- The VT Foundation should assess efficiency opportunities in its properties **leased to VT operations** and invest in cost-effective energy efficiency measures in these properties, lowering university utility bills to offset increased lease cost to finance improvements.
- The VT Foundation should **invest in projects to implement the VT CAC** that provide a return to the Foundation. These may include solar projects on Foundation buildings, and/or solar projects on VT or Foundation-owned land.
- As the university moves toward carbon neutrality and the economy turns toward clean energy, the VT Foundation should assess the **fiduciary risk associated with its investment in fossil-fuel-reliant industries** as part of its portfolio.
- The Foundation should broaden its investments to achieve **triple-bottom-line goals (financial, social, environmental)**. It is noteworthy that the CAC Working Group vigorously debated the issue of Foundation divestment from fossil fuels and different opinions are held among group members and the wider university community. However, consensus was reached among the WG on the need to strongly consider triple bottom line values in investment and other decisions.

14d. As a unique **power utility, VTES** has opportunities, in partnership with APCO and 3rd parties, for investment in renewable energy projects in serve both campus and its town customers.

14e. Additional sources of funds to implement the CAC should be pursued,

- **Federal and state grants and research funding** for the Climate Action Living Laboratory
- **Development donor funds** are also a potential source for some of the initiatives and projects needed to implement the CAC. Naming rights for a signature Zero-Net-Energy (ZNE) building or a showcase solar farm at entry to campus are up for grabs.
- **State funding** is also available for university project development. Virginia Department of Mines, Minerals and Energy (DMME) has a cost-sharing solar development fund to cover half the costs of the Sterrett rooftop solar project and possibly other projects.
- Funding from **foundation and philanthropic organizations** can support implementation of the CAC especially elements related to innovation and academic programs.

14f. In addition to project funding, implementation of the CAC needs to **upgrade staff** to rise to the needs of the commitment, especially in energy management, energy and utility systems, building analysis and design, waste management, University compost facility operation, and campus sustainability.

Goal 15. Develop Pathways after 2030 to eliminate offsets and fossil fuels by 2050

It is difficult to anticipate how **changing technology, the economy, and public policy** will evolve in the next 10-30 years. Super-efficient and inexpensive solar technology and energy storage, autonomous electric vehicles, smart buildings and controls, and enhanced communications are likely, and they will change our conception of what is possible. Public policies such as a carbon fee or tax, efficiency mandates, and funding incentives are also likely to change the economics of choices we have.

Potential Pathways:

15a. A long-term and continually updated **Utilities Master Plan** should incorporate the goals of this Climate Action Commitment.

15b. Use the 5-year VT CAC update process to assess **changing technology, the economy, and public policy** related to climate action.

- **2025: 5-year CAC revision** review explore options for 2030-2040 timeframe
- **2030: 5-year CAC revision** review explore options for 2040-2050 timeframe

15c. Beginning with the CAC 2025 revision, develop a **plan for full transition to renewable energy for campus heating systems**. To promote zero emissions energy options in the plan, refine GHG inventory estimates of methane leakage from VT natural gas sources and include those **estimates of methane leakage in the carbon neutral goal for 2035**.

- Explore geothermal and ground source heat pump systems and other non-fossil-fuel options for heating new districts of campus.
- New districts being considered on campus should evaluate hot water rather than steam heating systems. Understanding the extreme cost of extending steam tunnels, hot water systems sourced by the existing steam loop are already being explored for new districts.
- Conversion of steam to hot water central heating systems is being considered at other universities and offers the prospect of efficient geothermal and ground source heat pump heating and cooling systems in conjunction with renewable electricity.

3. Implications of VT 2020 CAC Goals and Pathways

The fifteen 2020 VT CAC goals call for the adoption of initiatives, programs, and projects to achieve the overall goal of carbon neutral campus operations by 2030. Each of the Working Group subcommittees assessed the impacts, costs, and benefits of their goals and pathways.

Most of the initiatives proposed provide significant non-monetary benefits to the University, including GHG emissions reductions, enhanced educational quality through the Climate Action Living Laboratory, increased campus quality and livability, cultural and behavioral change, climate social justice, community engagement, cleaner air and environmental quality, and an improved university reputation. Many of the pathways require financial investment. Some have a favorable financial return on investment, while others provide little financial return but high non-financial benefits.

3.1 Impacts on GHG Emissions

Goal #1 of the VT 2020 CAC calls for carbon neutral campus operations by 2030. The FY 2019 GHG inventory shows emissions of 240,959 metric tons (MT) CO_2e. This inventory did not include sources that have been added in the 2020 CAC GHG scope. These are listed below with the mid-range estimate of how they would change the 2019 inventory:

VT occupied leased space:	37,475 MT (+15.5%)
AEP new emissions factor:	16,761 MT (+6.7%)
Agricultural operations:	11,004 MT (+4.4%)
Upstream Elect. T&D losses:	5,447 MT (+2.2%)
Business travel:	6,282 MT (+2.6%)
BT bus system fuel:	3,515 MT (+1.4%)
VT forests:	- 2,178 MT (-0.9%)
TOTAL:	78,306 MT (+32%)

If added to the 2019 GHG inventory, total VT emissions would be 319,000 MT. In *figure 2.1*, the GHG emissions reduction line to zero emissions by 2030 would have to start at 32% more emissions. We will have to wait until the next GHG inventory for FY 2020 is completed in the fall using the 2020 CAC GHG scope and methodology to know what the new level of emissions will be.

Regardless of what we learn from the FY 2020 inventory, it is clear that achieving the goal of zero net carbon emissions will require meeting other goals, including: 100% renewable electricity (~50-55% reduction of emissions), transition to steam plant natural gas (~10% reduction), energy system efficiency (~5%), improved building efficiency (~10-12% reduction despite campus growth), carbon neutral agriculture (~4-5%), commuting and transportation efficiency (~2%), and other means (~3%). We would still emit about 10% of our new scope 2019 GHG estimate in 2030, or about 32,000 MT. To achieve carbon neutrality, these emissions would have to be balanced by carbon offsets. If purchased, these offsets would cost about $160,000 at $5/MT. There are better uses for these funds, so every effort should be made to drive down GHG emissions even further (see 3.2.12 below).

3.2 University Budget & Finance

This section describes the possible financial implications of many of the pathways and initiatives recommended by the CAC.

3.2.1 GHG Software Platform

While the *VT GHG Master Spreadsheet* has facilitated analysis of VT's carbon footprint in past years, it is recommended that VT purchase an annual license for a formal GHG assessment software platform. SIMAP® is a carbon and nitrogen-accounting platform that can track, analyze, and improve campus-wide sustainability. This platform is the most widely used by universities for their carbon and/or nitrogen footprints; the current version or its predecessor is used by 10 of the 12 peer institutions we reviewed. It has customizable carbon emissions coefficients, flexibility in data import and export, and includes a third-party data review, which provides additional points in the AASHE Sustainability Rating System. A tier 2 software license is $600/year.

3.2.2 Costs and benefits of University Compost Facility at Kentland

Both the Agriculture/Forestry/Land Use and Waste/Recycling/ Composting subcommittees strongly recommend a University Compost Facility at Kentland. The facility would reduce net animal waste GHG emissions, support soil health, relieve the need to purchase new land (estimated at $3 million) for future land application of animal wastes, and support sustainable agriculture education and research. The Facility will also provide significant benefits in management of campus organic wastes from dining halls, athletics, the vet school, and campus tree trimmings. Capital cost is estimated at $1.4-1.8 million with net operating cost of about $165,000/year.

3.2.3 Cost and benefits of Renewable Energy Certificates

In 2020, Virginia Tech purchased renewable energy certificates (RECs) from Appalachian Power Company (APCO) for $1/MWh of electricity purchased. Virginia Tech Electric Service (VTES) electricity purchases from APCO in FY 2019 were 327,452 MWh, of which 212,600 MWh were for campus use, with the remainder for town customers. For 2019, VT bought RECs for 10% of its purchases (32,745 MWh x $1/MWh=$32,745) and for 2020, VT bought RECs for 20% (65,490 MWh x $1/MWh = $65,490). APCO has 10% renewables in its power portfolio, so the total VT renewable electricity for 2019 was 20% and for 2020 30%.

Using APCO's 2018 GHG emissions rate (0.676 MT CO_2e/MWh (includes APCO's10% renewables), the **2020 GHG benefits of 20% RECs** of VT purchases from APCO = 20% x 212,600 MWH x 0.676 MT CO_2e/MWh = **28,744 CO_2e or 12% of total 2019 VT emissions**. The **REC price per MT CO_2e offset** = $1/MWh / 0.676 MT CO_2e/MWh = **$1.48/MT CO_2e.** Some argue that buying RECs seems like we are simply throwing money at the problem, but the $1.48 cost per MT CO_2e reduction is actually a good deal compared to carbon offsets, which currently run $5-10/MT CO_2e.

Nonetheless, we would rather generate or purchase renewable electricity than buy RECs, and indeed our pathways wean us from RECs as we move forward. But the 2020 RECs purchase makes a serious statement about our climate commitment, and we achieve two years early the Governor's E.O. 43 requirement that state agencies procure 30% of their electricity from renewable sources by 2022 and 10 years early the 30% by 2030 requirement for utilities.

3.2.4 Costs and benefits of 100% renewable electricity and financing/ownership options

Pathways for Goal #2— 100% renewable electricity—show it can be achieved through a combination of:

- **Solar energy projects on VT** lands and campus building rooftops. These can be VT owned or 3rd party owned with a VT power purchase agreement.

- **Power purchase agreements** (PPA) with utility or 3rd party-owned projects in Southwest Virginia
- Other PPAs or virtual PPAs.
- **Appalachian Power's increasing renewable portfolio**, which is now 10% and by new state law must be 14% by 2025 and 30% by 2030.
- **Renewable energy certificates** (RECs) (purchased MWh credits) from utility or 3rd party.

Achieving 100% renewable electricity by 2030 assumes **60% renewable generation** plus **30% APCO renewable portfolio** and **10% RECs** for VT steam plant cogeneration. The pathways assume a combination of solar on **VT buildings and land (15 MW)** owned by VT or 3rd-party PPA and 3rd-party-owned and APCO-owned SWVA **PPA capacity (130 MW**+15 MW=145 MW). **Capital costs** of VT owned solar systems are assumed to be $2/W for <0.5 MW projects and $1.50/W for >1MW projects. This works out to:

- Total capital cost for 15 MW on VT buildings/lands would be about $25-30 million.
- Total capital cost for 145 MW would be over $200 million.
- The best PPA contract rates on the market are 20-year, non-escalating flat rate of ~7¢/kWh.

While utility/3rd party PPAs are assumed to be the preferred approach for off-campus solar projects, on-campus projects can be either VT-owned or utility/3rd party owned with PPAs.

- The advantages of VT owned and managed renewable systems are greater control, reduced long-term electricity cost and greater financial return; and disadvantages are high initial capital investment and operation/maintenance requirements. VT has the unique advantage of having its own utility VTES to do this.
- The advantages of PPAs are little or no initial capital costs and no operation/maintenance cost; and disadvantages are potentially higher electricity costs and less operational control.

Considering the effects of the Covid-19 pandemic on university resources, it may make sense to initiate solar development through 3rd party PPAs, which would preserve university capital to invest in energy efficiency or other priorities.

3.2.5 Costs and benefits of steam plant improvements and chiller upgrades

Operating and upgrading the campus energy systems is a costly but necessary enterprise. Upgrades and modifications like the natural gas pipeline, new boilers, and new central and upgraded chillers require significant investment. However, the benefits, including a more modern energy system, greater efficiency, reduced operating costs, and reduced GHG emissions, make these smart investments. Further upgrades and modifications will be necessary, and they are part of the cost of running an institution the scale of Virginia Tech. Incorporating the energy goals of CAC to fully replace coal with natural gas and improve the efficiency of VT energy systems can be part of these necessary upgrades with marginal increase in cost, but with substantial additional benefits to the university.

3.2.6 Costs and benefits of 10-year energy management plan including auxiliary buildings

The 2015-2020 5-year Energy Management Plan was a great energy and economic success, as the university invested $14.2 million in energy efficiency improvements that resulted in an average 5.3-year payback or 19% return on investment (ROI). There are more opportunities for improvements in VT buildings, especially Auxiliary buildings, and the proposed 2021-2030 10-year Energy Management Plan should be funded at a level of $5-8 million per year and allowable average 8 year payback or 12.5% ROI. Retrofit of Auxiliary buildings may require a special financing mechanism.

However, additional energy management staff may be needed in Facilities to develop and implement the Plan effectively. The position of Energy Manager is still vacant and additional staff expenditures would be easily recouped by energy cost savings.

3.2.7 Energy efficiency retrofits in Leased buildings

1.4 million square feet of off-campus building space in Blacksburg is leased to Virginia Tech department operations, and we are now including this space in our 2020 VT GHG inventory. Therefore, it is subject to the goals of our CAC. The VT Foundation owns much of this space and the VT Office of Real Estate Management pays rent and utility bills.

The Foundation operates on a revenue neutral basis, so that any investment it makes in energy efficiency improvements in its leased buildings must be recovered by increasing rent. With prudent efficiency investments, the resulting increased rent for the university should be more than offset by a decrease in utility bills. The Foundation CEO is willing to engage in energy retrofits under these terms on a pilot basis, starting with the Corporate Research Center once a new CRC president is hired.

3.2.8 Implementing LEED-Silver and ASHRAE 90.1 Standards, New VT Design Standards

Facilities Capital Construction Design personnel have long incorporated LEED-Silver and ASHRAE standards in design and construction of new VT buildings and major renovations, so this part of the CAC will likely not be changed. Newly adopted VT Design and Construction Standards reflect CAC goals and are expected to streamline design decisions. Adding energy efficiency benchmark goals for energy intensity (energy/gsf) in newly initiated buildings in 2022 (20% below 2020 existing building average) and 2028 (40% below 2020 existing building average) may require some staff energy analysis, but it is intended to be a collective benchmark and not a design tool for individual buildings.

3.2.9. Waste Management: Costs and Benefits of a Zero Waste Campus

Waste management at Virginia Tech is a functional but fragmented enterprise, and an audit by a zero-waste consultant could yield recommendations to improve the efficacy and efficiency of operations. *Table 3.1* breaks down the $1 million/year cost associated with waste management, not including Facilities Waste Management Trash and Recycling unit personnel.

Waste audits typically reveal that about 50% of the material placed in trash containers could be recycled. By improving the infrastructure (e.g., appropriate collection containers throughout campus) and educating our students, faculty and staff on how to use them with appropriate signage and education on the cost and benefits of recycling, we would be in a position to realize reduced costs and increased waste diversion and recycling rates.

Table 3.1 Calendar Year 2019 Costs (excluding Virginia Tech Trash & Recycling Unit):

Republic Services:	$ 130,000
Meridian Waste Virginia:	$ 572,000
MRWSA Trash Tipping Fee:	$ 218,859
MRSWA Recycling Tipping Fee:	$ 11,518
ROF Food Waste Composting	$ 84,900
Total Cost	$1,017,277

In CY 2019 the university reported 6,000 tons of waste: 4,000 tons of trash and 2,000 tons of principal recycling materials (PRMs). Shifting 1000 tons from trash to recycling would reduce our

MRSWA Tipping Fee from $229,500 to $208,560 and increase our waste diversion rate and recycle rate to 81% and 55% respectively. The goal to become a Zero Waste Campus by 2030 requires a 90% waste diversion rate, defined as 90% of total waste kept out of landfill.

It is noteworthy that as of this writing the national recycling market is in disarray, and to keep VT recycling vendors afloat, our recycling costs will increase 50% and approach trash tipping fees in June 2020. As President Steger said in 2008 when the cost of recycling grew and advocates feared canceling the recycling program, "Yes it's costly, but it's a necessary cost of doing business."

3.2.10 Costs and benefits of transportation pathways

Transportation goals and pathways aim to reduce single-occupancy vehicle commuting and to reduce overall transportation related GHG by 40% by 2030. The benefits of these goals are numerous and far reaching. Moving people away from single-occupancy vehicles toward more sustainable mobility can enhance the quality of campus life by reducing congestion, noise, and pollution of vehicles. Improving trails, sidewalks, and mobility infrastructure will increase access for all, boost campus livability, enhance emergency access, and improve health, safety and sustainability. The reduction in vehicles also reduces roadway repair and maintenance costs and curbs the need to build costly parking structures (upwards of $25,000/space).

Costs associated with these goals and pathways include increased parking permit costs (ideally on a sliding scale based on salary), a cultural shift for those accustomed to driving, upfront costs associated with infrastructure improvements, and increased maintenance costs for existing and new alternative transportation infrastructure.

Parking Services is entirely self-funded. The revenue from parking permits and citations pays for parking structure debt, maintenance of parking lots, and salaries of employees. Therefore, any loss in revenue would have to be supplemented by a subsequent increase in revenue elsewhere. This might seem like a huge barrier to overcome, but fortunately VT parking permit prices are already comparatively low. Student resident and commuter parking permit fees are about at the median of peer institutions, but employee parking permit cost is the least expensive of peer schools, and 30% less than UVA's fees.

3.2.11 Costs and benefits of a testbed Agrivoltaic project at the Catawba Sustainability Center and/or Kentland Farm

The Agriculture/Forestry/Land Use and Renewables subcommittees recommend developing a dual-use farmland-solar project at Catawba and Kentland. Such a system would likely have capital costs of about $1.65 million/MW installed capacity, require 8 acres/MW, produce 1340 MWh/MW or **168 MWh/acre**, offset 1000 MT CO_2e/MW or **125 MT CO_2e/acre**, and have a levelized cost of electricity of about **7 cents/kWh for 25 years**, assuming 3% cost of money. This would be a cost-effective arrangement for VTES.

3.2.12 Costs of carbon offsets

Achieving the overall CAC goal of a carbon neutral VT campus by 2030 may require the purchase of carbon offsets. Many of the goals and pathways will drive GHG emissions down to near zero by 2030, especially 100% renewable electricity, energy efficiency retrofits to energy systems and buildings, replacing coal with natural gas, and reduction of transportation, agriculture, and waste emissions. But the CAC specifically calls for carbon offsets in 2030 to negate remaining emissions from agriculture, business air travel, and newly initiated buildings. Pathways for goals 3 and 15 call for the CAC 2025 update to plan for renewable heating and promotion of zero-emissions

options by including upstream natural gas methane leakage in our carbon neutral goal by 2035. This may initially increase the need for offsets after 2035.

Most universities use carbon offsets to reduce their GHG emissions and approach carbon neutrality. The purchase of carbon offsets can be costly. Current offset prices are \$5 - 10/MT CO_2e. Carbon offsets to cover 2020 VT CAC GHG emissions of about 300,000 MT would be \$1.5 – 3 million. As calculated in section 3.2.1, if we achieve our goals and pathways, we may still emit about 10% of our new scope 2019 GHG estimate in 2030, or about 32,000 MT. To achieve carbon neutrality, these emissions would have to be balanced by carbon offsets. If purchased, these offsets would cost about \$160,000 at \$5/MT.

There are better and more efficient uses for this money. Every effort should be made to avoid the need for offsets by investing in energy efficiency and renewable energy on campus. This type of investment not only reduces emissions and the need for offsets, but also provides local and long-term financial benefits.

3.3 University Educational Mission

As a Land Grant university, Virginia Tech has comprehensive educational instruction, research and outreach programs. Several of these programs focus on sustainability and its many dimensions related to the physical, natural, and social sciences; technology; humanities; and economics, policy, and politics. The 2020 VT Climate Action Commitment and its implementation provide a wide range of educational opportunities for these programs, faculty, and students.

The VT Climate Action Commitment is a bold initiative. It calls for aggressive changes in the campus physical plant and energy sources by applying cutting-edge technologies and designs. It calls for innovative partnerships and financial arrangements to fund and implement these changes. It calls for structuring cultural change to effect sustainable behavior in living, be it commuting to campus, recycling and composting, or overall consumption. It calls for engagement of all faculty, staff, students, and the larger community to work toward a common goal of climate action, social equity, and justice.

This bold initiative is ripe for study, for analysis, and for learning. As with many experiments, the CAC will have gotten some things wrong. We invite students, faculty and staff to engage with the CAC as a living document and with the campus as a living system, discovering what works and what does not. There is much to learn from this experiment and many lessons that Virginia Tech will be able to share with others.

The **Climate Action Living Laboratory (CALL)** aims to provide supportive infrastructure for various projects and initiatives. Some projects may be as small as a term paper or class project while other initiatives may be as large as well-funded research programs or new initiatives of Cooperative Extension. Regardless of size and complexity, the goal is to apply experiential learning to the implementation of the CAC using the living physical and human campus as its focal point. Since the 2009 VT CAC, the university has implemented programs to engage students in campus sustainability, mostly through the Office of Sustainability in the Facilities Division. The Sustainability Internship and the Green RfP programs have been very successful. The 2020 VT CAC builds on this experience and calls for broadening the effort to engage more students, faculty, departments, and colleges directly in the University's climate action endeavors.

Therefore, if CALL is to be effective, academic leaders, including the Provost, the college deans, and relevant department heads, will need to support the effort. Implementation Goal 13 calls for restructuring operations and governance to do this.

3.4 University Operations and Staffing

The goals and pathways of the 2020 VT CAC will require changes in some operations and staffing to pull them off.

3.4.1 Operations

The most important potential operations change proposed in the 2020 CAC involves the **Office of Sustainability** (OS), which has played a significant role in implementing the 2009 VT CAC and engaging the campus in sustainability programs. For its accomplishments with limited staff, the Office deserves great praise. The 2020 VT CAC calls for an expanded campus effort for engagement and to integrate climate action into the University's educational mission as recommended in goals 10 and 13. As a unit in the Facilities Department, the OS is somewhat constrained in its ability to engage the academic, student affairs, and auxiliary sides of campus to achieve both the concrete climate action goals and the Climate Action Living Laboratory (CALL) goal.

Goal 13 calls for implementation of the CAC "at a high level of university operations and governance." It recommends **restructuring the OS as a university wide unit,** and renaming it the **University Office for Climate Action and Sustainability (OCAS).** The OCAS would have primary responsibility for CAC oversight, with strong connections to Facilities units as well as to related activities in academic units (including the goal 10's Climate Action Living Laboratory), student life and student affairs, and other units.

The OCAS would be directed by a new University **Chief Climate Action and Sustainability Officer (CCASO)**. The CCASO would report jointly to the Senior Vice President and Chief Business Officer and to the Executive Vice President and Provost. The CCASO would chair the restructured Climate Action, Sustainability and Energy (CASE) committee, which would be a restructured version of the current Energy & Sustainability committee (see 3.5 below).

Goal 13 pathways also recommend supporting the CCASO with CAC implementation in Facilities, by creating a director position in the Division of Campus Planning, Infrastructure, and Facilities (DCPIF), who would oversee strategic Facilities initiatives including climate action and sustainability and other strategic goals.

A second implication for operations is included in Goal #7 pathways. **VT waste management**, including trash, recycling, composting, construction waste, and specialty waste, is functional but fragmented across several departments. The CAC calls for a zero-waste consultant to do a waste and management audit and recommend organizational changes to improve efficiency to achieve CAC goals. The Working Group considered recommending hiring a **Waste Manager** for all of campus or forming a **Waste Council** of all departments currently involved, but ultimately decided to rely on the consultant study to determine the best outcome.

3.4.2 Staffing

Some of the Facilities departments are already unstaffed, and implementation of the 2020 VT CAC will add to their requirements. The CAC specifically identified some areas in need of staffing:

- Create a university **Chief Climate Action and Sustainability Officer** (CCASO) to direct the new University Climate Action and Sustainability Office (CASO) to oversee implementation of the VT CAC. The CASO would elevate and replace the existing Office of Sustainability, and the CCASO would report jointly to the Senior Vice President and CBO and the Executive Vice President and Provost. The CASO would require sufficient staff to support CAC implementation.
- Fill the VT **Energy Manager** position and supplement staff as needed. This position has been vacant for more than one year and is critically important for implementing the entire Climate Action Commitment. The new energy manager should have sufficient staff.
- Sufficient **engineering and design staff** to achieve CAC goals for buildings

3.5 University Policies and Governance

The principal governance committee currently dealing with the CAC is the Energy & Sustainability Committee (E&SC). Since its creation in 2007, it has played an important role in climate action and sustainability. A subcommittee of the E&SC developed the 2009 VT Climate Action Commitment and Sustainability Plan, and another developed updates in 2013 and 2014. Indeed, the charge letter to the Working Group requires informing the E&SC of progress, and governance approval of the 2020 VT CAC will commence with E&SC review.

Like the current Office of Sustainability, the E&SC is positioned in the university's facilities world. Although it has faculty and students in addition to staff as members of the committee, it reports to the non-academic Commission on University Support (CUS), which reports to University Council.

2020 CAC Goal #13, and the associated pathways, calls for a reconstitution of the E&SC, renaming it the **Climate Action, Sustainability, and Energy (CASE) Committee**, and revising its charge, membership, standing subcommittees, and reporting lines not only to CUS but also to academic and student affairs commissions (see section 4.1).

3.6 University Culture

The 2009 VT CAC and Sustainability Plan aspired to create a campus "culture of conservation," understanding how important engagement and behavior were to the achievement of its goals. The same is true today as we develop the 2020 version of the CAC. We look around and while many students, faculty, and staff are dedicated to actions and behavior to enhance climate action and sustainability, we see people making choices about waste generation, littering, transportation, energy use, and overall consumption that are not consistent with sustainable living or necessary climate action. The actions of an individual will not save the world, but the world cannot be saved without their collective action.

In response, the Working Group established a subcommittee on Structuring Sustainable Choices to explore programmatic opportunities to create conditions where institutional barriers to sustainable behavior are reduced and sustainable choices are made easier, cheaper, and quicker. Our focus is not on changing people's values, but on improving information and opportunities for alternative transportation, waste recycling, proper waste handling, reducing energy waste, and other choices. Along with better choices comes conscious sustainable behavior and cultural change.

4. Implementing, Engaging, Monitoring, Reporting, Updating VT CAC

4.1 Structure, Operation and Governance of VT CAC Implementation

The governance and operations of climate action and sustainability at Virginia Tech has led to substantial progress during the last decade. However, the comprehensive nature of the VT 2020 CAC will require a broader approach than existing arrangements. Currently, the Office of Sustainability (OS) in the Facilities Department has primary responsibility for sustainability operations and the Energy & Sustainability Committee (E&SC) is the primary governance unit.

Both are positioned in the Facilities world, with OS reporting to the Chief Facilities Officer and the E&SC reporting to the Commission on University Support (CUS). Goals 1-5, 7, 9, and 15 are the most important actions to reduce GHG emissions and are all dependent on initiatives by the Facilities departments. Facilities must play a critical and key role in CAC implementation.

However, the CAC goals go farther than the physical plant and call for action through the university's educational mission, campus culture, social equity and justice, and engagement of all departments, faculty, staff and students. Both the OS and the E&SC have engaged a broader perspective than Facilities. For example, with a limited staff, OS has operated effective student internship and student-initiated Green RfP programs, and the E&SC has a diverse membership of faculty, students, and Facilities staff.

But to fully implement the VT 2020 CAC, modification of both operations and governance must be considered. *Goal #13* and the associated pathways suggest operational and governance structures that aim to elevate the university's commitment and better reflect the comprehensive nature of the 2020 CAC.

4.1.1 Structure and Operations for VT CAC Implementation

Goal #13 and the associated *implementation* pathway call for changes in the direction, responsibilities, staffing, location, and reporting lines of the operational **unit charged with oversight in implementing the CAC.** CAC implementation includes goals related to the physical plant and facilities and those relating to academics, student affairs, and campus culture. The Office of Sustainability (OS) has been a logical unit for CAC implementation, but its location in Facilities will constrain its effectiveness. Given the proposed breadth of the CAC, Goal #13 calls for:

- Making the OS a university-wide unit, renamed the **University Office of Climate Action and Sustainability (OCAS).** The OCAS would have primary responsibility for CAC implementation, with strong connections to Facilities units as well as to related activities in academics (including the Climate Action Living Laboratory), student life and student affairs, and other units.
- A new **University Chief Climate Action and Sustainability Officer (CCASO)**. The CCASO would **report jointly** to the Senior Vice President and Chief Business Officer and to the Executive Vice President and Provost. The CCASO would direct the OCAS and chair the restructured Climate Action Sustainability and Energy (CASE) committee (see below).
- Recognizing the critical work to be done within Facilities, creating a **director position in the Division of Campus Planning, Infrastructure, and Facilities** (DCPIF), who, working with the CCASO and appropriate staffing, would oversee strategic facilities initiatives including climate action and sustainability and other goals such as campus safety and accessibility and inclusion.

4.1.2 Governance for VT CAC implementation

The *governance* pathway in goal #13 calls for restructuring **the university Energy and Sustainability Committee (E&SC)**, including its name, charge, membership, and reporting, to oversee the implementation and review of the CAC goals and progress involving all stakeholders.

- Rename the E&SC the **Climate Action, Sustainability, Energy (CASE) Committee**.
- Revise the **reporting lines** of the CASE committee to include, in addition to CUS, relevant commissions for student life, academics, faculty and staff.
- Modify the current charge of the E&SC for the CASE Committee. Consider the following:
  "To review and provide guidance to all facets of University Administration on implementation opportunities and issues relating to the university's Climate Action Commitment and the pursuit of environmental quality and social sustainability, through policy, infrastructural and operational changes, education, and broad engagement."
- Modify the **membership** of the new CASE committee to include additional representation of the VP for Campus Planning, Infrastructure & Facilities (VPCPIF), the Provost's Office, Student Affairs, student environmental organizations, and local community partners.
  - Current E&SC membership:
    Six Ex-Officio; Two from Facilities Services; One from Environmental Health & Safety; Four from Faculty Senate; Two from Staff Senate; One College Dean; Two graduate students (GSA); Two undergrad students (SGA)
  - Suggested additional members:
    Ex-Officio (Chief Climate Action & Sustainability Officer (CCASO), Chair; Sustainability Manager, Dining Residence Life; Asst. VP for Utilities; Executive Vice Provost; Director, Parking & Transportation; Sustainability Manager, Town of Blacksburg); student representing environmental group (by SGA); student representing frontline communities (by Vice Provost for Inclusion/Diversity)
- Create **CASE subcommittees** (SC) that may include: CAC Implementation SC, GHG Inventory SC, Climate Action Living Laboratory (CALL) SC, Climate Justice SC, Engagement & Sustainable Choices SC, Education & Student Involvement SC, Town-Gown Sustainability SC. Subcommittees may include participation beyond formal CASE membership.
- **Process for renaming, reconstituting E&SC to CASE:** Changes to VT governance structure, names, membership, charges are not straightforward and take some time with annual appointments. It is recommended that the following process be used:
  - In fall 2020, E&SC forms a task force or subcommittee to explore CAC operations and governance recommendations, including developing paperwork for changing committee name, charge, membership, and subcommittees.
  - Provided the BOV approves the 2020 CAC update, the E&SC will submit proposed changes in spring 2021 for University Council approval. The new CASE would begin in fall 2021.

4.1.3 Duties of Operations and Governance units

- **Collect data** relevant to the CAC (energy use, GHG inventory, and other pathway metrics) and prepare an **Annual Report** of CAC Progress each fall semester for the previous fiscal year.
- **Evaluate CAC goals according to best practices** in light of new information and standards and lead **five-year update review of CAC** (2025 and 2030)
- **Establish mechanisms to engage and educate** the Virginia Tech community on the CAC and climate action
- Establish ad hoc committees to develop instructional, research and outreach programming for the **Climate Action Living Laboratory** (CALL)

- Broaden the geographic scope of the **CAC to all Virginia Tech properties** in future 5-year updates to include other University properties/locations
- **Advocate** for allocation and prioritization of resources to support the CAC

4.2 Engaging the Community

Implementation of the CAC requires major changes in the campus physical plant. But it also requires involvement of the entire community including students, faculty and administrators, staff, and academic and auxiliary departments in order to:

- Develop innovative instructional, research, and outreach initiatives incorporating these physical changes as part of the **Climate Change Living Laboratory (CALL)**,
- **Structure sustainable choices** by the community to enhance the campus sustainability culture,
- Participate in **annual reviews and 5-year updates** of the Climate Action Commitment.

Goal #13 describes the means for this engagement through the restructured **University Office for Climate Action Sustainability** (OCAS) for operations and the **Climate Action, Sustainability, and Energy (CASE) Committee** for governance.

Under the direction of a university **Chief Climate Action and Sustainability Officer** (CCASO), the restructured OCAS and CASE Committee would not only monitor developments related to the CAC in Facilities but also develop and promote academic and student life CAC initiatives through engagement groups of academic departments and faculty for CALL programs and student affairs and student life representatives for campus culture programs. These latter initiatives would engage existing student life programs, including student orientation, VT Experience, Dining and Residence Life, and others to promote sustainable choices and behavior.

4.3 Annual Report of Progress and AASHE STARS Reporting

Each fall semester, the current Office of Sustainability has prepared an annual sustainability report describing climate action and sustainability activities in the prior fiscal year (FY) using the VT 2009/2013 CAC framework. Indeed, the annual report was called for in the original CAC and has been very effective in not only documenting progress for all to see, but also enhancing performance.

The new OCAS would prepare an **Annual Report on VT Climate Action & Sustainability**.

In addition, the OS conducts the AASHE STARS assessment every three years. The Association for the Advancement of Sustainability in Higher Education (AASHE) monitors and evaluates college sustainability programs. AASHE's Sustainability Tracking, Assessment & Rating System (STARS) is used to assess sustainability progress. More than 400 institutions have earned a STARS rating, making the program the most widely-recognized framework in the world for publicly reporting comprehensive information related to a college or university's sustainability performance. Participants report achievements in five overall areas: academics, engagement, operations, planning and administration, and innovation and leadership. The 2014 update of the VT Sustainability Plan adopted the STARS assessment as the main evaluation tool for overall VT sustainability.

Because of demonstrated effectiveness of the annual report and the AASHE STARS assessment, the Working Group recommends their continued use to monitor and evaluate progress in achieving the VT 2020 CAC. As described in section 4.2, the restructured OCAS would continue to take the lead for these reviews with enhanced engagement of stakeholders through review groups and through the CASE Committee in governance.

4.4 GHG Inventory Procedures

The GHG Inventory Subcommittee Report details data collection scope, method, and process recommendations. They call for annual review of various data sources and assumptions including:

- Geographic Boundaries
- Global Warming Potentials
- Electricity
- Other energy Fuels
- Transportation
- Business Travel
- Water Use and Waste Water
- Waste Disposal
- Food and Dining
- Agricultural and Forestry Operations
- Use of Climate Action Living Laboratory to assist in GHG Inventory

While the *VT GHG Master Spreadsheet* has analyzed VT carbon footprint in past years, it is recommended that VT purchase a formal GHG assessment software platform. **SIMAP** (Sustainability Indicator Management and Analysis Platform) is a carbon and nitrogen-accounting platform that can track, analyze, and improve your campus-wide sustainability. It is the most widely used GHG inventory method of analysis and is used by 10 of the 12 peer institutions we reviewed. It has customizable carbon emissions coefficients, flexibility in data import and export, and includes a third-party data review, which provides additional points in the AASHE Sustainability Rating System.

4.5 Timing of Recommended Pathways and Implementation Milestones

4.5.1 Timing of Recommended Pathways

The VT 2020 Climate Action Commitment provides a long-term vision of Virginia Tech progressing in its duty to contribute to a carbon neutral world. But every long-term journey begins with initial steps. Therefore, our goals below identify not only aspirations but also Pathways to achieve them. These Pathways identify actions in following three timeframes:

a. **Immediate Actions, 2020-2022**
   It is critical that the university take some action quickly, not only to show it is serious about the commitment, but also because climate change is upon us and it is time to act. **Chapter 9** presents several "shovel ready" initiatives ready for action in this timeframe.

b. **Mid-term Actions, by 2030**
   Other aggressive actions will require developing partnerships, detailing strategies, and securing funding that will take time, but we believe 2030 to be a critical target since it is a key milestone of the VT 2020 CAC and the Virginia Clean Economy Act of 2020.

c. **Long-term Actions, by 2050**
   Some significant actions that affect the overall infrastructure of the university will require more time for affordable technology to develop, energy markets to evolve, and state and federal policies to advance, including a meaningful price on carbon.

4.5.2 Implementation Milestones

The VT 2020 CAC calls for an annual review and report of progress conducted by the new UOCAS and a five-year update to the CAC conducted by the reconstituted E&SC, the Climate Action, Sustainability and Energy (CASE) Committee. The five-year updates should occur in 2025 and 2030. The following milestones in table 4.1 are taken from the goals and pathways.

Table 4.1 VT 2020 CAC Implementation Milestones

Date	Goal	Milestone
2020	2	30% Renewable Electricity
		BOV approves VT 2020 CAC
2021	13	E&SC renamed Climate Action, Sustainability & Energy (CASE) Committee
	11	Operation plan for Climate Action Living Laboratory (CALL)
	5	Candidate identified for Zero-Net-Energy new building to be built by 2026
	3,4	1st year of 10-year 2021-2030 Energy Management Plan
	2	Fishburn Forest student-led wind assessment
2022	2	2.3 MW solar PV on VT rooftop and land
	2	VTES Solarize program for Town customers, 250 kW net metered
	4	Electricity use 10% below 2006 (Governor's E.O. 43)
	5	Newly initiated buildings EUI 20% below 2020 existing average
	8	Sustainable Procurement Policy v.2
2023	14	VT Foundation energy efficiency plan for leased buildings (CRC)
	2	VTES Community Solar project for Town customers 0.5-1 MW
2024	3	Chiller Phase II Upgrade complete
2025	3	Total conversion to natural gas in steam plant; plan for transition to renewable fuel
	15	5-year CAC update: Explore options for 2030-2040
	7	Recycling rate 55%; Waste diversion rate 85%; reduce trash to landfill/capita by 25%
	9	Reduce Single-occupancy-vehicle commuting by 20%
	2	10 MW solar PV on VT lands
	3	Explore geothermal heat pump hot water heating options for new districts
2026	5	Signature Zero-Net-Energy (ZNE) building on campus
2027	2	10 MW battery storage for VT Smart Grid research by VT PEC-VTES partnership
	2	35 MW solar PPA with Apco/3rd party
2028	5	Newly initiated buildings EUI 40% below 2020 existing average
2029	2	100 MW solar PPA with Apco/3rd party
2030	15	5-year CAC update: Explore options for 2040-2050
	1	Carbon neutral campus operations
	2	100% Renewable Electricity
	4	Total building energy use down 10%, EUI down 20% below 2020
	5	Newly initiated buildings carbon neutral operations
	6	Carbon neutral agriculture/forestry operations
	7	Zero Waste campus
	9	Transportation emissions reduced 40% from 2020
2050	15	Fossil fuel free campus

4.6 Five-year CAC Update

The VT 2020 Climate Action Commitment is our best effort for today, but the world is changing rapidly in technology, economy, policy, and priorities. It is important to keep the CAC current by providing annual reviews and updates on a five-year cycle. The update process should not be as intense as that of the 2020 CAC Working Group, but it should engage a committee of faculty, students, and staff stakeholders. The update would be led by a subcommittee of the CASE Committee in governance. The annual reports will ease the pain of data gathering, but there is a need to assess the conditions and assumptions of the 2020 CAC process and modify goals and pathways as needed.

Our focus in the 2020 CAC has been on 2030, mainly because it is difficult in these changing times to envision the world of climate change, its effects, mitigation strategies, and the state of technology and policy beyond the next decade. For this reason, 2020 CAC goal 15 provides a vision for a fossil fuel free campus in 2050 without much detail because we just don't know what the next three decades will bring. Therefore, the Five-year CAC Update gives the opportunity to take stock of the world, of the nation, of the Commonwealth, and of the university, as well as of technology, economy, policy and priorities, to revise as needed the CAC goals and pathways. Goal 15 recommends the 2025 update assess preliminary prospects for the 2030-2040 decade, and the 2030 update do the same for 2040-2050. It also suggests the 2025 update begin to initiate climate action at other Virginia Tech locations beyond Blacksburg.

5. What We Learned from Community Engagement

The 2020 Climate Action Commitment (CAC) update process placed great emphasis on genuine and meaningful community engagement. Engagement provides opportunities to: crowdsource good ideas; collect feedback, including on implementation challenges and different impacts, from as wide and diverse a swath of the population as possible; inform the community of our efforts, including options being considered; and build support for the recommendations the CAC working group will ultimately make.

The Engagement Subcommittee chose various means of participation that ranged from 'informing' to 'involving' on the International Association for Public Participation's Spectrum of Participation.[1] The CAC update process overall--with its robust network of subcommittees--may be considered a true 'collaborative' enterprise, with over 100 students, staff, faculty, and community members involved.

In terms of wider outreach, the Engagement Subcommittee originally planned on holding a major half-day town hall event on campus. Unfortunately, COVID-19 made that impossible. Nonetheless, the group facilitated the implementation of a range of 'physically distanced' engagement activities:

- Created a dedicated website portal introducing the CAC process and sharing committee materials[2]
- Shared videos focused on progress updates regarding the work of the WG and the subcommittees
- Crafted VT News stories
- Managed a dedicated email address for the initiative
- Distributed a survey widely throughout the community, which received 242 unique responses
- Convened a series of 12 Zoom meetings, 3 general and 9 focused on subcommittee topics, which involved over 226 people[3]

Each of these streams of engagement is further detailed in this section, and insights and information collected through them is summarized.Even more information is available in the Engagement Subcommittee final report. **Key findings from these various engagement efforts are:**

- **Aggressive action to tackle climate change is broadly supported** throughout the community
- Various **good ideas both emerged and were affirmed** through this process, underscoring their potential value to the community

[1] International Association for Public Participation (2018). IAP2 Spectrum of Public Participation. https://cdn.ymaws.com/www.iap2.org/resource/resmgr/pillars/Spectrum_8.5x11_Print.pdf

[2] The central engagement website is: https://svpoa.vt.edu/index/VTCACRevision.html

[3] These are not unique people, as many participated in more than one session

- Emphasis was placed on **systemic or "upstream" solutions** rather than placing the onus on behavior change of individuals
- **Key champions and additional stakeholders** important for propelling further action were identified
- There is **broad support for key actions proposed through the CAC update** process, including:
    - A shift to **carbon neutrality and 100% renewable energy**, with an emphasis on increased solar energy
    - **Alternative transportation** and reductions in private automobile usage
    - A **reduction in overall energy demand** via improved building efficiency standards
    - Better **waste and energy management**, including through a comprehensive composting system and a more sustainable (i.e. circular and local) procurement system
    - **Partnering with the local community** and municipal governments to implement climate solutions
    - **Structuring VT as a 'living laboratory'** for sustainability, integrating sustainability into academics, research, and operations and engaging faculty, staff, students, partners, and the community through action-focused networking
    - **Incorporating environmental justice** (including climate justice, energy justice, and food justice) considerations into all decision-making processes pertaining to the procurement and consumption of resources.

5.1 Means of Engagement: Webpages, Videos, and VT News Coverage

The CAC 2020 update web pages and videos play critical roles in both disseminating information and encouraging community members to further engage. Thanks to the generous involvement of the communications team in the Office of the Senior Vice President and Chief Business Officer, the initiative established a network of webpages. The various pages setup for the CAC 2020 update convey the following:

- Central webpage - https://svpoa.vt.edu/index/VTCACRevision.html
- Working Group information (process and interim products) - https://svpoa.vt.edu/index/VTCACRevision/VTCACWorkingGroup.html
- Engagement process - https://svpoa.vt.edu/index/VTCACRevision/VTCAC-Convene.html

A key outreach activity for information dissemination is a series of videos introducing the scope, preliminary findings, and proposed strategies of the overall workgroup and each subcommittee. In total, ten videos were prepared; these are available through the 'Engagement Process' page.[4] These videos were created by subcommittee members themselves and authentically reflect the breadth of issues and ideas being tackled by subcommittees.

The site also contains working group and subcommittee files.

[4] https://svpoa.vt.edu/index/VTCACRevision/VTCAC-Convene.html. The videos are permanently available through YouTube at: www.youtube.com/playlist?list=PLNp2Qle0vp7spOjgZxcQvyie56MQCvBfN

5.2 Survey Process and Results

A survey was designed and deployed to engage community members--including students, staff, faculty, and residents of Blacksburg and the wider region--to collect their feedback on the issue of climate change, VT's prior and ongoing efforts to address the issue, and potential future actions. Best practices in survey design were employed to ensure that questions adequately met the research objectives of the Climate Action Commitment update process. A copy of the survey instrument is attached to the Engagement Subcommittee report as *Appendix 1.* The survey was hosted on Qualtrics, a VT-supported survey management system.

The survey was distributed through a variety of channels, with the dual goals of reaching both a wide and diverse audience. Distribution channels included various departmental email lists, community email lists, student emails lists, and constituency organization email lists. The Engagement Subcommittee placed emphasis on getting a diverse set of opinions *and* ensuring that various communities were engaged.

Calls to participate were also included in the various versions of the VT Newsletter, and were sent multiple times to students, faculty and staff, and community members and alumni. All were invited to watch the videos prepared by the various Climate Action Commitment subcommittees (see section above), complete the survey, and register for one or more of the Zoom convening sessions (see next section). The exact questions asked are outlined in *Appendix 1* of the Engagement Subcommittee report.

5.2.1 Survey Responses

In total, 242 people completed the survey. Note that not everyone answered all questions, so the response rate per question (N) is provided in this analysis as appropriate. Given COVID-19 and all of the distractions that entailed, the Engagement Subcommittee was very satisfied with this response rate. This cannot be considered a representative sample of the university community by any means; however, it suggests that a significant number of community members are concerned about this issue and feel that action is necessary. The following subsections summarize survey findings.

Perspectives on climate change

The vast majority of respondents (92% of the 205 that answered that question) feel that "most scientists do think climate change is happening". Ten responded that there is "still significant disagreement among scientists". In terms of their own views, a similar number (91%) believe that "climate change is mostly caused by human activities". 11 respondents believe that "climate change is happening, but is mostly caused by natural processes, not human activities". Only one respondent believes that "climate change is not happening".

Participants were also asked how serious of a threat they believe climate change is to human existence within the next 50 years, on a scale from 1 (not happening) to 5 (major threat). The mean response was 4.41 (N=205), indicating overwhelming belief that climate change is a critically important issue to the vast majority of respondents.

When asked to rank in order who is responsible for slowing climate change, a large proportion (129 out of 199 respondents) chose 'public sector organizations (governments)'. This suggests a strong degree of support for government intervention to tackle a problem of this complexity and magnitude. An even larger proportion (136) chose 'private sector organizations (corporations)' as second most responsible; this would suggest that respondents feel that companies must shoulder significant responsibility for implementing necessary changes to their business practices and operations to address climate change. Roughly equal proportions ranked 'individuals' and the 'nonprofit sector' third most responsible (81 and 76 respectively), and fourth most responsible (71 and 107).

When asked to assess how important it is that VT act to address climate change--on a scale from not important (1) to top priority (5)--the vast majority (140 of 199) chose '5'. The mean choice was 4.52. Participants were also asked *why* it is important that VT in particular acts (or should not) in an open-ended question. Representative responses include:

- "VT is a land grant university, and as such, has a responsibility to take care of the land and those who dwell on it, and to direct its teaching and research for the improvement of all of Virginia's citizens."
- "I think the most important role is doing climate-change-related education. Make every Virginia Tech community member realize how serious this issue is and the importance of taking actions."

These are just two examples of the almost 200 comments submitted. Many are longer, reflecting the thoughtfulness of respondents. The raw submissions to this any the other questions throughout this section may be found in *Appendix 2* of the Engagement Subcommittee report.

When asked how familiar they are with Virginia Tech's current climate commitments on a scale from 1 (not at all) to 5 (extremely familiar), responses were mixed; the mean response was 3.2. Ten respondents out of 201 reported they had no familiarity at all (1). This relatively low rating among a response pool that presumably has a higher than average level of concern and awareness about this issue suggests that more should be done to inform and engage the community around VT's climate plans and actions.

Respondents also feel that Virginia Tech is not doing enough to meet its climate commitments. When asked how well they would say Virginia Tech is doing at meeting its current climate action commitments on a scale from 1 (extremely poor) to 5 (excellent), the mean response was 2.99. Only nine respondents think VT is doing 'excellent'. A similar number (10) said 'extremely poor', with the rest between those two polls. When asked *why* they feel that way with an open-ended follow up question, participants gave thoughtful responses; three that reflect differing views are:

- "Being a student involved in the Climate Action Commitment Subcommittee for [agricultural] GHG emissions I believe that the University is meeting the goals of the commitment. Introducing proposals for a greener future at Virginia Tech is important and following through on those goals is also important."

- "I think we could do more to enact policies that promote sustainable energy use and procurement practices. I think we are lacking some of the systemic pieces that will actually make large changes. I think this is also hard because most changes that are made require departments to front the cost - which is challenging."
- "I haven't seen a lot of visible examples of VT taking action to combat climate change"

In an effort to better understand the degree to which respondents would prioritize climate action vis-a-vis other important issues the community faces, they were asked: *If Virginia Tech were to receive a million-dollar gift, what percentage would you allocate to addressing climate change versus other interests VT faces (e.g., housing, diversity scholarships, etc.)?* The mean response was quite high at 49%, with individual responses ranging all the way from zero to 100%. The standard deviation was 26.9%.

Climate actions and barriers

Participants were also asked what they would recommend that Virginia Tech do as an organization to address climate change (through an open-ended question). Here too, respondents provided a rich set of responses that are informative to the Climate Action Commitment update process. Sample responses are:

- "Set goals and stick to them. For instance, the commitment to having a carbon neutral campus by 2030 is a great goal. Having committees and institutional accountability to ensure that VT is on track to meeting this goal is imperative. The specific ways by which these goals can be achieved are highly variable, but there seems to be obvious areas where a huge difference can be made from an institutional level, such as decreasing the energy consumption of campus buildings, pursuing construction practices with a lower carbon footprint, initiating renewable and/or lower emissions energy use for campus power, investing in more sustainable transportation infrastructure around campus and blacksburg."
- "Remove single use plastic bags (banned), support Blacksburg transit in transitioning to electric busses, all buildings should be powered by renewables much sooner than 2040."

Participants were also asked what they would recommend that we as individuals do to address climate change. Responses crossed a wide variety of areas, including but not limited to transportation, energy consumption, waste production, and diet. Two sample responses are:

- "Be the change! Get involved with groups that are creating policies that will help the entire VT community adopt and engage in the efforts. We need to embrace the goals and do our part to achieve them."
- "We as individuals should simply do the "small things". We've seen that, with the spread of COVID-19, things so small as washing your hands and staying 6ft apart make MASSIVE differences in the spread of the disease. Climate change is the same way. Small, little contributions such as turning the lights off, getting more efficient systems, or potentially switching to a solar system, makes a huge difference when everyone does it."

Participants were asked what barriers prevent them from using alternative forms of transportation. 92% of respondents identified 'convenience' as a reason why they drive or get a ride to campus. Comments provided included:

- "During the morning time (8:00-9:00AM) and afternoon time (4:00-5:00pm), the bus is too crowded. And sometimes already full. So it might take me 30-40 minutes to get onto a bus."
- "12 min commute from [Christiansburg] vs. 40+ min by bus and only intermittent service."

72% said 'access (e.g., no bus stop near me)' is a primary barrier. An example comment here: "Nearest bus stop would be several miles walk, along busy roads, with no sidewalks". 60% said 'safety (e.g., no bike lanes)'. Safety concerns expressed in the comments included:

- "When it snows sidewalks are often not clear. One has to either walk in the street or risk falling on the sidewalk."
- "No showers at the Northern Virginia Center"
- Drivers are not used to leaving room for pedestrians or bikers here. Prices Fork over 460 is especially dangerous."

Participants were asked a similar question around diet: "What barrier(s) prevent you from having a more 'sustainable' diet, which may include eating more organics, eating local products, being vegan or vegetarian, and/or eating fair trade or similarly certified foods?" Price was identified as the largest barrier here. "Grad school stipend isn't enough to consistently buy high quality fair trade foods - produce is no issue though", said one respondent. Preferences was the second-highest reason chosen. One respondent shared that " I'm a meat and potatoes guy. That ain't changing." Another lamented that "If there were taxes/ restrictions on eating meat I would follow them, but I'm not convinced one person makes much of a difference by themselves".

Participants were asked what barriers prevent them from being able to reduce (e.g., less packaging), reuse (e.g., travel mug), repurpose (e.g., composting) and/or recycle their waste. This was a purely open-ended question; sample responses include:

- "Lazy"
- "Some apartment complexes do not have recycling programs that allow tenants to recycle their waste."
- "Companies packaging choices are poor for many things (single use plastic)"
- "Most of my waste comes from the lab and field work that I do for my job at VT. One use throw away sampling and processing methods tend to be cheaper and easier, which is a shame! And when working with micro-organisms, you often don't have a choice. It would be great to have a composting facility for the town. I have to do all of my composting in my backyard."

Participants were also asked what barriers prevent them from conserving energy. As with all questions throughout this section, the rich set of responses may be found in *Appendix 2* of the Engagement Subcommittee report. Sample responses include:

- “My biggest energy usage is from lab equipment and driving to field sites.”
- “Not having enough money to energy proof my place. I am trying to do what I can saving money and conserve energy.”
- “I don't have control over the excessive energy use of the building where I work. I don't have access to community-owned solar or wind power.”

A key proposal emerging from the 2020 Climate Action Commitment process is that the university shift to 100% renewable energy. Survey respondents overwhelmingly support this. When asked how important it is, ranging from not important at all (1) to top priority (5), the mean response rate was 4.48. 122 of 187 people that answered this question chose 5.

Demographics

Demographic questions were asked to get a sense of what the response pool looked like. In terms of various constituent groups, the sample was fairly well distributed - 30% are undergraduate students, 21% grad students, 16.6% teaching or research faculty, 6.4% staff, 7% alumni, 4.8% community members without VT-affiliations, 0.5% postdocs (1 person), 9% administrative & professional faculty, and 4.8% other. Based on zip code, the vast majority of respondents live in Blacksburg (at least during the academic year). Those with VT affiliations come from a very wide range of departments. Age-wise, the largest group (38%) are 18-25. Gender-wise, most respondents identify as female.

Unfortunately, there was not a good mix racially or ethnically - 81% of respondents identify as white. 7.7% identified as asian, and there were only two respondents that identify as ‘American Indian or Alaska Native’ and two as ‘Black or African American’. A very high proportion (50%) have professional or graduate degrees, underscoring how different the response poll in this university environment is from the wider public. Politically, the largest proportion (33.5%) identify as ‘liberal’ politically. 18% identify as ‘very liberal’. Only 11% identify as either conservative or slightly conservative. 15.4% identify as ‘moderate/middle of the road’.

5.3 Zoom Convening Ideas and Exit Survey

The Engagement Subcommittee sought to go beyond simply sharing information and collecting feedback to engage community members in a more deliberative process, exploring options together. The Subcommittee had originally planned to hold a face-to-face town hall event, but COVID-19 necessitated a quick pivot to virtual engagement. A series of 12 convenings were subsequently held via Zoom over a five-day period in April. There were at least 226 instances of participation across the 12 sessions, with many individual participants partaking in multiple sessions.

There were three “general” sessions and nine sessions aligned with the following VT Climate Action Commitment subcommittee topics:

- General Sessions: April 22 (21 participants), April 22 (13), and April 28 (22)
- Agriculture, Forestry & Land Use: April 27 (21)
- Building Opportunities: April 24 (13)
- Climate Justice: April 24 (17)

- Energy Opportunities: April 24 (14)
- Greenhouse Gas Emissions Inventory: April 27 (12)
- Renewable Energy Opportunities: April 24 (20)
- Structuring Sustainable Choices: April 23 (21)
- Transportation Opportunities: April 27 (40)
- Waste, Recycling & Procurement: April 28 (21)

Although the topics differed, the process for each Zoom convening session was the same:

- Upon registration for each session, participants were invited to
  - Watch a short video produced by the associated subcommittee, and
  - Respond to the VT Climate Action Commitment survey.
- The virtual engagement sessions each lasted an hour and included the following steps:
  - Brief introductory comments by a member of the subcommittee, which included background research, preliminary findings, and proposed strategy themes;
  - Individual ideation, which was collected through a Google form and then shared back with the group;
  - Small group deliberations on one to three ideas chosen collectively within each small group, again facilitated with guiding questions provided through a Google form;
  - Small group report-outs to the larger group of participants, accompanied by some Q&A and discussions on each small groups' work; and
  - An exit survey participants were asked to complete.

Below is a synthesis of the key collective takeaways from the sessions by topical area. The Community Engagement SC report presents session-by-session results of the Convenings, including ideas generated and small group report-outs.

5.3.1 Climate Action Living Laboratory

This idea of a 'living lab' with opportunities for collaborations between campus operations, research, and teaching generated the most discussion and excitement during several of the Convening sessions. Specific opportunities were discussed relating to energy systems, renewables, buildings, waste management:

- The need to *integrate sustainability in to educational opportunities*, and make sustainably and climate action a reason to come to VT.
- *Energy showcase* - senior design projects or Living Lab w/ operations to show potential donors and alumni. Signals commitment to sustainability.
- Use our *green buildings as learning tools* through virtual tours. Net Zero Energy Buildings + Joint Project with Students.
- *Sustainability education office* - Education for students, staff, and faculty. Way to foster longer-term behavior change with lasting impacts.
- *Focusing on educational programs* - Implement in freshmen orientation so students feel they have a part (duty) in this. Possibly a 1-credit class that all students take so they can navigate what they are interested in & opportunities to learn more. This could be a Pathways requirement.
- One group emphasized opportunities for a 'living lab' for *new technology development*, circular design, and pilot demonstrations.

- VT as a Living Lab setting an example of a healthy ecosystem, *living in harmony with the region*. Involve classes in sustainability implementation.
- The Living Lab is particularly exciting. It puts learning and sustainability into perspective (not just being in a green building).

5.3.2 Renewable Energy

The prospect for renewable electricity development received significant support in the general, energy, and renewables sessions. A few of the statements of support:

- *Integrate renewables into building design*…Install rooftop gardens and solar panels on existing and future campus buildings…Use roof space on buildings for green roofs, photovoltaics… Integrate solar panels into future building design… Put solar on every new building, and on off-campus structures too (e.g., apartment complexes)
- The need to shift to *100% renewable energy*. The focus is on shifting the electricity system first, then all energy, including transportation fuels.
- *More renewable electricity* on campus, accelerating movement away from natural gas.
- Develop *community solar project* with VT Electric Service town customers
- Agrivoltaics was listed as the #2 idea for 4 out of 5 groups, with one identifying it as a viable dual use of land, educational opportunity, research funding, engineering and agriculture instructional benefits, showcase development.
- Solar was identified as a viable option by a group, and in particular on new buildings. There was some overlap with the *energy opportunities* session with groups flagging the need to both reduce peak demand and reduce consumption.
- Take a 'systems approach' that mixes micro-renewable energy generation, battery storage, and a *campus and town micro-grid to increase resilience*. Energy storage was also emphasized as a way to overcome current challenges with the intermittency of renewables.
- *Solar from former coalfields* - Seek opportunities to invest in and source solar power from photovoltaic farms built in formal coalfields as a means of jump-starting an alternative economy in lower-income communities currently dependent on climate damaging industries, stimulating industry in region…VT role in coalfields, payback to region… Revenue sharing with siting communities of renewable energy outputs to wholesale markets.

5.3.3 Transportation

Transportation issues especially alternative mobility and reducing single occupancy vehicle use were prominent topics in the transportation and general sessions. Here are some of the statements heard:

- *Decarbonize transportation by enhancing alternatives* besides driving solo…Need to reduce number of incoming students driving personal vehicles on-campus.
- *Restrict freshman from having cars on campus* - Set habits and norms early on, well supported with Blacksburg Transit, car sharing and other infrastructure.
- Expand *bike lanes and paths* and extend a good bike network into the community, especially to major residential neighborhoods…Enhance safety…Normalize biking over driving...Covered bike parking on campus, which incentivizes biking on campus… Collaborate with the Town of Blacksburg to improve alternative transportation infrastructure.

- Creating *'wheel only'* sections, which permit bikes, scooters etc. (not on sidewalks).
- Move to an *all-electric fleet of Blacksburg Transit* (BT) buses…Expand bus routes in and around Blacksburg, Christiansburg and the New River Valley
- *Reduce private vehicle access and speed limits* in central areas of campus and Blacksburg
- *Pedestrianize the Drillfield* loop, banning and separating cars from accessing central campus during specified times, but making allowances for needs of staff and accessibility
- *Increase parking fees* while creating waivers or sliding scale for low wage employees for parking passes…Fewer parking spaces on campus
- *Game-ify* alternative transportation options on social media to make it fun for students
- Greater accountability for *business air travel*, given that air travel has a large carbon footprint.
- Implement more electric vehicle charging stations on campus.

5.3.4 Energy systems

There was strong support for replacing coal with natural gas in the steam plant, but also for weaning VT from natural gas.

- Strong support for *eliminating coal* from the steam plant right away.
- *Navigating transition away from natural gas* - Natural gas is not a climate-friendly solution and thus should not be seen as such. Transition from natural gas, potentially with geothermal energy
- Switch the campus (centralized) heating system to *geothermal*. Opportunities to go to electric heat on parts of campus as we expand, infrastructure is there already (time, energy, and money)
- *Heating Buildings* - Might need more expertise, maybe use a company that knows geothermal
- *Use geothermal energy*, while recognizing that it can be expensive as a retrofit. There may be opportunities with new buildings, including at a 'district' scale as the campus expands.

5.3.5 GHG emissions/inventory

The Convening GHG inventory session raised issues about GHG sources and geographic scope and the inventory process.

- GHG sources *Scope boundaries* (e.g., adding leased space, like the North End Center and Math Emporium).
- Include *upstream methane leakage* in order to put this out front for consideration
- Effectively measuring GHG emissions by, among other things, adopting and managing effective *GHG accounting software*, and using a standard assessment tool to measure GHG emissions
- *Getting more people involved* in the GHG monitoring process. Educating students, including with a 'carbon footprint test'
- Support for the expansion of *scope boundaries* to inventory partner GHGs and other VT sites…*Expanding the scope* - Expand scope of the CAC to other campuses

5.3.6 Buildings

Ideas for buildings opportunities included using VT buildings including green labs and zero-net energy showcase building in the Living Laboratory, existing building retrofit, building real-time energy monitoring including an Energy Dashboard, and the net-zero-space-growth concept.

- Value of engaging students around *green labs* best practices…Energy efficiency opportunities, including through 'greening labs.'
- Sustainable design methodologies and goals, including a *'zero net energy' building* and integrating biophilic features. Building carbon neutral buildings (and renovations/retrofits).
- Focus on *existing buildings*, not just new buildings…Retrofit buildings, monitoring for efficiency…
- *Lighting solutions* - Lighting strategies + Include students in exploration + LED Retrofits. Improving lighting through both passive & active designs.
- *Online real-time monitoring* of building performance…*Increase monitoring to prompt behavioral change* - Improve operational efficiency and monitoring to increase knowledge and awareness of occupants…Building-level energy dashboard to encourage occupant behavior…Improve energy efficiency (reduce usage), including by improving monitoring and sharing data
- *Accountability and oversight*- Build a "Hokie Team" that focuses on building and energy projects
- *Net zero space growth.* Need to optimize space usage...Better utilization of campus space. *...Growth Plan* - Net zero space growth on campus. If you tear down a building, the new one shouldn't be bigger. Keeps energy use down. Re-educate people about space as an asset, not to be wasted. Think more about shared space.

5.3.7 Agriculture and Forestry

Three issues dominated Convenings discussions related to agriculture and forestry: the proposal for the University Compost Facility at Kentland, tree policy and planting, and sustainable agriculture education.

- Broad support for much more composting as a sustainable way to manage waste…Support for a *compost facility* was listed as the #1 idea for 4 out of 5 groups…There is strong support for a composting facility on campus (or satellite university lands) that can serve the entire campus and Blacksburg
- Integrate with waste management with a *biodigester* at new compost facility
- *Campus tree policy:* Increase tree conservation/planting and increase coverage/canopy cover
- *Sustainble agriculture and local food.* Get the College of Agriculture and Life Sciences to focus research on sustainable agriculture and sustainable food systems. The integration of a *living laboratory* as a pathway towards making these changes using Kentland Farm and Catawba Sustainability Center

5.3.8 Waste management

Waste management including trash, recycling, composting, construction waste, and specialty waste produced several supporting ideas about operations, administration, and compost facility.

- Hire a waste consultant to conduct a campus wide waste audit…Centralize waste management operation under one unit…Hire a Full Time Waste Manager;
- Broad support for the University Compost Facility at Kentland…much more **composting** as a sustainable way to manage waste…Support for a compost facility was listed as the #1 idea for 4 out of 5 groups…Strong support for a composting facility on campus (or satellite university lands) that can serve the entire campus and Blacksburg.
- Improve waste management practices by *improving the infrastructure* across campus…Recycling bins should be separated and labeled…Better bin signage
- Get Athletics more involved in zero waste and promoting it…Host a zero waste event then enhance policies, signage training based on findings
- Integrate with waste management with a biodigester at new compost facility
- Educate students about zero waste at orientation; promote student organizations and other university events to go zero-waste, including with 'game-ification'…Education, training, and outreach to university staff, students, faculty to ensure broad participation
- Offer composting opportunities to residence halls, with weekly collection…Decrease student waste - have to change the culture to get rid of single use plastics and disposable things...Promote student organizations and other university events to go zero-waste.
- Breakout Group Idea: Composting facility widely discussed in all groups

5.3.9 Procurement

Procurement was addressed in the waste/recycling and general sessions because of its importance to both in-flow of materials and services and out-flow of waste and recyclables.

- *Sustainable purchasing policy* with our office supplies, food and beverage, and all other materials to reduce packaging waste…Add an interface directly to HokieMart for sustainable products
- Procurement, purchasing things that are recyclable, sustainably made…Encouragement of *"circular economy" products* through procurement
- Need to integrate social justice by, among other things, adopting ethical sourcing guidelines for purchasing solar and wind tech
- Focus on *lab-specific* waste management
- *Measurement* - Life cycle analysis for purchased products. Also data dashboards displayed on campus showing energy, water, waste, and other key metrics

5.3.10 Climate Justice and social equity

Climate Justice is advanced as a core value of the CAC, and the Convening sessions provided significant support:

- *Community engagement* - Involve community members through focus groups on climate justice matters as well as on ethical issues…Direct engagement with *underrepresented groups on campus* - Importance of actively seeking diverse perspectives while not overburdening under-represented groups.
- Consider social justice implications in purchasing and all other decisions including adopting ethical sourcing guidelines for purchasing solar and wind tech

- *Affordability* - Need to improve energy efficiency at low/no cost for low-income users. Energy cost protections for low-income residents; tiered rate structures…VTES could provide incentives/support for marginalized groups to add rooftop solar
- *Repairing historical harms* - Need to bring non-profit/advocacy leaders from marginalized frontline communities into planning immediately

5.3.11 Sustainable Choices

Some good ideas emerged regarding campus behavior in both sustainable choices and general Convening sessions:

- The need to foster both *structural and individual behavior changes*, including through persuasive design, upping the 'coolness factor' of sustainability, and using a mix of incentives and disincentives (i.e., carrots and sticks)
- *Nudging* changes in transportation behaviors, including by banning freshmen from bringing cars to campus and using various prompts to encourage alternative transport
- *Gamifying Transportation* in Blacksburg - Healthy competition to motivate behavior change, builds community, better utilization of existing services, very low cost.
- *Persuasive, intentional design* - Making sustainable choices easier, e.g., safer bike options, co-benefits for other groups. Promote behavioral change through building design and operation
- *Ban stuff*: no straws, no freshman cars, meatless Mondays, travel carbon caps, no single use plastics
- *Promote stuff*: transportation alternatives, diet alternatives, nudges towards reducing energy consumption, travel, etc.
- *Student Life: Dining and Dorms*- Dining halls: composting, food waste reduction, vegetarian food option days and education for why that is.
- *Waste* - Advance and incentivize waste recycling/composting. Meet aggressive goals for zero waste, touting educational benefits.
- *Food:* Potential behavioral prompts in campus dining; *Expanding sustainable food options on campus* - Aligns well with the agricultural history of the University.

5.3.12 Engagement and Partnerships

Collaboration emerged as a theme in several Convening sessions. Discussion of partnerships with other VT campuses, other universities, the Town of Blacksburg, and other organizations was very useful.

- *Partnerships* with other schools (universities), branching out to other organizations in the future
- *Cross-campus coordination* - Promotes cohesion across campuses (Blacksburg, NOVA, Roanoke, and beyond)
- *Getting more of the community involved* - Improving town-gown and private businesses' linkages to energy management. Shared projects with VT Electric is a great starting place …Need to include the whole community beyond the university's borders
- *Direct engagement with underrepresented groups on campus* - Importance of actively seeking diverse perspectives while not overburdening under-represented groups.

5.3.13 Implementation, Administration and Financial

Some issues related to administration and finances also emerged from participant discussion, including:

- *University Administration* - Increase staff and elevate the Sustainability Office to have reporting lines to both operational and academic sides - office can serve as a bridge between these entities
- Create a *revolving fund* to continually finance energy efficiency projects
- *Divestment* from fossil fuels Divestment from fossil fuels…A call for the university to take a stand, including through divestment… Get rid of coal by 2024. Divest from fossil fuels.

5.3.14 Exit survey outcomes

Participants in all 12 Zoom sessions were asked to complete an exit survey as they wrapped up. The survey had three goals: Evaluate the Zoom Convenings themselves; give participants a final opportunity to provide substantive feedback on the ideas and discussions that emerged during the session; and ask for their ideas on how engagement might take place moving forward, as the updated Climate Action Commitment is implemented.

Of the approximately 226 Zoom session participants, 98 completed exit surveys. Of those that responded, 40 identified as graduate students, 23 as undergraduate students, 17 as administrative/ professional faculty, 19 as teaching and research faculty, 7 as staff, 17 as community members, and 27 as alumni. Note that N (150) is greater than the survey response rate (98) because many people identified more than one affiliation. Some also identified 'other' affiliations, including a few people that work for local agencies (e.g., Blacksburg Transit, regional planning commission) and a couple of retirees. While happy with participation rates overall, the relatively low number of undergraduate and staff participants underscores the need to reach out to those key constituencies as implementation moves forward.

Participants were asked what **ideas they thought were *best* coming out of the sessions**. Not surprisingly, their responses tend to mirror the topics that received the most attention within the sessions. A few common themes are: Better use of rooftops for both energy and greening; the need for broad engagement, including through a 'living laboratory'; shifting to 100% renewable energy; gamification as a way to promote behavior change around transportation and in other domains; the construction of a new VT composting facility; a new campus-wide waste coordinator and regular audits; a new 'net zero' building, while recognizing the need to retrofit existing buildings; the need for climate justice; restricting cars further in the center of campus; not selling parking permits to new freshmen; and coordinating more frequently and deeply with the Town of Blacksburg and other local partners to more effectively achieve objectives, including but not limited to transportation and waste management goals.

The next question asked participants if they have any ***concerns* with ideas discussed**. Most respondents expressed no real concerns. Among those that were expressed, common themes include: Feasibility of implementing in practice, including getting resources. Some participants were clearly not aware of what has already been done; potentially significant pushback will need

be overcome, for example to implement a freshmen car ban. And the emphasis was on shiny new things (buildings, renewables projects) rather than on conservation, efficiency, and restoration.

When asked any **ideas they wish had been discussed**, the most common response was a desire to go into further detail on those that did come up. Unfortunately, an hour per Zoom session was not sufficient to go in depth. Some wished that we could have learned more about what other universities are doing. A few respondents wished more attention had been devoted to the justice considerations, including the implications of adopting policies. Transportation and waste reduction were also common themes, including outside of the respective sessions devoted specifically to those topics.

The Zoom Convenings were organized on a very short timeline as COVID-19 rendered previous face-to-face plans impossible. Given uncertainty around when and how we will be able to return to in-person deliberative engagements, the organizers seek to learn from these experiences. To that end, participants were asked to rate how **productive the Zoom sessions were**, on a scale from 1 (not at all) to 5 (extremely). The average was 4.3, indicating a very positive take on the experiences. Digging deeper, participants were asked for **feedback on how the sessions could be improved**. Both of the two participants that rated the productivity at '2' (there were no '1's) suggested that the goals should have been clearer; one lamented that their group seemed to focus on 'old' topics while (s)he wanted to explore new ideas. A few others felt that the sessions were too short. A couple suggested that there could have been more facilitation in the breakout groups.

When asked what **other ways we could involve people in the CAC update process** in these times of physical distancing, respondents felt that ***social media*** could be more effectively harnessed. Other respondents noted that Zoom sessions and other means of engagement should be better promoted, especially to students and more broadly in the community. It is too late to use that advice with the current process, but it is useful to keep in mind as implementation moves forward. More importantly, we asked respondents **how the administration could best involve people in implementing the CAC moving forward**. Responses included:

- Keeping everyone *informed* of what exactly is happening and how they can be involved through various channels, including:
  - Regular email updates
  - A strong social media presence
  - Spreading both information and engagement opportunities through classes
  - Keeping the CAC websites up-to-date
- Zoom sessions like those run here to continue the *consultation* process
- Expanding the *network* by, among other things:
  - Personally reaching out (by phone, since emails can be ignored) to ask people to be intensively involved
  - Forming strong connections with frontline communities, including with a climate justice advisory committee
  - Strengthening relationships with both community leaders (e.g., elected officials) and residents and neighbors more widely
- Ensure that there is adequate *resourcing* and *expertise* by:
  - Allocating dedicated staff resources (or faculty buyout) to support implementation

    - Finding resources to support others that engage in implementation (e.g., ‘comp’ time for faculty and staff)
    - Taking advantage of alumni, and in particular their expertise
- Make the *carbon neutral by 2030* commitment a major part of the university’s branding in all arenas
- Be open, admitting and discussing challenges

In general, respondents expressed a strong desire to remain involved and see other stakeholders join the effort as implementation moves forward. It is clear that there is a strong foundation for broad community engagement in the implementation of the CAC, but that the network must be significantly expanded.

5.4 Conclusion

The extensive engagement process organized for the 2020 Climate Action Commitment update yielded important insights and provided the community with updates on the work of the group. A few new ideas emerged from participants through the survey and Zoom Convenings, which served as opportunities to assess the viability and support for various options. All signals—including the ‘climate strikes’ and governance resolutions that precipitated this work, the level of intensive involvement in the working group and various subcommittees by more than 120 students, staff, faculty, and community members, and the significant response to outreach efforts despite the pandemic—suggest that there is a strong desire to see climate action at VT *and* that stakeholders are keen to be involved.

Engagement should not stop with the submission of the 2020 CAC update report. Rather, this should be a living process that features ongoing opportunities for students, staff, faculty, and other stakeholders to access information on how VT is progressing against the ambitious goals, contribute and deliberate on new ideas, and find ways to get involved in implementation. The reorganized University Climate Action and Sustainability Office (CASO) and Climate Action, Sustainability, and Energy (CASE) Committee should make ongoing engagement a top priority as the CAC works through governance and hopefully moves into an implementation phase.

6. Progress in Implementing 2009 VT Climate Action Commitment

In April 2008, President Charles Steger charged the **Energy & Sustainability Committee** (E&SC) to develop a Virginia Tech Climate Action Commitment and Sustainability Plan (VTCAC&SP). The E&SC was formed in 2007 to address growing university needs for energy efficiency and interests in sustainability among students, faculty and staff. Because of the strong relationship to the university's physical plant, the committee reported to the Commission on University Support.

The E&SC engaged over 75 stakeholders in preparing the CAC&SP, which was approved by University Council on Earth Day, April 22, 2009, and by the Board of Visitors on June 1, 2009. While the VTCAC&SP was 100 pages with another 100 pages of appendices, the Climate Action Commitment was boiled down to 14 key elements.

In 2012-13, the E&SC decided to review the 14 elements and made minor modifications and added a sustainability definition, vision, and mission, which were approved in May 2013. The E&SC reviewed the Sustainability Plan in 2014 and made modifications that were approved in May 2014. The principal change was tying VT sustainability tracking to the nationally recognized Association for the Advancement of Sustainability in Higher Education's (AASHE) Sustainability Tracking and Rating System (STARS).

6.1 Summary and Introduction

Virginia Tech has made considerable progress implementing its 2009/2013 Climate Action Commitment (2009 VT CAC) during the past decade. The 2009 VT CAC & Sustainability Plan was a leading effort for its time, but a decade later it falls short of both necessary action and recent initiatives of many peer universities.

Virginia Tech is a recognized leader in campus sustainability with a Sustainability Tracking and Rating System (STARS) Gold score that is highest among Virginia and ACC peer schools. VT has won numerous awards and recognitions since 2010, including Princeton Review's top 50 Green Colleges (twice), Governor's Environmental Excellence Award (7 times), Best Workplaces for Commuters (every year, gold in 2019-20), Bicycle Friendly Campus (every year, silver level in 2019), Tree Campus USA certification (every year), and many others.

We have reduced greenhouse gas (GHG) emissions by 24% from 2006 to 2019, despite 22% growth in campus building size and enrollment. This reduction is faster than the 2009 CAC targeted trajectory. It resulted from investments in energy efficiency in existing and new buildings, and most importantly from replacing steam plant coal with natural gas enabled by a new gas pipeline. We now have 36 LEED certified buildings constructed or in process, amounting to 30% of campus space, and in 2015-2020 we invested $14 million in energy efficiency improvements resulting in energy and dollar savings with a 5-year payback.

We have done much to develop alternative transportation choices, from bike racks and dual use trails; to bike share, ride share, car share programs; to increased ridership on our partner Blacksburg Transit; to innovative plans for campus mobility. We have a functional, although fragmented, waste management program with a 80% waste diversion rate (waste diverted from landfill) and 40% recycling rate, although shy of the 50% by 2020 goal of the 2013 VT CAC. In April 2020, our Procurement Department unveiled a Sustainable Procurement Policy, and in May, Facilities

produced new Design and Construction Building Standards, both of which reflect the ideals of the Climate Action Commitment.

We have an enviable array of sustainability-related academic programs, majors, coursework, and research, in green engineering, natural resources, energy systems, and environmental policy, and many others. In the STARS rating system, VT scores 89% of possible points in academic categories. It also scores 95% of possible points in campus engagement. We have a rich campus life for students with a wide array of opportunities, including strong environmental student organizations. Indeed, these student groups have pushed the university to move forward on climate action, both in 2008 and in 2019.

Our Facilities Department has embraced sustainability and climate action as part of its mission, and our Office of Sustainability is second to none, even with limited staff. We have the one-of-a-kind Virginia Tech Electric Service (VTES), a university-owned independent utility that serves not only campus but also 6000 Blacksburg customers.

6.2 Progress Implementing the Virginia Tech 2009 Climate Action Commitment

The 14 elements of the 2009/2013 VT CAC are given in their entirety in Table 6.1. The CAC has served the university well. But the world has changed, and in President Sand's words, "Virginia Tech has a duty to respond." This section reviews the progress toward meeting the VTCAC. It relies on the Sustainability Annual Reports as well as additional data and information developed by the Working Group. This review addresses the elements individually or in groups below.

Table 6.1 Virginia Tech Climate Action Commitment, as revised May 2013

1. Virginia Tech will be a **Leader in Campus Sustainability**. Sustainability is an integral part of the fabric of the university as it pursues enhanced economic stability and affordability, diversity and inclusion, environmental stewardship, expansion of knowledge, and education of future leaders.
2. Virginia Tech will represent the **VTCAC&SP in the university Strategic Plan**.
3. Virginia Tech will establish a target for reduction of **campus GHG emissions to 80% below 1990 emission level** of 188,000 tons by 2050, and interim targets from 2006 emissions of 316,000 tons for 2012, 295,000 tons (on path to 2025 target); for 2025, 255,000 tons (2000 emission level); and for 2050, 38,000 tons (80% below 1990 emission level).
4. Virginia Tech will work toward these emission reduction targets **through improved energy efficiency, reduction of energy waste, replacement of high-carbon fuels**, and other measures identified in the VTCAC&SP.
5. Virginia Tech will maintain a **sustainability office** to:
   a. Coordinate programs for campus sustainability;
   b. Oversee implementation of the VTCAC&SP;
   c. Monitor annual electricity and other energy use and GHG emissions;
   d. Working with faculty and departments, manage a campus-wide student internship and undergraduate research program using the campus as a sustainability laboratory; and
   e. Coordinate communication regarding campus sustainability initiatives and programs to the university community and external audiences.
6. Virginia Tech will improve the sustainability of its **built environment** by:
   a. Achieving **LEED Silver certification or better** for all eligible & applicable new buildings and major renovations;
   b. Evaluating the feasibility of LEED for Existing Buildings certification for its existing buildings.
7. Virginia Tech will **improve electricity and heating efficiency of campus facilities** and their operations by:
   a. Exceeding the most current version of ASHRAE 90.1 energy performance by 10% for all new buildings and major renovations. Capital budgets should account for future energy price, life cycle cost of building operation, and environmental benefits of achieving this level of performance;
   b. Improving the heating and cooling infrastructure and operation, lighting efficiency, equipment efficiency, and metering and controls of its existing buildings.
8. Virginia Tech will **minimize waste and achieve a 50% recycle rate by 2020**.
9. Virginia Tech will:
   a. Require **purchase or lease of Energy Star rated equipment** and maximum practicable recycled content paper, in accordance with University Policy 5505, with exceptions for special uses;
   b. Consider a product's life cycle cost and impact when making purchasing decisions.
10. Virginia Tech will **engage students, faculty, and staff** through education and involvement to develop and implement innovative strategies for efficient and sustainable use of energy, water, and materials in all university-owned facilities.
11. Virginia Tech will **improve transportation energy efficiency** on campus through parking, fleet, and alternative transportation policies and practices. The university will continue to implement programs that encourage the use of alternative transportation methods and will continue to implement programs and services that promote eco-responsible fleet management.
12. Virginia Tech will continue to **develop and implement innovative sustainability-related academic programs** in instruction, research, and outreach, and will coordinate and communicate these programs to the university community and external audiences.
13. Virginia Tech will **monitor energy use and GHG emissions** as well as changing internal and external conditions, prepare an annual 'report card' showing progress towards targets, and periodically re-evaluate targets, making adjustments to targets as appropriate based on changing internal and external conditions and evolving technologies.
14. Virginia Tech will work to **provide funding to support sustainability programs**. With regard to all the items in this resolution, major personnel and investment decisions, including capital projects, associated with implementing the VTCAC&SP will be based on a joint review of costs and benefits by university financial and facilities staff and be subject to availability of funds.

6.2.1

VTCAC #1: *Virginia Tech will be a* ***Leader in Campus Sustainability****. Sustainability is an integral part of the fabric of the university as it pursues enhanced economic stability and affordability, diversity and inclusion, environmental stewardship, expansion of knowledge, and education of future leaders.*

Virginia Tech has continued to be recognized as a campus sustainability leader. Table 2.1 lists the numerous sustainability-related awards and recognitions received in 2010-20. Prominent among them are the 2019 APPA Sustainability Innovation Award For Facilities Management, the Princeton Review "Top 50 Green Colleges" Ranking, several Governor's Environmental Excellence Awards (including gold in 2011 and 2013), and AASHE STARS Gold Rating in 2014 and 2017.

Table 6.1. Virginia Tech, Leader in Campus Sustainability: Selected Awards and Recognition, 2010-2020

2019-20
- **2019 APPA Sustainability Innovation Award For Facilities Management**
- **Princeton Review "Top 50 Green Colleges" Ranking #14**
- Best Campus Food in America, #2 Ranking, Niche
- Best Workplaces for Commuters, Gold Level
- Sierra Club 2019 Cool Schools Ranking
- Tree Campus USA Certification (received every year 2010-2020)
- Princeton Review Guide to Green Schools List (received every year 2010-2020)
- Best Workplaces for Commuters Gold Rating (received every year 2010-2020)

2018-19
- Governor's Environmental Excellence Award, Honorable Mention, "Sustainability Program"
- AASHE 2018 Sustainable Campus Index
- Sierra Club 2018 Cool Schools Ranking
- The Best College Dining Program in Each State, FoodService Director

2017-18
- **STARS Gold Rating from AASHE**
- Governor's Environmental Excellence Award, Honorable Mention, "Reusable To-Go Program"
- Top 10 Best Universities for Healthy Eaters, Healthline

2016-17
- Governor's Environmental Excellence Award, Silver, "Sustainability Week"

2015-16
- NACU Food Service Sustainability award for Reusable To-Go container program

2014-15
- Governor's Environmental Excellence Award, Bronze, "Student Engagement Programming"
- **STARS Gold Rating from AASHE**

2013-14
- Governor's Environmental Excellence Award, Silver, "Dining Services Sustainability Programs"
- STARS Silver Rating from AASHE
- RecycleMania Pledge Recycling Drive Champions
- America Recycles Day Photo Contest First Place
- Keep America Beautiful Recycling Bin Grant Recipients
- USGBC Best of Green Schools, Best Collaboration, "Sustainability Week Program"
- RecycleMania Case Study Competition, First Place, "Caught Green Handed Selfies"

2012-13
- **Governor's Environmental Excellence Award, Gold, "Sustainability Program"**
- **Princeton Review Guide to Green Schools Honor Roll—Top 16 Schools**

2011-12
- STARS Silver Rating from AASHE

2010-11
- **Governor's Environmental Excellence Award, Gold, "Sustainability Plan Implementation"**
- Tree Campus USA Certification (received every year through 2019-20)
- Princeton Review Guide to Green Schools List (received every year through 2019-20)
- Best Workplaces for Commuters Gold Rating (received every year through 2019-20)

The Association for the Advancement of Sustainability in Higher Education (AASHE) monitors and evaluates college sustainability programs. AASHE's Sustainability Tracking, Assessment & Rating System (STARS) is used to assess sustainability progress. More than 400 institutions have earned a STARS rating, making the program the most widely-recognized framework in the world for publicly reporting comprehensive information related to a college or university's sustainability performance. Participants report achievements in five overall areas: academics, engagement, operations, planning and administration, and innovation and leadership.

This program is open to all institutions of higher education. Because STARS ratings are based on credits earned and are transparent and accessible, the program allows for both internal comparisons as well as comparisons among similar institutions. The STARS protocol consists of over 60 topical areas (credits). Data and information submitted are measured against a national standard. Points are earned for each credit. Total points yield an overall rating, Platinum, Gold, Silver, or Bronze.

In 2013, Virginia Tech adopted the AASHE STARS protocol as the foundation of its Sustainability Plan. Virginia Tech has received 4 STARS ratings (2011: Silver; 2013: Silver; 2014: Gold; and 2017: Gold). For the 2017 Gold rating, Virginia Tech earned 71.94 points, which at that time represented the highest achieved for any college or university in the Commonwealth of Virginia, and the highest achieved by peer institutions in the Atlantic Coast Conference. The STARS Gold Rating is good for three years.

VT has received its high rating based on excellent results in Academics and Engagement scoring 87% of possible points and in Coordination/Planning and Diversity/Affordability scoring 90%. However, in specific criteria related to climate change, VT has not fared so well: Operations overall was 43%, drawn down by **Air & Climate (23%), Energy (21%),** and **Food and Dining** (25%). A 2% score in **Investment & Finance** was due to lack of information on investment portfolio of the Foundation.

Table 6.2. 2017 Virginia Tech STARS Score

Topical Areas (Credits)	Points Earned	Maximum Points	Percentage
Academics	**51.45**	**58**	**89%**
Curriculum	35.01	40	88%
Research	16.44	18	91%
Engagement	**34.89**	**41**	**85%**
Campus Engagement	20.00	21	95%
Public Engagement	14.89	20	74%
Operations	**29.40**	**69**	**43%**
Air & Climate	*2.52*	*11*	*23%*
Buildings	4.25	8	53%
Energy	*2.12*	*10*	*21%*
Food & Dining	2.00	8	25%
Grounds	1.88	3	63%
Purchasing	4.59	6	77%
Transportation	3.90	7	56%
Waste	5.29	10	53%
Water	2.85	6	48%
Planning & Administration	**20.14**	**32**	**63%**
Coordination & Planning	7.75	8	97%
Diversity & Affordability	8.42	10	84%
Investment & Finance	*0.12*	*7*	*2%*
Wellbeing & Work	3.85	7	55%
Innovation & Leadership	4.00		

6.2.2
VTCAC #2: *Virginia Tech will represent the* ***VTCAC&SP in the university Strategic Plan***

In 2009, the committee wanted the university to formally recognize the Climate Action Commitment in the Strategic Plan that was revisited a few years earlier. The Plan had not mentioned sustainability previously, and the committee wanted reference. Thereafter, university plans have represented the CAC in general terms, and the president's annual report often highlighted sustainability accomplishments. But strategic planning changed in subsequent years and other plans including a variety of master plans were more specific to the needs of the CAC.

The latest Strategic plan *The Virginia Tech Difference: Advancing Beyond Boundaries*, approved in June 2019, recognizes the 2009/2013 CAC in Strategic Priority 4:

> Approved by the Board of Visitors on June 1, 2009, the Virginia Tech Climate Action Commitment envisions Virginia Tech as a model community for a sustainable society. The Virginia Tech Climate Action Commitment affirms that Virginia Tech will be a leader in campus sustainability and outlines several goals and milestones for improving sustainability. Areas of focus include reducing emissions, improving sustainability of the built environment, minimizing waste, and improving electricity, heating, and transportation efficiency. Virginia Tech engages and involves the university community in these efforts through multiple activities including the development and implementation of sustainability-related academic programs and innovative strategies for efficient and sustainable use of energy, water, and materials in all university owned facilities.

The *Campus Master Plan Beyond Boundaries 2018*, approved November 2018, gets more specific. It includes a network of amenities and services designed to improve the student experience; an integrated approach to accessibility and mobility; and a series of mixed-use districts featuring new cross-disciplinary academic, research, and partnership facilities. It has five overarching goals (1) enhance learning and research environments; (2) expand strategic partnerships; (3) protect the land grant legacy; (4) facilitate accessibility and mobility; and (5) foster an inclusive campus experience. Still pretty general, but it gets more specific in the Sustainability Outcomes section. The intent is to

- Minimize consumption of natural land and reduce vehicular emissions via a land use strategy focusing on infill development rather than sprawl (including a growth boundary established by the proposed Western Perimeter Road);
- Reduce vehicular emissions via an alternative transportation-focused mobility system (e.g. transit, walking, bicycles), the relocation of parking to the perimeter of campus, and the construction of a transit hub at the academic core;
- Advance green stormwater and carbon sequestration efforts through strategic reforestation along major campus corridors and the integration of substantial landscape elements into the proposed accessible pathway system (particularly the Green Links);
- Conserve energy by promoting energy-efficient building siting and design, as well as conversion to alternative energy sources (in keeping with the university's climate action commitment).

This reference is the most specific reference to the 2009/2013 CAC of any university plan to-date. But other more focused plans and standards have embraced the spirit and intent of the CAC, including the Parking and Transportation Master Plan (2014), the Five-Year Energy Management Plan (2015), the Bicycle Parking Master Plan, the Electric Vehicle Master Plan, among others. And other related plans are in the works and have been embraced by our current 2020 VT CAC,

including Building Design and Construction Standards (2020), Sustainable Procurement Policy (2020), Campus Tree Policy, and Utility Master Plan.

6.2.3

VTCAC #5: *Virginia Tech will* ***maintain a sustainability office*** *to:*

a. *Coordinate programs for campus sustainability;*
b. *Oversee implementation of the VTCAC&SP;*
c. *Monitor annual electricity and other energy use and GHG emissions;*
d. *Working with faculty and departments, manage a campus-wide student internship and undergraduate research program using the campus as a sustainability laboratory; and*
e. *Coordinate communication regarding campus sustainability initiatives and programs to the university community and external audiences.*

VTCAC #13: *Virginia Tech will* ***monitor energy use and GHG emissions*** *as well as changing internal and external conditions, prepare an* ***annual 'report card'*** *showing progress towards targets, and periodically re-evaluate targets, making adjustments to targets as appropriate based on changing internal and external conditions and evolving technologies.*

The Sustainability Office had been initiated before the 2009 CAC&SP, but element #5 was intended to define its mission and to firmly establish it in university organizational structure and governance. Over the last decade, it has been one of the most successful outcomes of the VT CAC&SP, largely as a result of its long time head, Denny Cochrane.

With a staff of two plus a graduate assistant, the office has provided all of the specified duties listed above, although it leans on the energy manager's office for data on energy and GHG emissions. The Office is instrumental in nominating the university for various sustainability recognitions, operates the very successful sustainability internship program and Green RfP program, and performs the Herculean task of preparing and submitting data and information for the AASHE STARS rating system, which as discussed previously, is critical to Virginia Tech's standing in sustainability.

The **Sustainability Internship Program** and Green RfP Programs are worth highlighting. For many years, the office has accepted 20 students each year to create lasting, sustainable change at VT while developing professional skills through experiential learning. The program uses the campus and the community as a living-learning laboratory.

The Sustainability Office and the Energy & Sustainability Committee (E&SC) operate the **Green RfP program,** which funds student-proposed sustainability projects on campus. From 2010-2019, the university has provided more than $1 million to support these projects, giving students an important voice in campus sustainability and climate action.

The Office of Sustainability prepares the **Sustainability Annual Report,** the **"annual report card"** of element #13. It gives a comprehensive assessment of annual progress of the CAC element by element. The report is mainly descriptive and complimentary of VT progress, but the effort resulted in a re-evaluation and revision of the 2009 CAC in 2013. The revision process by a subcommittee of the E&SC mostly validated the elements with a few changes including shortening the deadline for achieving 50% waste recycling rate from 2025 to 2020. The following year, the Sustainability Plan was revised by embracing the AASHE STARS protocol as the principal means of monitoring VT sustainability progress.

6.2.4

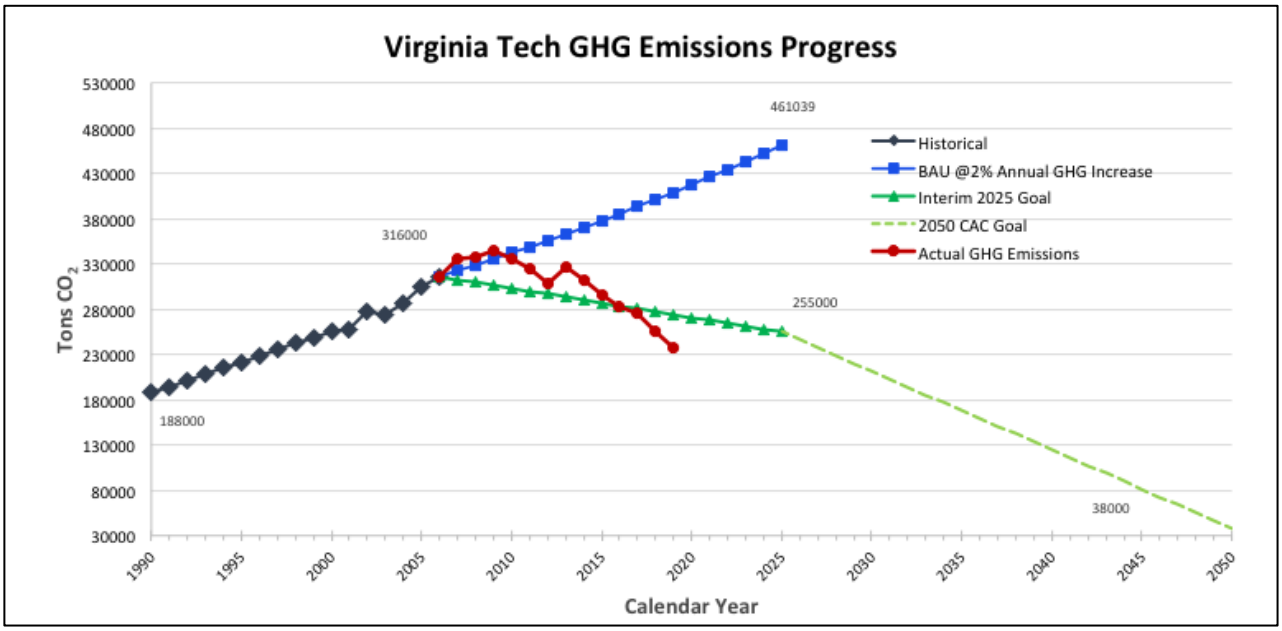
VTCAC #3: *Virginia Tech will establish a target for* ***reduction of campus GHG emissions to 80% below 1990 emission level*** *of 188,000 tons by 2050, and interim targets from 2006 emissions of 316,000 tons for 2012, 295,000 tons (on path to 2025 target); for 2025, 255,000 tons (2000 emission level); and for 2050, 38,000 tons (80% below 1990 emission level).*

Figure 6.1 from VT Facilities Office graphs the VT GHG calendar year emissions against this commitment. From this plot, it is seen that VT has already met the 2025 target. It should be noted that the data in Figure 6.1 includes the addition of new buildings on campus over time. Table 6.3 below shows the main campus building gross square footage (gsf) and the student body enrollment for the first year of the GHG inventory and 2019. GHG emissions have dropped 24% while campus gsf and enrollment increased 22%. Figure 6.2a gives emissions 2011-19 and Figure 6.2b normalized the data to campus square footage to show GHG intensity.

Table 6.3 VT Campus Emissions, Square Footage, Enrollment

Year	2006	2019	Change (%)
GHG Emissions (tons CO_2)	316,000	240,959	-23.7%
Main Campus Square Footage (ft^2)	8,712,895	10,615,927	+21.8%
Main Campus Enrollment	28,259 (2008)	34,131	+20.8%

Figures 6.1: GHG Emissions Progress



Figures 6.2a-b: Carbon Footprint, and Carbon Footprint per gross square foot (gsf)

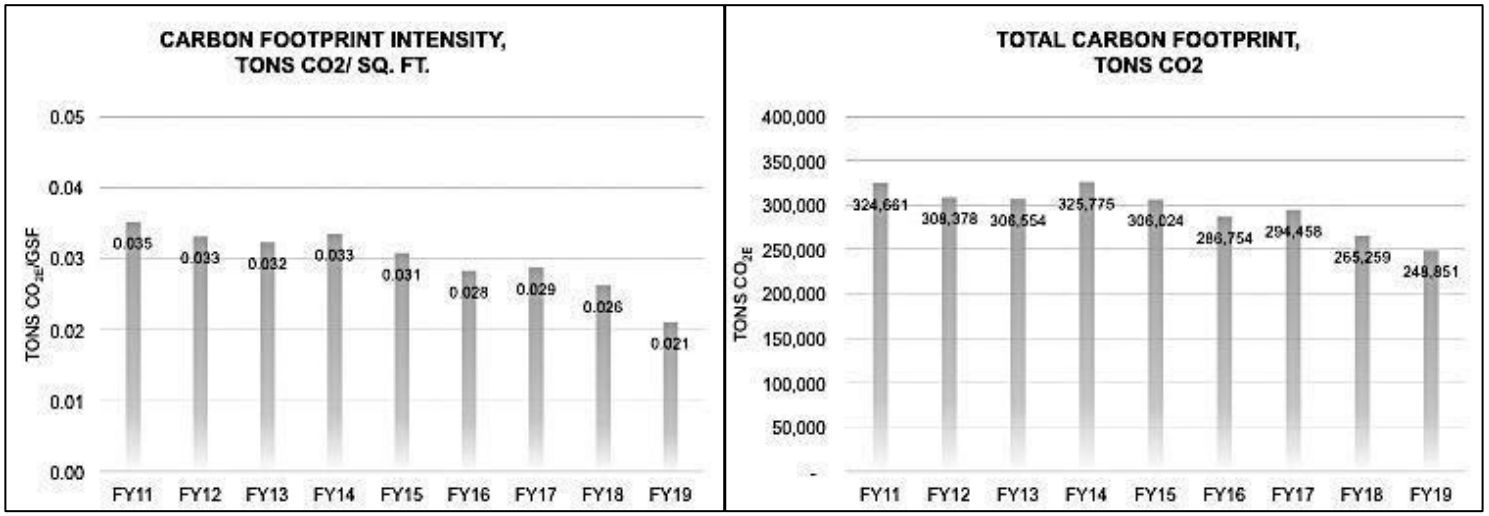


Figure 6.3. Breakdown of VT 2019 GHG Emissions

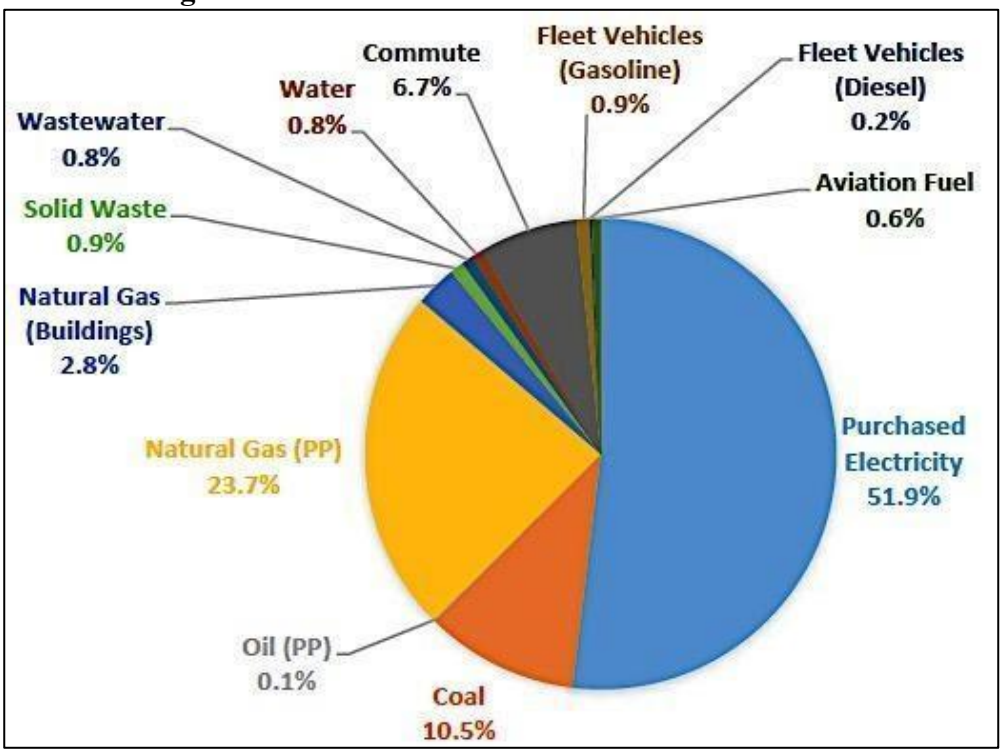


Figure 6.3 gives GHG sources in 2019. Purchased electricity from APCO is the dominant source of GHG emissions at 52%, with coal and natural gas in the steam plant 34%, and other natural gas 3%. Transportation fuel for commuting and VT operations is about 8%.

The good news from Figure 6.1 is that despite significant growth in enrollment and building area (+20+%) Virginia Tech has reduced its absolute CO_2 emissions (-20+%) to 2019 at a rate faster than the trajectory to the 2009/2013 VTCAC interim goal for 2025, and indeed is 5% below that goal six years early. The reasons for the decline are because efficiency improvements and fuel switching related to VTCAC #4, 6, and 7.

6.2.5

VTCAC #4 *Virginia Tech will work toward these emission reduction targets through improved* ***energy efficiency, reduction of energy waste, replacement of high-carbon fuels****, and other measures identified in the VTCAC&SP.*

VTCAC #6 *Virginia Tech will improve the sustainability of its built environment by:*

a. *Achieving* ***LEED Silver certification or better*** *for all eligible and applicable new buildings and major renovations;*
b. *Evaluating the feasibility of LEED for Existing Buildings certification for its existing buildings.*

VTCAC #7 *Virginia Tech will improve* ***electricity and heating efficiency*** *of campus facilities and their operations by:*

a. *Exceeding the most current version of* ***ASHRAE 90.1 energy performance by 10%*** *for all new buildings and major renovations. Capital budgets should account for future energy price, life cycle cost of building operation, and environmental benefits of achieving this level of performance;*
b. *Improving the heating and cooling infrastructure and operation, lighting efficiency, equipment efficiency, and metering and controls of its* ***existing buildings.***

There are three primary reasons for the 24% reduction of campus GHG emissions from 2006 to 2019 despite a 20% increase in square footage and enrollment:

1. Fuel switching from mostly coal to mostly natural gas in the steam plant,
2. APCO's electricity fuel mix becoming less carbon-intensive,
3. Investment in efficiency: LEED-Silver new buildings and retrofit of existing buildings.

1. Fuel Switching from Coal to Natural Gas in the VT Steam Plant, Steam Plant Upgrades

Virginia Tech's nearly 1 trillion Btu/year steam plant has long provided central steam to heat most of the campus and cogenerated about 10% of VTES electricity. Coal was the primary fuel until 2015 when Tech worked with ATMOS Energy to install a larger gas pipeline to the plant, and natural gas has become the plant's primary fuel. This conversion and its effects are described in Figure 6.4a-d. Between 2009-10 and 2018-19 coal use declined 79% (Figure 6.4a). In 2009-10, natural gas supplied only 3% of steam plant fuel; in 2018-19 it supplied 80% and it 2019-20 93% (6.4b, 6.4d). This has led to a significant reduction of steam plant CO_2 emissions per campus gsf, down 41% from 2009-10 to 2018-19 (6.4c). Steam plant CO_2 of 140,000 tons in 2009-10 halved to 72,000 tons in 2019-20.

In addition to fuel switching, the steam plant fuel use has become more efficient through replacing old boilers with new, efficient gas boilers. While this is all good news, future GHG reduction from fuel switching is limited as we are close to full conversion to natural gas.

2. APCO Electricity Fuel Mix from 90% coal to 63% coal

VTES buys 90% of our electricity from APCO. The utility and its parent American Electric Power (AEP) are converting from coal to cleaner fuels. APCO's fuel mix was 90+% coal in 2006 and 63% in 2018, with continuing movement from coal to renewables according to plans of APCO's parent AEP. Figure 6.5 shows overall AEP fuel mix in 1999, 2005, and 2019, and "Future" fuel mix with expected changes for 2030. APCO's fuel mix now is more coal and carbon intensive (1.57 $lbCO_2$/kWh) than AEP system-wide (1.38 $lbCO_2$/kWh), so APCO's future may have slightly more coal than Figure 6.5. However, Virginia's Clean Economy Act enacted in 2020 will accelerate APCO's movement to renewables, requiring 30% renewables by 2030 and 100% renewables by 2050. The greater APCO's renewable mix, the lower are VT's GHG emissions and the less renewables we have to build/buy.

Figure 6.4a-d: Steam Plant Fuel and CO_2 Emissions, 2009-2019

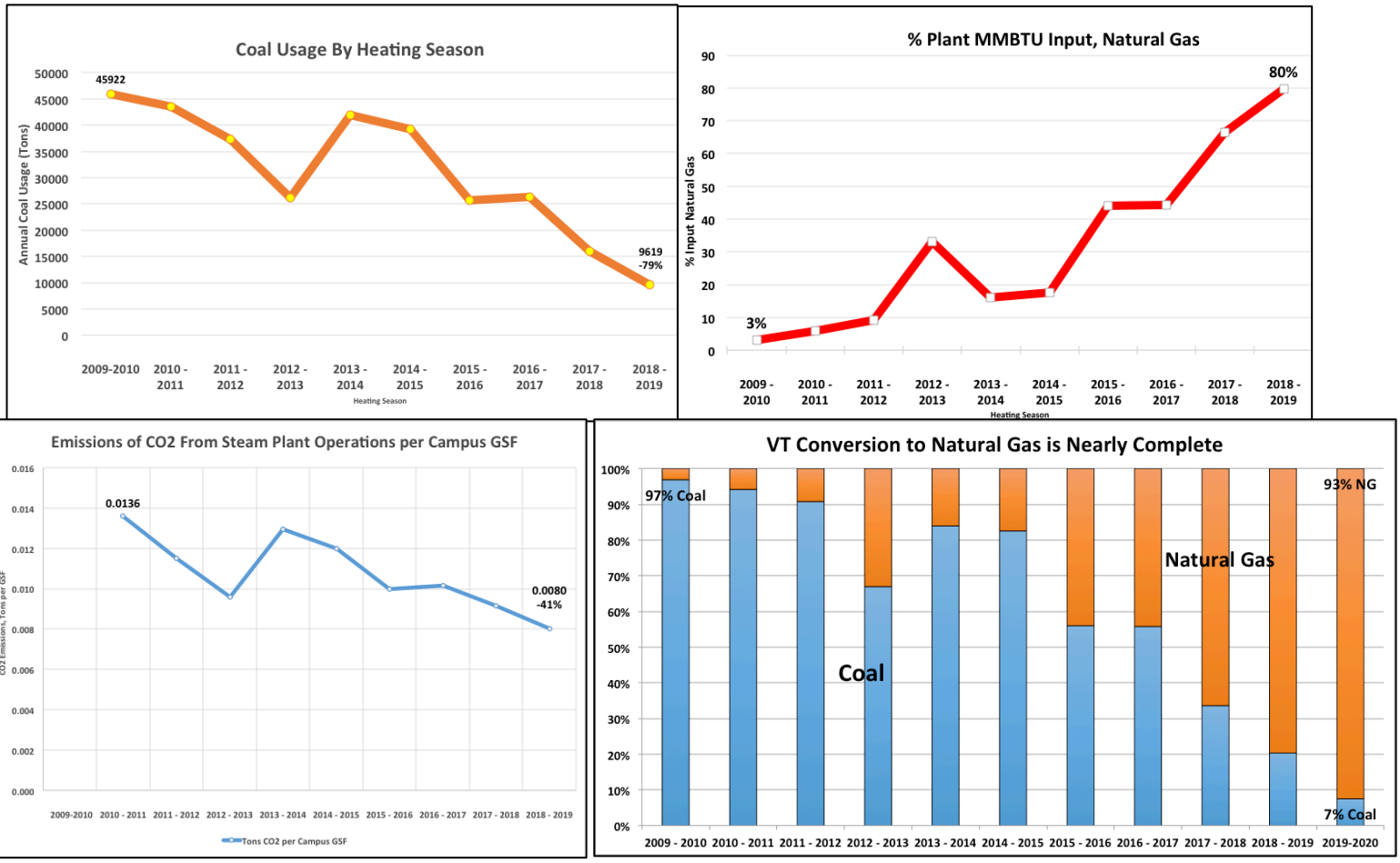
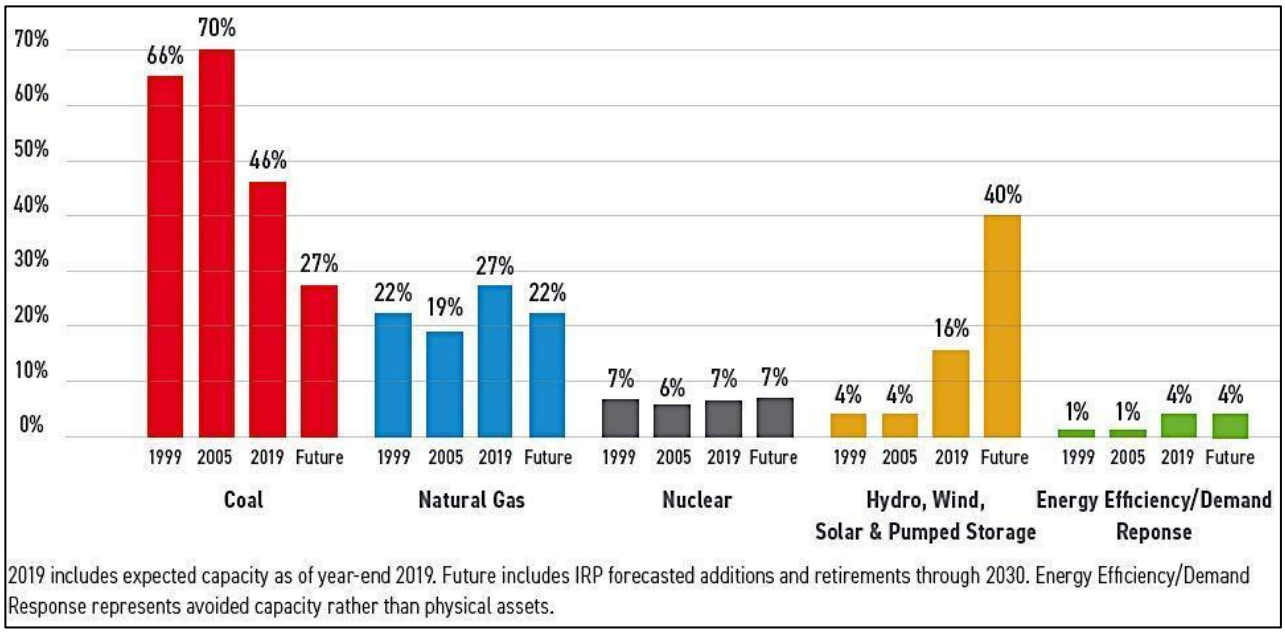


Figure 6.5: Transforming AEP's Power Plant Fleet for a Clean Energy Future



3. Investment in Efficiency: LEED Buildings and Five-Year Energy Management Plan 2015-20

3a. The 2009 VTCAC item #6 required all new VT buildings and major renovations, including E&G and auxiliary buildings, to be built to **LEED-Silver standards** and to meet **ASHRAE 90.1 energy performance + 10%**. Figure 6.6a gives the 2-25-2020 status of VT LEED projects about 3.1 million ft^2 or 30% of campus building space. Figure 6.6b illustrates 16 of VT's LEED certified buildings.

LEED standards are continually upgraded and the latest version is LEED 4.0. To achieve Silver rating, projects must score 50-59 points out of a possible 110. Zero-point prerequisite for Silver is to exceed ASHRAE 90.1 by 5%. The largest single category is Energy & Climate (E&C, 33 points) and the largest single criterion in that category is Optimize Energy Performance (OEP, 18 points). To get just half of the OEP points requires demonstrating 22% better energy performance over baseline code building. There are other categories and criteria to get LEED points, but it is difficult to achieve Silver status without scoring well in OEP, which requires significant energy performance above code.

Figure 6.6a. VT LEED Project Status as of 2-25-2020. Figure 6.6b. 16 LEED Buildings, 2010-18

	Number of Buildings	Gross Sq. Ft. (GSF)
❑ Projects Completed:		
✓ LEED Certification - *Attained*	16	1,302,345
▪ LEED Certification - *Pending*	7	295,730
❑ Projects under Construction:		
▪ LEED *Registered*	5	504,253
❑ Projects under Design:		
▪ LEED *Registered*	4	439,106
▪ *LEED Registration Pending:*	4	592,500
❑ Total:	36	3,133,934

3b. Energy efficiency and reduced emissions in new buildings are essential, but to reduce overall emissions we must address efficiency of our existing buildings. In 2015-16, the Facilities Department conducted a benchmarking analysis of campus buildings and identified about fifty energy intensive buildings or "energy hogs". ***Representing only 35% of the university's grounds, these facilities collectively account for approximately 70% of campus utility costs.***

In 2015, VT initiated a **Five-Year Energy Management Plan**, 2015-2020 to focus on ten of these buildings per year and make other improvements for metering and chiller efficiency. Now in its fifth year, the program has invested $14.2 million or about $3 million per year and resulted in energy savings that are estimated to pay back the investment in 5.3 years, as shown in Figure 6.7, which anticipates 2020 projects. Many of these improvements will have a 10-20 year life. Projects included LED lighting retrofits, new steam meters on buildings, retro-commissioning (thorough inspection of old building systems), and putting more buildings on energy monitoring soft-ware, among others.

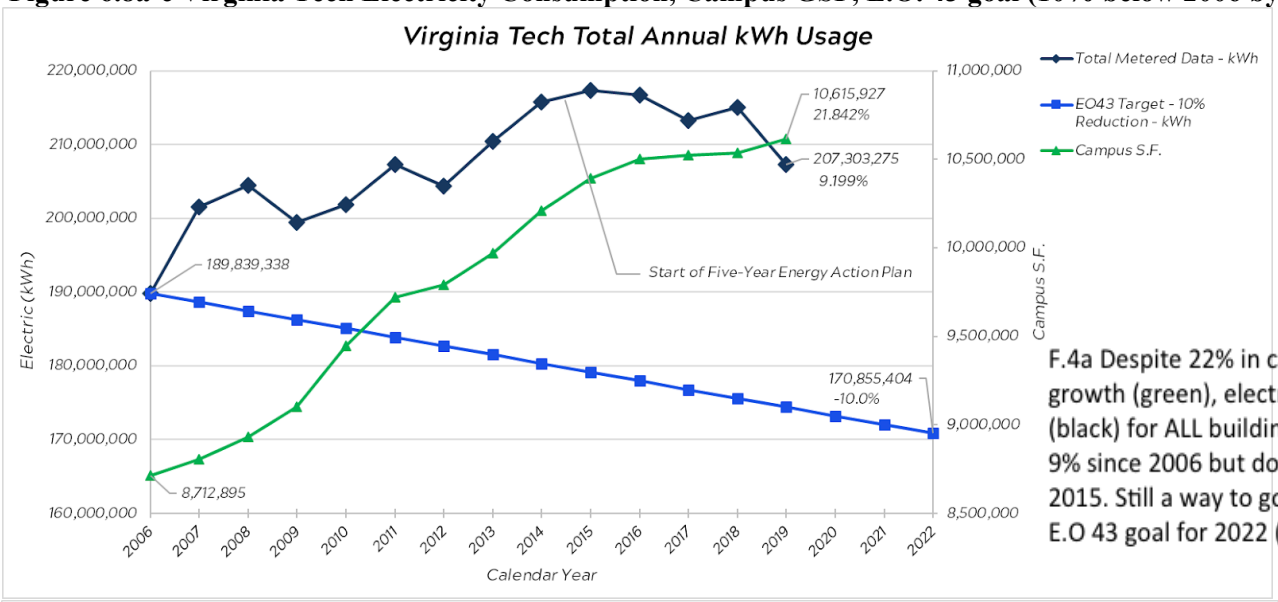
Figure 6.7 Five-year Energy Management Plan, 2015-2020: Estimated/As-built Costs, Savings, Payback

Energy Conservation Measure/Program	Estimated Cost, $	Estimated Savings, $	As-built Cost, $	As-built Savings, $	Payback, Yr
Implement various energy retrofit projects identified in Phase 1	1,975,000	295,000	1,917,790	337,691	5.7
Implement various energy retrofit projects identified in Phase 2	2,700,000	645,000	2,537,534	581,905	4.4
Implement various energy retrofit projects identified in Phase 3	2,535,000	710,000	2,641,609	594,694	4.4
Implement various energy retrofit projects identified in Phase 4	2,200,000	540,000	1,686,081	315,506	5.3
Implement various energy retrofit projects identified in Phase 5	1,750,000	425,000	1,676,124	309,140	5.4
Install new steam meters in the buildings	1,985,000	255,000	2,092,414	0	-
Integrate more buildings to ICONICS	775,000	320,000	751,067	0	-
Retro-commissioning program	840,000	315,000	624,057	539,054	1.2
Sterrett PV Rooftop Solar Project	1,130,000	59,500	-	-	-
Part-time Students/Energy Engineer + Auditor/Field Controls Tech	480,000	-	277,155	0	-
TOTAL	16,370,000	3,564,500	14,203,831	2,677,989	5.3

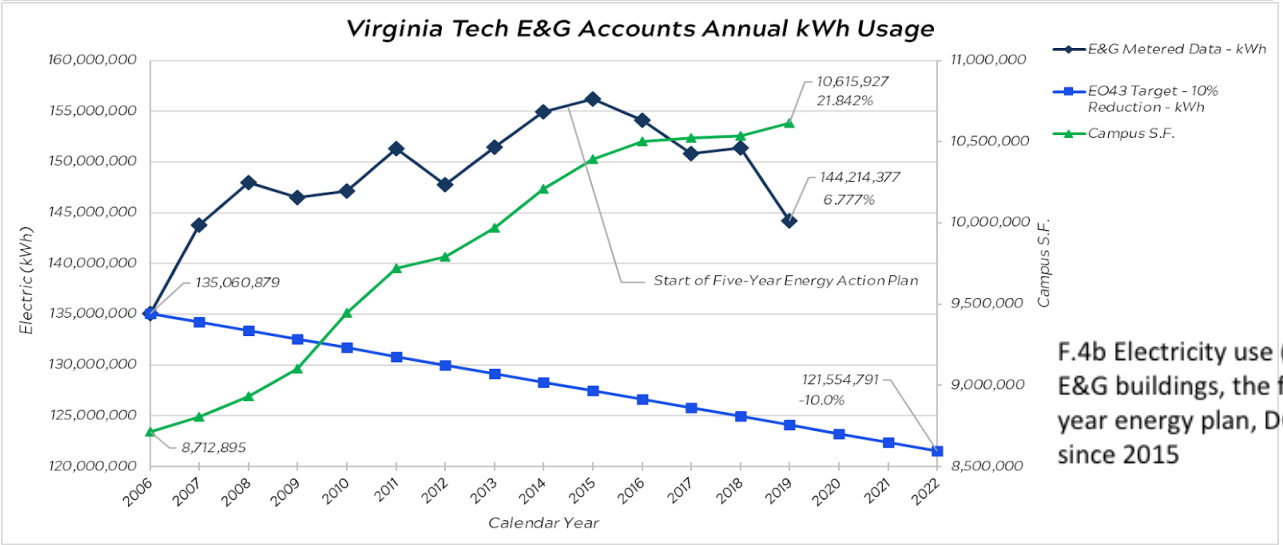
The last year of the Five-year Energy Management Plan is this year 2020. The success of the program is apparent in Figure 6.8a-c below, which shows VT annual electricity usage and campus growth in building area from 2006 to 2019. F.6.8a gives electricity use for all buildings: it increased significantly from 2006 to 2015, but has declined sharply since 2015, despite continued campus growth. This decline is largely due to the Five-Year Energy Plan. The effect of the plan is even more dramatic as shown in F.6.8b and 6.8c, which show the same data but for E&G buildings (6.8b) that have been part of the Five-year Plan and Auxiliary buildings (6.8c) that have not been. E&G buildings electricity use has fallen sharply since the Plan started. Auxiliary buildings have risen.

The figures also show, in blue, the goal of the Governor's Executive Order 43 calling on all state agencies to reduce their electricity consumption in 2022 by 10% compared to 2006. VT has some work to do to achieve this 2022 goal. Upgrading the Energy Management program is essential and a similar program needs to be implemented on Auxiliary buildings probably using a different financing mechanism.

Figure 6.8a-c Virginia Tech Electricity Consumption, Campus GSF, E.O. 43 goal (10% below 2006 by 2022)



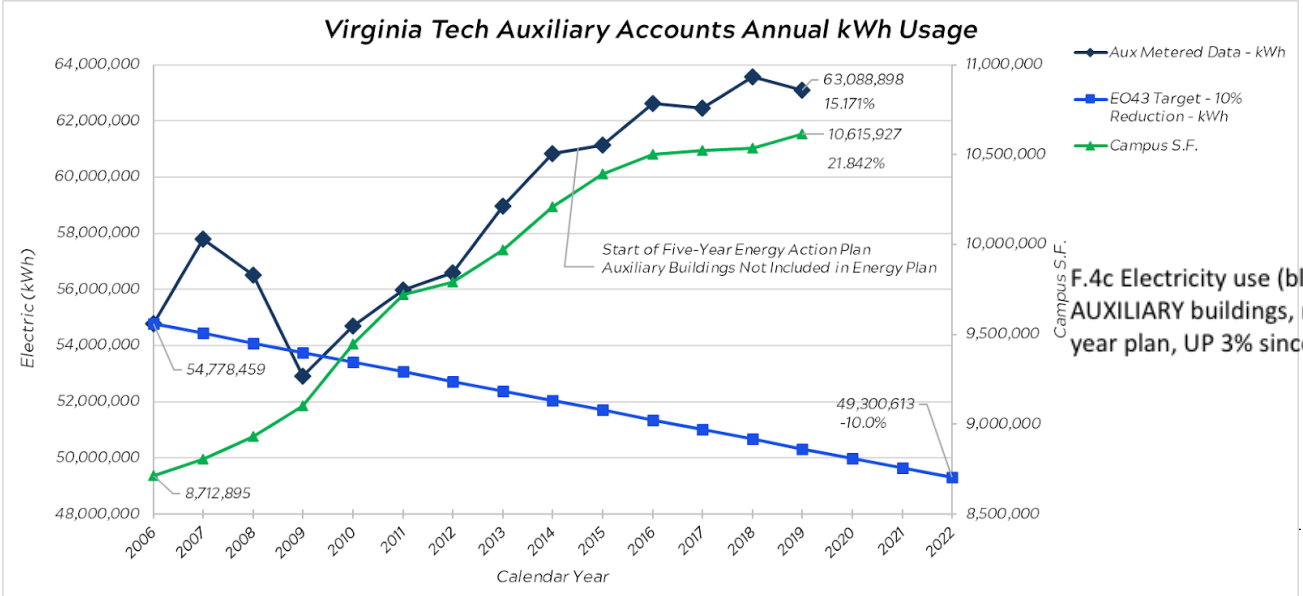
F.4a Despite 22% in campus growth (green), electricity use (black) for ALL buildings up just 9% since 2006 but down 4% since 2015. Still a way to go to meet E.O 43 goal for 2022 (blue)



F.4b Electricity use (black) for E&G buildings, the focus of 5-year energy plan, DOWN 8% since 2015

3c. Chiller efficiency planning

The steam plant provides heating, but cooling is provided by the campus chiller network. As shown



F.4c Electricity use (black) for AUXILIARY buildings, not in 5-year plan, UP 3% since 2015

in Table 6.2a, chillers consume about 16% of total campus electricity. There are two central chillers, others serving more than one building, and several serving individual buildings, as shown in Table 6.2b. Facilities has been studying means of improving efficiency, which can be achieved with efficiency improvements and shifting more buildings to central chillers.

Table 6.2a Chiller Electricity Consumption

Summary - 2016-2019 Annual Average Chiller Electric Consumption		
Chiller Electric Accounts	23,398,346	kWh
Estimated Chiller Electric Usage from Building	10,029,662	kWh
Other Chillers Estimated	91,000	kWh
Total Chiller Estimated Usage	**33,519,008**	kWh
Total Annual Electric Bill - E&G & Aux 4-Year Avg	212,598,203	kWh
Chiller % of E&G & Auxiliary Buildings Bills	15.77%	

Table 6.2b Chiller Data

VPI & SU CHILLER SUMMARY

Location	Capacity (tons)
Ag Forestry #1	450
Ag Forestry #2	450
Agnew	240
Anerobe	300
Basketball Practice Facility	140
Bioinfomatics 1 #1	175
Bioinfomatics 1 #2	175
Bioinfomatics 2 #1	310
Bioinfomatics 2 #2	310
North Chiller Plant #1	3000
North Chiller Plant #2	3000
North Chiller Plant #3	1480
North Chiller Plant #4	1480
North Chiller Plant #5	1500
Cheatham	350
Dietrick #1	750
Dietrick #2	750
Football Locker Rm	275
Fralin #1	275
Fralin #2	275
Grove,The	23
Henderson Hall	169
Hillcrest	40
IDRF	120
Inn Conf CTR #1	450
Inn Conf CTR #2	450
Lane End Zone	330
Lane West #1	500
Lane West #2	500
Litton Reaves (Process)	310
McComas #1	100
McComas #2	110
McComas #3	110
Merryman	130
New Residence Hall West	185
Owens #1	400
Owens #2	400
Pamplin #1	650
Pamplin #2	600
Plantation Road - ARDF	30
Plantation Road - ARDF	20
Sandy	40
Southwest Chiller Plant #1	1500
Southwest Chiller Plant #2	1500
Southwest Chiller Plant #3	3000
Squires #1	550
Squires #2	350
Vet IDU	80
Vet Med #1	650
Vet Med #2	600
Vet Med #3	580
Visitor Center	65

Serves multiple buildings

3d. Design and Construction Standards, May 2020

The Virginia Tech Design and Construction Standards (DCSM) is a continually revised document to keep up with increasing sustainability goals and requirements as well as the ever changing construction industry. The DCSM is required for all Virginia Tech projects, both capital and non-capital. One of the requirements set forth in the DCSM is to follow the Virginia Tech Climate Action Commitment (CAC) and its goals and standards. This requirement allows Virginia Tech to modify our sustainability goals through the CAC and the DCSM will stay on target for designers and contractors. The DCSM also has specific requirements that are in conjunction with the goal of the CAC, such as a minimum of LEED-Silver being the standard for sustainability on new buildings. This standard brings in all different aspects of sustainability and keeps Virginia Tech at the forefront of green building development.

6.2.6

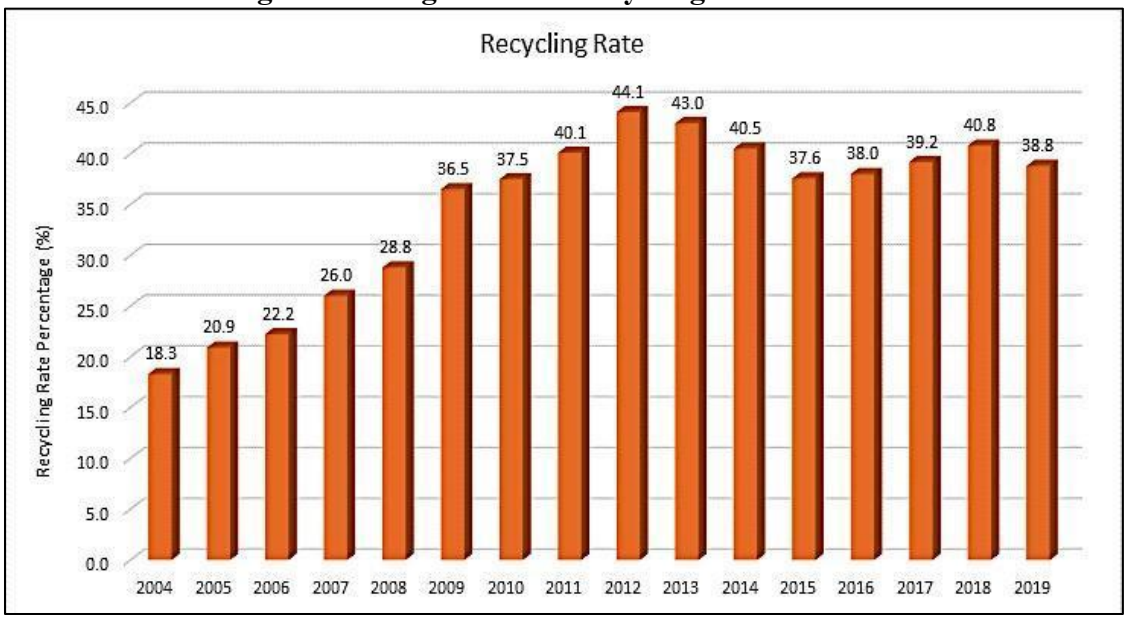
VT CAC #8: *Virginia Tech will* ***minimize waste and achieve a 50% recycle rate by 2020.***

Figure 6.9 gives Virginia Tech's recycling progress since 2004. In 2004, Virginia Tech had a recycling rate of 18% and doubled it by 2009. The 2009/2013 Virginia Tech Climate Action Commitment (VTCAC) Point #8 stated: "Virginia Tech will adopt a goal of 35% recycle rate by 2012 and 50% by 2025." By 2012, the rate had increased to 44% as a result of food waste composting, so the 2013 revision to the VTCAC moved up the target date for 50% recycling rate from 2025 to 2020.

However, the recycling rate peaked at 44% in 2012, and subsequently dropped mostly due to the unexpected 2015 closing of the Poplar Manor Enterprises composting facility, located in nearby Riner. It took two years to establish a composting contract with Royal Oak Farm (ROF), 77 miles from Blacksburg, the only permitted composting facility within 100 miles of Virginia Tech.

In 2019 the university generated 2,031 tons of principal recyclable materials (PRMs), and achieved a 39% recycle rate. Our food waste composting (566 tons) represents nearly 28% of our PRMs. Our waste diversion rate was 80%, including Hokie Stone waste rock crushed to usable gravel.

Figure 6.9 Virginia Tech Recycling Rate 2004-2019



Despite the dip in recycling rate, Virginia Tech has made considerable improvements in waste management since 2009. Management is functional but is complex and fragmented across a number of departments, including **Facilities Building & Grounds** (trash and recycling from all buildings), **Dining Services** (food waste composting from 11 dining halls), **Environment Health & Safety** (hazardous and electronic waste), animal waste by relevant departments, **Procurement** for disposition of surplus property, and **construction contractors** for construction waste.

Virginia Tech partners with local jurisdictions in the Montgomery Regional Solid Waste Authority (MRSWA), through which solid waste is sent to the New River Resource Authority's landfill near Dublin and principal recyclable materials (PRM) are sent to Recycling and Disposal Solutions in Roanoke. Food waste composting, considered a recyclable material, is transported 77 miles to Royal Oak Farm (ROF) near Lynchburg.

While waste management at Tech is functional, there are notable opportunities for more efficient organization and management of trash, recycling, food waste, and other wastes. A big upgrade would be a University compost facility to process all campus food waste and animal and other organic waste.

6.2.7

VTCAC #9 *Virginia Tech will:*

Require ***purchase*** *or lease of* ***Energy Star rated equipment*** *and maximum practicable recycled content paper****,*** *in accordance with University Policy 5505, with exceptions for special uses; Consider a product's* ***life cycle cost and impact*** *when making purchasing decisions.*

Policy 5505 reinforced CAC #9 on procurement and the University made progress in centralizing recycled paper purchasing and purchasing Energy Star equipment. Procurement Department also handles surplus property and Hokie Swap and Surplus that facilitates reuse of office furniture and equipment. In 2019, Procurement initiated development of a Sustainable Procurement Policy that aimed to conform to the goals of the 2009/2013 VT CAC. It was adopted in April 2020.

6.2.8

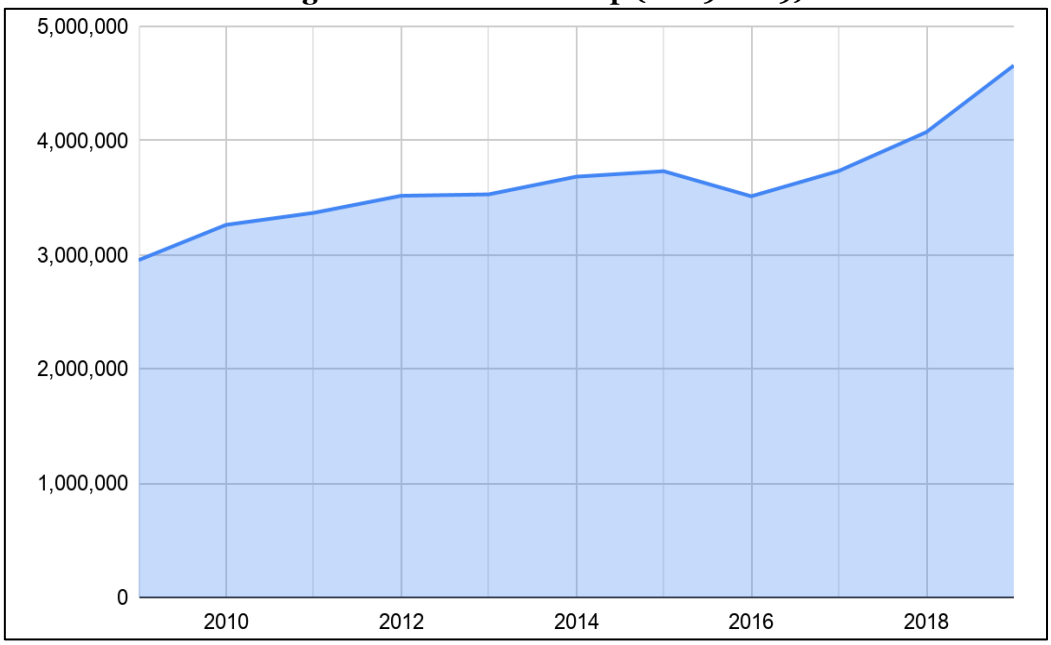
VTCAC #11: *Virginia Tech will improve* ***transportation energy efficiency on campus*** *through parking, fleet, and alternative transportation policies and practices. The university will continue to implement programs that encourage the use of alternative transportation methods and will continue to implement programs and services that promote eco-responsible fleet management.*

Alternative Transportation began in a 2007 as a subsidiary of Parking Services, and became an independent department in 2015 within Virginia Tech Parking and Transportation. In close coordination with partners, the program provides a robust array of travel options and resources, targeted at reducing single-occupancy vehicle (SOV) reliance on campus. Many of those options have been added since the first Climate Action Commitment (CAC) was adopted.

These options include:

- **Carsharing** (first offered in 2013, now 3-5 Zipcars on campus with over 2,000 active members).
- **Ridesharing** (first offered in 2012, now provided locally through RIDE Solutions, who also manages the region's Guaranteed Ride Home Program.
- **Blacksburg Transit** (Town of Blacksburg)
  - Prepaid for students through student fee and for employees through general fund
  - Ridership grew from 2.95 million in 2009 to 4.66 million in 2019 (Figure 6.10)
  - 9 of 53 buses are diesel-hybrid electric and five total electric buses to be added by end of 2020
  - Named 2019 Outstanding Transit System for North America by APTA.

Figure 6.10: BT Ridership (2009-2019)



- **Other Transit**
  - Smart Way Express (2012) Blacksburg to/from Roanoke campuses;
  - Campus Connect (2017) Blacksburg to/from Roanoke and Ballston/Arlington
  - Coordinated services (Virginia Breeze intercity bus (Blacksburg to D.C), Amtrak to Roanoke
- **Bicycling**
  - 349 bike racks, 5,202 capacity (up from 3,924 in 2013), 11% are covered. 20 miles of shared-use paths on campus more than road network. 4,500 daily bikes on campus.
  - Hokie Bike Hub (2013) free, assisted, bicycle repair/maintenance facility (3,000 users/yr)
  - Five bicycle Fix-IT Stations across campus (2013)
  - Roam NRV Bike Share system (2018). 4,000 sign-ups, 11,000 trips, 28,000 miles. Plan to double fleet from 75 to 150 and replace with electric-assist bikes.
- **Carpooling** (carpool park permits (988 sold in 2019)
- **Van Pooling** (mixed results: 3 van pools in 2017, now only one)
- **Teleworking/Alternative Work Schedules**
  - Early 2020: 113 telework and 83 alternative work schedule agreements;
  - During Covid-19 73% of faculty/staff (~8,000) teleworking demonstrated the viability
- **University Motor Pool** (replacing older vehicles with more efficient newer vehicles)
- **Transportation Plans** (*Parking and Transportation Master Plan*; *Beyond Boundaries 2047: The Campus Plan*; *Bicycle Parking Master Plan*; and *Electric Vehicle Master Plan)*.
- **Road Network** (roundabouts, Southgate Interchange)

Since 2009 the university has been recognized as one of the **Best Workplaces for Commuters**, receiving the "Best of the Best" in the university category in 2014. The university has also been recognized as a **Bicycle Friendly University** (BFU) from the League of American Bicyclists since 2012. From 2012-2018, the university was a bronze-level BFU, and in 2019 the university moved up to the silver level.

6.2.9

VTCAC #10 *Virginia Tech will* ***engage students, faculty, and staff*** *through education and involvement to develop and implement innovative strategies for efficient and sustainable use of energy, water, and materials in all university-owned facilities.*

a. Engagement by the Office of Sustainability

Engaging Virginia Tech's in implementing the 2009/2013 VT CAC has fallen mostly on the Office of Sustainability, which tracks and reports progress, operates student and community involvement, and nominates the university for various sustainability awards and recognitions.

Sustainability Tracking and Reporting

- ***Sustainability Annual Reports*** - In compliance with the 2009 Commitment approved through governance, the Office has prepared and disseminated these reports annually since 2010 to show the university's progress in meeting climate and sustainability goals. The key sustainability metrics these reports cover include: greenhouse gas (GHG) emissions, energy use intensity, alternative transportation use, recycling, and water consumption.
- ***Sustainability Tracking, Assessment & Rating System (STARS) reporting*** - The Office of Sustainability prepares evaluations following the STARS framework, which is the prominent national tracking systems of the Association for the Advancement of Sustainability in Higher Education's (AASHE). The tracking system considers five core areas when measuring a university's sustainability standing: Education & Research, Operations, Planning Administration & Engagement, Innovation, and Supplemental Data. It is noteworthy that VT has performed well according to this metric--achieving a 'gold rating--but does have room for improvement in the 'engagement' category; VT's 'campus engagement' score is quite high (20/21) but 'public engagement' is rated at only 14.89/20. The weakest sub-categories in this area are 'continuing education' and 'community service'.

Student & Community Engagement

- ***Sustainability Internship Program -*** One of the Office of Sustainability's key tasks is to oversee a campus wide student sustainability internship program. The Office is committed to providing valuable experiences that foster rapid personal and professional growth. The student projects are paired with Career and Professional Development curriculum and other training, and allow students to sharpen and expand their environmental professional skill sets. For the past several years this office has had 20 student interns from all colleges with many disciplines.

  Each intern cohort is broken into teams of 5 members based on topic areas of interest, such as energy, water, waste, and food. Each team has 5 members; one student serves as team leader and another as a communications representative. The team leader is responsible for facilitating meetings, tracking success of projects, and reporting progress to the team advisor (an Office of Sustainability employee). The communications representative is responsible for social media management, graphic design, photography, and content creation.

  Intern teams work on a variety of tasks, including:
  - *Partner Projects:* Teams partner with departments such as Energy Management, Stormwater Management, Sustainable Dining, and Housing & Residence Life to complete technical projects.
  - *Education & Outreach*: Teams plan and execute outreach events in partnership with community organizations such as the YMCA, Town of Blacksburg, and Blacksburg Farmers Market. Past events have included Thrift Swaps, a Pop-up Farmers Market, and seed plantings.

- *University-Wide Campaigns:* Teams assist in executing large-scale campaigns, including Earth Week and Sustainability Week.

- ***Green Request for Proposals (RFP) Program.*** Recognizing that good ideas often come from the community and that "student engagement is the driving force for advancing sustainability at Virginia Tech", students are invited to develop proposals in response to the annual *Request for Proposal for Sustainability Initiatives from Student Organizations Program* (a.k.a. the Green RFP Program). Proposals submitted are evaluated based on their projected environmental benefits, feasibility, and cost considerations (including return-on-investment). Launched in academic Year 2010-2011, the university has sponsored this program for ten consecutive years. To date, 83 student proposals have been approved with funding exceeding $1.2 million, and estimated saving approaching $1 million and growing.

  The Green RFP was established as an alternative to a proposed 'student green fee' to solicit proposals from recognized student organizations that support the goals of the Virginia Tech 2009 CAC&SP. The Office of Sustainability manages and coordinates the program soliciting and reviewing of all proposals. The university established a fast track formal review and approval process with the goal of having the results announced and implementation initiated in the same academic year. VT's formal Energy and Sustainability Committee reviews and prioritizes select proposals, the Office of Budget and Financial Planning identifies potential funding sources, and the Senior Vice President and Chief Business Officer approves and funds the projects.

  Virginia Tech was awarded the 2019 APPA – Leadership in Educational Facilities Sustainability Innovation Award for the Green RFP program.

- ***Green Workplaces.*** While most Office of Sustainability initiatives have focused on students, the ***Green Office Certification Program*** is targeted at helping faculty and staff (and graduate students) to make their offices more sustainable. Offices interested in participating are asked to identify a 'Green Representative' that completes a training program in order to most effectively support and coordinate implementation. Participating offices are scored based on six criteria: Recycling & Events, Energy, Purchasing, Waste Reduction, Transportation, and Innovation.

Other Events and Initiatives

- ***Sustainability Week*** is a flagship series of events held in Blacksburg that engages the whole Virginia Tech campus and the wider community each fall. Sustainability Week was first established in 2006, and now represents a lasting partnership between the VT Office of Sustainability, the Town of Blacksburg, and Sustainable Blacksburg, a citizen-led organization, along with many other community and student groups.
- Another key annual series of sustainability-themed events take place each ***Earth Week***. While largely student-organized, the Office of Sustainability plays an important supporting role.
- The Office of Sustainability ***Game Day Green Team*** promotes recycling during tailgates. Students collect bottles and cans, distribute recycling bags, and work to build awareness around sustainability, recycling, and waste reduction. The Office has 80–100 different student volunteers per year, potentially reaching hundreds of VT football fans before games.
- The ***Green Graduates of Virginia Tech*** program asks graduating students to take a pledge that they will address environmental impacts and strive to make sustainable choices as they move on to their future careers and wider lives. Pledgers receive a free green cord to wear at graduation.

b. Student groups lead the charge for climate action and sustainability

The Sustainability Office is prolific in supporting a wide variety of initiatives on campus that promote sustainability. However, other organizations - and in particular student groups - also play key roles in advocating, promoting, and implementing changes to advance sustainability on campus and beyond.

Environmental stewardship has been part of Virginia Tech's mission for decades, and ensuring that environmental justice is part of these efforts has long been a priority for its students. As early as the late 1960s, student- and community activists' fought against pollution from the Radford Army Ammunition Plant. In 2008, it was students in the **Environmental Coalition** who met with President Charles Steger and convinced him to have the university develop its own Climate Action Commitment, which it did in 2009.

In recent years, Virginia Tech student groups have renewed their focus on local environmental issues, with a particular focus on climate justice. The Environmental Coalition participated in the student fight against the Mountain Valley Pipeline (MVP), a 303 mile natural gas pipeline currently under construction just miles from Virginia Tech's campus. In 2016, the club took a road trip along the proposed route to speak with impacted residents and to see the land, water, and forests that are threatened by the project. MVP opposition is also fueled by effects of local residents and an understanding of the climate effects of the project operating for a 50-year period as proposed. In 2017 and 2018 the Environmental Coalition campaigned on campus against the MVP through tabling, flyering, information sessions, and fundraising for resistance efforts.

In August 2019, a group of students, faculty, and Blacksburg community members met to plan a strike for climate action at Virginia Tech. The mobilization was held in solidarity with the September 20th International Day of Climate Action organized by the Youth Climate Strike Coalition. Blacksburg's strike drew nearly a thousand people, including Virginia Tech students, faculty and staff, high school students, and community members, who gathered for a rally and march for climate action. Organizers wrote and delivered six demands for climate action to Virginia Tech's President Tim Sands. Following the march, student leaders spoke with Provost Cyril Clark regarding next steps. The student organizers formed **Virginia Tech for Climate Justice (VT4CJ)**, a coalition of Virginia Tech students, faculty, staff, and Blacksburg community members that further refined recommendations for climate action at Virginia Tech. President Sands met with VT4CJ representatives twice and agreed to convene a Climate Action Commitment working group to update the University's Climate Action Commitment. The Climate Justice Subcommittee was the first subcommittee of the Climate Action Commitment Working Group to be formed, and its membership is composed of many of the original members of VT4CJ.

6.2.10

VTCAC #12 *Virginia Tech will continue to develop and implement innovative sustainability-related* ***academic programs in instruction, research, and outreach****, and will coordinate and communicate these programs to the university community and external audiences.*

Sustainability Academic Offerings

Virginia Tech's STARS report earned the University 89% of possible points in academics. 71 VT departments (90%) offer 525 sustainability courses and an additional 341 courses that include sustainability in class topics. Over 22 percent of VT faculty are engaged in sustainability research. 83 percent of students adopt at least one sustainability learning outcome prior to graduation and

new student orientation continues to be a focus of the Office of Sustainability. Every July, the Office of Sustainability staff help train orientation leaders to equip them with the most accurate information on sustainability programs and offerings. The Office of Sustainability also sets up an informational table at "Gobblerfest," the premier festival to introduce students to community, clubs, and other organizations on campus in the fall.

Most colleges have academic and research programs related to sustainability and climate action, including the colleges of Engineering, Natural Resources & Environment, Architecture & Urban Studies, Agriculture & Life Sciences, Sciences, and Liberal Arts & Human Sciences.

6.2.11

VTCAC #14 *Virginia Tech will work to* ***provide funding to support sustainability*** *programs. With regard to all the items in this resolution, major personnel and investment decisions, including capital projects, associated with implementing the VTCAC&SP will be based on a joint review of costs and benefits by university financial and facilities staff and be subject to availability of funds.*

The last item of the 2009/2013 VT CAC dealt with was money. The committee spent considerable time word-smithing this item and it ended with the paltry statement that the university would "work to" provide funding…"based on a joint review of costs and benefits" and "subject to availability of funds." It cited no specific funding and provided conditions that could be interpreted as no commitment at all. Despite this, the university came through with adequate funding for CAC-related programs.

Investments led not only to a reduction of emissions at a rate exceeding the 2009 CAC target trajectory, but also to a positive financial return due to reduced energy costs. Many of the investments were part of "the cost of doing business," i.e. necessary maintenance and modern upgrades of energy systems, building design, and campus life infrastructure to keep the campus operating. Most of these investments incorporated the 2009 CAC goals with a modest increase in cost, such as shifting from coal to natural gas in the steam plant and building LEED certified buildings. Investment in student-initiated projects has led to energy cost and GHG savings while providing students with a voice in campus sustainability.

Some details:

- The last decade was one of considerable growth on campus as building square footage and enrollment each increased by about 22% from 2006 to 2019, but **GHG emissions actually decreased 24%**. This resulted from university investments in energy efficiency in new and existing building, fuel switching, waste recycling, and other sustainability measures.
- VT has **36 LEED certified buildings** now totaling about 30% of campus space, most built to Silver standard based on the 2009/2013 VTCAC.
- The **Five Year Energy Management Plan** (2015-2020) invested $14.2 million and achieved $2.7million/year in energy savings for an average 5.3-year payback or 19% return on investment.
- The university invested in **steam plant upgrades** including a dedicated natural gas pipeline and new natural gas boilers that led to shifting from 97% coal in 2009 to 93%% natural gas in 2019-20 and resulting drop in GHG emissions.
- The university is investing in **chiller upgrades** that with reduce chiller energy use by 20% when commissioned in 2023.
- The **Green RfP program** funds student-proposed sustainability projects. From 2010-2019, the university has provided more than $1 million to support these projects, giving students an important voice in sustainability and climate action.

- Funding for **numerous initiatives** in alternative mobility, waste recycling, campus grounds and woodlands, and agricultural practices have enhanced the quality and sustainability of campus life.
- **University plans** build on this experience with a sustainable vision for the future, including the *Beyond Boundaries 2047: the Campus Plan*, and master plans for parking and transportation, bicycle parking, and electric vehicles.

6.2.12 Other Progress: Virginia Tech Electric Service

One of the university's most valuable energy resources is its electric utility, Virginia Tech Electric Service (VTES). VTES is unique: it is the only "municipal" electric power system owned by a research university, serving campus as well as retail customers in Town. VTES has been an integral part of the university since the 1890s, and its recently appointed director envisions the utility playing an instrumental role in the implementation of the 2020 VT Climate Action Commitment.

6.3 Structure, Partnerships, and Arrangements to address Sustainability

6.3.1 Structure and Arrangements

The 14 VTCAC points remain University policy today. The intent was for implementation to be shared throughout the university but, with the exception of elements #10 (engagement of all students, faculty, staff) and #12 (sustainability related academic instruction, research, and outreach), implementation has rested largely on Facilities dealing with energy, buildings, transportation, waste management, and monitoring greenhouse gas (GHG) emissions.

The **Office of Sustainability** in Facilities, as called out in CAC element #5, plays a key role in implementing the CAC&SP, coordinating campus sustainability, monitoring and reporting annual energy and GHG emissions, and partnering with sustainability related programs on campus and in the community. (See section 6.2.3 above).

Other units in Facilities (now **Division of Campus Planning, Infrastructure, and Facilities** (DCPIF)) are critical to success of the CAC, including

- **Virginia Tech Electric Service** provides electricity to campus and 6000 customers in Blacksburg;
- **Utilities** operates the steam plant, chillers, and distribution systems;
- **Energy Manager's Office** monitors energy and GHG emissions and plans and oversees energy efficiency projects;
- **University Planning** develops campus transportation, landscape, space, and master plans.
- **Capital Construction** oversees design and construction of campus buildings;
- **Buildings and Grounds** maintains buildings, grounds, and manages waste and recycling; and
- **Real Estate** manages leased properties

Beyond Facilities, several other departments are critically important to the implementation of the Climate Action Commitment, especially with its goals of engaging the entire university including student life and academics.

- **Administration:** President, Executive Vice President & Provost, Senior Vice President & Chief Business Officer (CBO)
- **Academics:** Provost's office, College Deans, Academic Departments, faculty, students
- **Operations:** Budget & Finance, DCPIF
- **Student Affairs:** Housing & Residence Life. Dining Services, Student Engagement
- **Auxiliaries:** Residence, Dining, Athletics

- **University Governance:** Board of Visitors, University Council, Committees, Commissions, Student Government, Faculty Senate, Staff Senate
- **Student Organizations**

6.3.2 Partnerships

It is difficult to list all of the critical partners that have contributed to the university's implementation of the 2009 CAC, and who will also be key participants as we move forward.

- **Virginia Tech Foundation**
- **Town of Blacksburg:** Town Council, Town Administration, Blacksburg Transit, Sustainability Office, Housing and Community Development
- **Energy service utilities:** AEP/APCO, ATMOS
- **Regional Authorities** for Waste, Water, Sewerage: MRSWA, BVPISA, BCVPIWA

7. Critique of Virginia Tech Progress in Climate Action

Although the 2009/2013 VT CAC was a leading effort for its time, from the perspective of 2020, it is limited in both scope and ambition. It does not include several sources of campus GHG. It does not even mention renewable energy. Its overall goal of 80% reduction of GHG from 1990 levels by 2050, while a typical goal for its time, is not aggressive enough compared to the current need for climate action and the national movement of our peer institutions. There is much more we can do improving energy, buildings, waste management, transportation, and campus behavior and engagement. This chapter summarizes the limitations of the 2009/2013 CAC and areas where we could improve substantially.

7.1 GHG Scope of 2009/2013 CAC

The 2009/2013 VT CAC was limited in both its GHG footprint and in its vision for necessary GHG emission reduction. The footprint scope did not include agriculture operations, business travel, or leased building space. The vision aimed to reduce GHG by 80% from 1990 by 2050, still would leaving us with substantial GHG emissions in 2050. Our 2020 VT CAC aims to correct these limitations by adding previously omitted operations in the GHG footprint and becoming carbon neutral by 2030.

7.2 Renewables: 2009 VT CAC did not even mention Renewable Energy

An indication of how the world of energy has changed in a decade, renewable electricity is a centerpiece of the 2020 VT Climate Action Commitment, while the 2009 VT CAC did not mention renewable energy at all. The closest mention of renewables was in CAC point 4:

> "Virginia Tech will work toward these emission reduction targets through improved energy efficiency, reduction of energy waste, **replacement of high-carbon fuels**, and other measures identified in the VTCAC&SP"

7.3 Energy

Virginia Tech has made considerable progress in managing its energy systems and reducing GHG emissions by 24% from 2006 while the campus has grown by 22%. Most of this progress was achieved by converting from coal to natural gas in the steam plant; the steam plant fuel was 97% coal in 2009-10 and down to 7% in 2019-20. There is still some GHG reduction to be had as we move completely to natural gas by 2025, but this source of reduction is now limited. We will be dependent on the fossil fuel natural gas for some time, and emissions from natural gas, including upstream methane leakage from gas operations and transport, will be difficult to reduce.

While our AASHE STARS sustainability score was very good (71.94/100) and earned a Gold rating, our points for Operations (43% of maximum points) and especially operations categories Air & Climate (23%) and Energy (21%), brought us down.

7.4 Buildings

The 2009/2013 VT CAC was instrumental in improving the quality and efficiency of new building construction on campus, and in influencing the successful energy efficiency improvements of existing E&G buildings through the 5-year energy plan. However, in two building categories these efforts were less successful:

- **Existing auxiliary buildings** were not part of the 5-year energy retrofit plan and as a result, as Figure 6.8 well demonstrates, electricity efficiency in these buildings lags behind academic buildings that were part of the plan. These buildings make up 45% of academic + auxiliary square footage. The reason auxiliaries were not included was that academic funds were used to finance the retrofit plan and thus were applied to E&G buildings only. A means of financing auxiliary building retrofit is needed.
- The 2009/2013 VT CAC did not include **leased space off campus** used by university department operations. Most of these buildings, amounting 1.45 million ft^2 or 13% of total square footage, are included in the 2020 VT CAC GHG footprint. To reduce emissions from these buildings is a challenge since Virginia Tech does not own them. However, the VT Foundation owns 70% of the space, and they can play a role in improving energy efficiency and reducing emissions.

7.5 Agriculture, Forestry, Land Use

Agricultural and forestry operations GHG emissions were not included in 2009/2013 CAC and this was a critical omission. However, these operations are included in the 2020 VT Climate Action Commitment and GHG inventory. To understand the potential significance of this addition, the subcommittee provided a detailed analysis of emissions from agricultural operations as well as sequestered CO_2 from agriculture conservation tillage and Virginia Tech forested lands in the region.

Total net A/F/LU GHG emissions in 2019 are 8,046 MT CO_2e or about **3.3% of 2019 VT GHG emissions**.

7.6 Waste/Recycling/Composting

- **We will likely fail to meet VT CAC 2020 recycling rate goal.** The original 2009 VT CAC included a goal of 50% by 2025 and in the 2013 revision of the CAC the date was moved up to 2020 since in 2012 we were already at 44%. However, in subsequent years the recycle rate went down and has averaged about 40% from 2013 to 2019.
- **Waste Management Program is functional, but fragmented.** There are notable opportunities for improvement of waste management. The current organization is fragmented with multiple units having only a portion of the overall responsibilities. We need to conduct a comprehensive zero-waste audit in order to streamline operations to enhance efficiencies, reduce costs, and meet existing and future waste management needs.
- **No local composting facility.** Our food waste composting operation is limited in that there is only one state permitted facility within 100 miles of campus. Food waste composting must be expanded to include the Athletic Department. We need to develop a university composting facility near campus that can process campus food waste, other campus organic waste, and agricultural animal waste.

7.7 Transportation

While there was progress developing commuting options other than single occupancy vehicles (SOVs), there are other areas that have lagged behind. Most notably, SOV commuting increased by 10% from 2014 to 2018, there is an oversupply of parking, parking permit prices are cheap and provide no incentive for alternative commuting, VT is one of only a few universities that allow freshman to bring cars to campus, motor pool vehicles do not use alternative fuels, and business air travel was not included as a source of GHG in 2009 CAC.

- VT lacks policies and programs to incentivize more shifts to non-SOV modes.
- **2009 VT CAC point 11 is incomplete.** The 2009 CAC point pertaining to transportation is not time bound, makes it difficult to measure success.
- **Oversupply of parking** (2000 spaces sit empty on any given day)
- **Parking permit prices** are too low to discourage driving to campus. Getting people out of their SOVs and into other modes is largely about incentives and disincentives.
- **On-campus freshmen are allowed to bring their cars to campus.** Nearly all universities in Virginia prohibit on-campus freshmen from bringing cars to campus. This forces students to explore other transportation options available to them.
- **Student orientation and employee onboarding processes include little education on transportation options.**
- **University motor pool vehicles do not use alternative fuels.** Several years ago there were a few hybrid vehicles in the motor pool, but they have since been replaced with standard gasoline-powered ones. There is not a policy mandating the purchase of vehicles that utilize alternative fuels.
- **Behind on implementing parking demand management strategies.** The university has used some parking demand management strategies (i.e., metered parking in select lots, the Perry Street Area commuter/graduate permit, and preferred parking for carpools and vanpools) but is behind other universities. Parking demand management reduces parking demand, preserves parking for certain trips, and promotes a shift away from SOV trips. It includes both parking pricing (raising parking fees) and supply-side (restricting parking supply) strategies.
- **Unmaintained shared-use paths and inconsistent bicycle lanes.** Across the over 19 miles of paved paths, many examples of poor path conditions (e.g., holes and cracks) result in low use of the network. As mentioned earlier in this report, only .1 miles of the 1.8 miles of bicycle lanes on campus meets the AASHTO standard of ≥4 feet wide.

7.8 Sustainable Choices

The idea of creating the Sustainable Choices subcommittee emerged later in the Working Group process from the recognition that many of the challenges discussed involve, at their core**, behavior change**. That is to say, they are about the various choices individuals make that enhance or inhibit progress in meeting our climate and other sustainability goals.

Subcommittee members started by making a short list of "problematic" or unsustainable behaviors evident within the Virginia Tech community based on the Greenhouse Gas Inventory data. Although there have been good efforts to make easier decisions about recycling and alternative transportation, this problematic list still included: unnecessary car commuting, improper disposal of waste, unsustainable food choices in dining halls, and low return rates of reusable to-go containers in dining halls.

The subcommittee recognized that behavioral choices are not just about individuals being educated and expected to make good decisions, but, perhaps more importantly, about how they are supported and ***nudged*** into making better or worse choices. Recognition of this approach led to exploring how structures could be changed to discourage unsustainable behavior, and more importantly, facilitate sustainable behavior. This served as the basis for CAC Goal 12.

7.9 Community Engagement and Climate Justice

Virginia Tech has made progress in engaging students through the Sustainability Internship and Green RfP programs, and student groups have done much to raise awareness on campus about climate and environmental issues. In addition, there are faculty who developed exceptional instruction and research programs related to climate action and sustainability, and many staff who have been engaged in efforts to reduce their departments' environmental impacts.

However, these initiatives involve only a **small proportion of the campus population**, and they fall short of the level of involvement necessary to create a sustainability culture. The 2020 Climate Action Commitment envisions climate action and sustainability to become a more integral component of campus life, work, and culture. The CAC aims to achieve this by setting aggressive goals, elevating climate action to higher levels of university administration, integrating the exciting campus physical climate action projects into the university's educational mission, and engaging more students, faculty, staff, alumni, and community members in the implementation of the CAC.

8. Comparison to Peer Universities

One of the Working Group's deliverables is a comparison of Virginia Tech progress in climate action to peer universities. There are three good reasons for this:

1. To offer an evaluative reference point (To see how we are doing),
2. To adopt effective plans and avoid ineffective ones (To borrow and steal good ideas), and
3. To demonstrate that what we're proposing is feasible and in line with similar universities (To show we are not crazy with our bold and aggressive climate action)

Knowing that our perspective is comprehensive and that other universities have different strengths in different areas, we decided to have our specialty subcommittees select the peer and exemplary universities to assess in their specialty area. Those areas include

- Carbon neutrality and GHG inventory
- Renewable Energy
- Buildings
- Energy Systems
- Transportation
- Waste-Recycling-Composting
- Agriculture, Forestry, Land Use
- Climate Justice
- Community Engagement
- Budget and Finance

In most areas we selected 3-8 universities that we consider as peers or exemplars in that area. Some are from Virginia, some are Land Grants, some are from the ACC, some are far away, but all offer good examples and benchmark our progress to-date and our aspirations for our 2020 Climate Commitment.

Our peer review told us that, while our **2009 Climate Action Commitment** was right for its time and has led to improved energy efficiency and reductions in GHG emissions, it now **lags behind many of our peers**. This deficiency is most notable in the quest for carbon neutrality, 100% renewable energy, zero waste, zero-net-energy buildings, robust alternative transportation, and community engagement to advance climate action and sustainable behavior.

Many of our related programs do standup well in comparison to others, but if Virginia Tech is to regain its leadership role in climate action and sustainability, we need to move to a new Climate Action Commitment that is right for <u>this</u> time.

We believe that we have found the right balance of aggressive, yet pragmatic climate action. Our goals are for carbon neutrality by 2030, 100% renewable electricity by 2030, investment in energy efficiency in existing and new buildings, carbon neutral agriculture, zero-waste campus by 2030, sustainable procurement, sustainable mobility, climate justice as a core value, ongoing community engagement avenues, and the Climate Action Living Laboratory to integrate these goals into the fabric of the university.

Relative to the peer and exemplary universities reviewed in this analysis, this 2020 VT Climate Action Commitment sets the stage for Virginia Tech to shine as an exemplar and leader in university climate action. Beyond our climate neutrality and zero-waste campus goals, **six areas of the 2020 CAC stand Virginia Tech above the rest:**

1. The detail and **specificity of the pathways** developed to achieve the CAC goals
2. Our own **unique utility VTES** leading our way to 100% renewable electricity, while most other universities are totally dependent on private utilities and companies
3. Using our considerable **land resources** not only to manage our agricultural climate impacts, but also to sequester carbon and develop renewable energy

4. Incorporating in our carbon neutral goal **scope 3 GHG emissions relating to behavior** (e.g., commuting, waste/recycling, business travel), while most others include just scope 1 & 2
5. Integrating our physical climate action into the **university's educational mission** through the Climate Action Living Laboratory (CALL).
6. Specifically addressing **community engagement, sustainable behaviors, and social equity and justice** as core elements of our climate action.

8.1 Carbon Neutrality and GHG Inventory

As part of this review, the GHG assessment scope and methods were compiled for the peer institutions listed in Table 1. This list includes state universities, research peer institutions, and a number of exemplary institutions from farther away.

Table 8.1 – Peer Institutions for GHG Analysis

Peer Institutions	Second Nature Reporting	AASHE GHG Score (0 - 10)	GHG Software Platform	Carbon Neutrality Date / Emissions Goal
Virginia Tech (VT)	No	2.02 (2017)	Internal Excel	80% reduction from 1990 by 2050
University of Virginia (UVA)	No	5.18 (2018)	SIMAP	2030
University of North Carolina (UNC)	Yes	3.58 (2017)	SIMAP	2030
College of William & Mary	No	1.5 (2016)	UNH CCC*	2050
Virginia Commonwealth Univ. (VCU)	Yes	3.25 (2018)	UNH CCC*	2050
James Madison University (JMU)	No	3.4 (2018)	UNH CCC*	Through 2025, JMU will maintain annual adjusted net Scope 1, 2 GHG emissions less than 0.02 MtCO2e /gross square foot of energy use intensity-adjusted floor area
George Mason University (GMU)	Yes	5.07 (2017)	Clean Air Cool Planet	2040
Radford University (RU)	Yes	3.38 (2019)	SIMAP	2050
University of Maryland	Yes	7.16 (2019)	SIMAP	80% reduction from 1990 by 2050
University of Tennessee	Yes	8.11 (2018)	UNH CCC*	2050
Penn State University (PSU)	No	4.37 (2017)	Internal Excel	2061
Purdue University	No	complete (2013)	NA	
North Carolina State Univ. (NCSU)	Yes	4.87 (2016)	Clean Air Cool Planet	2050
Univ. of California Berkeley	Yes	6.52 (2018)	UNH CCC*	2035
Arizona State University (ASU)	Yes	6.04 (2017)	UNH CCC*	2025

***University of New Hampshire Campus Carbon Calculator (excel-base) was replaced by SIMAP (online) in January 2018.**

There are many metrics that one could use for peer institution comparisons. However, these types of comparisons are difficult due to the individualized nature of universities with regard to characteristics like student enrollment, land area, age of buildings, urban or rural setting, research level, professional schools and hospitals, etc. In general, overall GHG emissions or even GHG emissions per student or building area are not particularly useful.

Table 8.1 shows the schools' AASHE subscores for the GHG Assessment only. This gives a relative comparison of how well each school is doing for GHG Assessment based on the same third-party rating system. There are a number of requirements in this rating and it is compiled on a 10 point basis, where a higher score represents a more thorough GHG Assessment. Note that **VT is in the bottom third of the schools** based on this metric.

Table 8.1 also shows either the most recent Carbon Neutrality Date or Emission Goal. **VT is in the lower tier in this regard and its 2013 CAC goal is an 80% reduction goal rather than carbon neutrality.**

Schools vary widely in their reporting of Scope 1, 2, and 3 GHG emissions. It was difficult, in fact, to even find the GHG scope for some of these schools. It should be noted, however, that 2 schools

with very aggressive Carbon Neutrality Goals (ASU and UC Berkeley in 2025 and UVA in 2030) are **limiting their initial carbon neutrality goals to Scope 1 and 2**, though they are reporting some scope 3 goals in their GHG assessments. UC Berkeley aims to reduce Scope 1 & 2 emissions by 80% by 2025 and use carbon offsets for the remainder (see sections 8.3 and 8.4). This causes them to miss out on accounting for some common sense GHG emissions that we intend to include in our analysis.

Most of the schools in the table are including the scope 3 emissions of bus systems and airline travel in their GHG assessment. Only a few of these schools are including food emissions or leased spaced in their estimates. Most of the schools do include electricity Transmission & Distribution (T&D) losses, mainly because this is calculated automatically by formal GHG Assessment software. The only institution that mentions upstream methane leakage was the University of North Carolina at Chapel Hill. No details were provided and this was part of an emissions category of "Other," which represented 6% of the total GHG emissions.

All of these scope 3 emissions have been under consideration for future VT GHG Assessments, and the **Working Group recommends that that our carbon neutral by 2030 goal include scope 1, scope 2 (including leased buildings), and scope 3 emissions related to sustainable choice (commuting, bus system, business travel, waste/recycling, water/wastewater).** Other scope 3 emissions including upstream natural gas methane leakage and emissions related to dining hall food are not included in carbon neutral by 2030 goal, but they will be estimated, monitored, and minimized.

Finally, 10 out of 13 schools in this table use either the Sustainability Indicator Management and Analysis Platform (SIMAP) or its predecessor, the University of New Hampshire Campus Carbon Calculator. The University of North Carolina specifically mentioned a change from an internal spreadsheet to SIMAP to analyze its GHG emissions in a more accurate and repeatable way.

8.2 Renewable Energy

Many universities have committed to 100% renewable electricity. Although not a complete list, *Environment America* gives 33 universities committed to 100% renewables including Florida State, Maryland, Wisconsin, Michigan State, among others. Our Virginia peers have made good progress in this area. UVA partnered with Dominion Power to build two solar farms in late 2018. Dominion built the solar farms and under the power purchase agreement (PPA) UVA is the sole owner of all produced power and renewable energy credits for 25 years. The College of William & Mary announced a similar project with Dominion in 2020. These schools are described below.

Table 8.2 presents a comparison of universities identified as Virginia Tech peers. Considering other universities with respect to renewable energy generation, we identify three exemplary schools in our region: the University of Virginia, William & Mary, and Penn State.

One common trend with all three of these schools is the use of **Power Purchase Agreements (**PPA). These agreements enable the schools to have little to no upfront costs, which makes them attractive options. The universities then pay for the power that comes from the renewables, in all three of our cases solar farms. The rates that the power costs vary, and some of the agreements can have complicated cost structures, but most indicate that the power coming from these agreements is likely cheaper than what they would normally pay from a utility.

It is important to understand that renewable energy projects benefit greatly from subsidies through tax credits and sales of RECs; since state universities cannot directly benefit from tax savings, they

Table 8.2: Peer and Exemplary Universities for Renewable Electricity

School	VTES Equivalent	Steam/Power Plant	Energy Center	Renewable Energy
University of Virginia	**Power and Light office in Utilities Department**	**Natural gas, coal & oil produce 84% of UVA's heat energy.**	**Renewable Energy Tracker and Energy Working Group**	**2 PPA's with Dominion: 32 MW total, 21% of UVA's electricity; solar substation; rooftop lease with Dominion**
Penn State	**Utility Services**	**2 Combined Heat & Power (CHP) plants with a capacity of 13MW**	**EMS Energy Institute**	**70 MW solar farm PPA (25 years) with Lightsource BP; provides 25% of electricity**
William & Mary	**None**	**Currently use natural gas and oil. New steam, hot & chilled water plant under construction**	**Commonwealth Center for Energy and the Environment**	**PPA with Dominion for 20 MW solar farm that will produce ~50% of W&M load; online in 2021; savings after 6 years**
UNC Chapel Hill	Energy Services	Cogeneration facility, 50/50 coal & natural gas	Institute for the Environment	20 kW solar roof, residence hall with solar heated water, 34 geothermal wells, plans for 0.5 MW solar
James Madison University	Partner with Harrisonburg Electric	East Campus Power Plant	Center for the Advancement of Sustainable Energy	10 kW solar project (2003); small wind training - 100 kW solar, 126 kW wind
University of Texas, Austin	Utilities & Energy Management-Electrical Dist.	100% natural gas	Energy Institute	500 kW solar
Ohio State	Partner with Ohio State Energy Partners	CHP plant construction starting in May 2020	Center for Energy Res., Training, and Innovation	Purchase of RECs (18 MWhr in 2010)
Purdue	Energy and Utilities Office	Wade Utility Plant, 3 natural gas and 1 coal boiler	Energy Center	Duke leases from Purdue for 1.6 MW solar- electricity to "Indiana Customers"
NC State	Energy Systems Office	CHP plant with 2 gas turbines	Clean Energy Technology Center	Various small-scale projects
VCU	None	2 heating plants	Electric Power & Energy Syst. Res. Lab	6.6 kW solar array on steam plant
University of Maryland	Engineering & Energy Department	CHP (natural gas)	Energy Innovation Institution	5 solar arrays: 1 rooftop and 4 carports: total of 3.07 MW
University of Tennessee	Electrical Services	Steam plant; mixture of natural gas and diesel, 5 boilers		5 MW west Tennessee solar farm (owned and operated by the university)
Notre Dame	None		Center for Sustainable Energy	Geothermal; solar (150 kW array); hydroelectric (2.5 MW, 7% of load)

***bold = exemplary universities**

can indirectly benefit from for-profit owners using the tax incentives, lowering the project cost, and therefore lowering the cost of electricity produced by the project. Here we can see why these PPAs are so attractive for universities, no upfront cost, often cheaper power, and greener power.

Penn St took a slightly different route in its PPA than UVA or W&M. Penn St's PPA is with a renewable energy contractor, Lightsource BP, while UVA and W&M have their PPAs with a utility, Dominion Energy. Despite this difference the PPAs still function the same. Penn St's contract with BP is for 70MW solar over 25 years. UVA's for 32MW solar, and W&M's for 20MW solar with Dominion. These solar agreements will provide about 25%, 21%, and 50% of this electricity at these universities, respectively. Although PPAs are important, they are not the only aspect that set exemplar universities apart from the rest.

William and Mary has plans to **use their solar farms for educational outreach** as well. Two demonstration solar projects are being planned on campus for educational purposes. W&M's Director of Sustainability has said, "we want this to be a teaching and learning opportunity" about the solar projects. They are taking their renewable projects a step further and want to use them as a chance to educate the public and their students on the importance of environmental sustainability.

The University of Virginia and Penn State each have an energy center. UVA's Energy Working Group leverages campus and community resources to promote energy conservation at UVA. Penn State's Earth and Mineral Sciences Energy Institute aims to diversify campus energy sources and improve efficiency when generating and using energy. Having a body dedicated to working with the community to promote energy research and implement renewable energy on campus is what sets these schools apart from the rest.

8.3 Buildings

Among 25 Virginia Tech's SCHEV-approved peer universities, most have some ongoing initiatives related to climate mitigation and sustainability that address energy efficiency of campus buildings. Majority of considered options are aligned with our 2020 CAC, for example:

University of California Berkeley's 2009 Climate Action Plan called for reducing **80% of GHG emissions** produced from campus buildings, primarily focusing on lighting, HVAC, and commissioning measures. In 2013, the university "pledged to become carbon neutral by 2025, becoming the first major university to accomplish this achievement." Its *2025 Carbon Neutrality Planning Framework* was produced in 2016 and upgrades its building efficiency through retrofit projects, behavior change, green building practices, and improved space utilization.

Cornell University's 2015 Climate Action Plan is also striving to be carbon neutral, and is committed to campus zero carbon emissions by 2035 from their 2008 baseline. One of the key pathways to achieve this is adopting an **Earth Source Heat geothermal system** to heat the campus. Other efforts include building high-performance buildings to use less energy and do so more efficiently, improving energy conservation of existing buildings by updating building envelopes, adding automated control systems, improving lighting, and recovering heat.

In their 2015 Illinois Climate Action Plan (iCAP), University of Illinois at Urbana-Champaign commits to ensure that **all new buildings and major renovations are net zero energy**. On existing buildings, measures include reducing energy use when spaces are unoccupied and incentivizing behavioral changes that would encourage energy conservation, retro- commissioning, HVAC improvements, scheduling and control strategies, lighting improvements, and Energy Performance

Contracting (EPC). Their earlier 2010 iCAP also established a **"no net increase in space" policy** that applies to all buildings on campus including auxiliary and rented spaces. Such an approach would reduce GHG emissions that drive the peak energy demand for utilities. Among other energy savings options, iCAP lists centralized conservation efforts, development of campus fume hood efficiency program that would consider use schedules, disassemble unused and antiquated units, and convert system to variable-air-volume systems.

In February 2020, University of Pittsburgh announced their carbon neutrality commitment and committed to achieving a net zero carbon footprint by 2037. Under this plan, the university will improve building efficiency by pursuing **50% energy reduction of existing and 80% of new buildings**.

Rutgers, the State University of New Jersey, developed a new Pathway toward a Carbon Neutral, Climate Resilient Rutgers in February 2020. Proposed initiatives include upgrades to building automation for real time monitoring and scheduling, various conservation efforts such as energy audits, retrofits, HVAC upgrades, envelope improvements, operations and maintenance improvements and training, time use shifts in class times and used spaces, and **behavioral interventions such as training and education of users of spaces and labs**.

As a part of their efforts, Gov. Cuomo announced in 2019 that State University of New York at Buffalo will add the first new $33.5 million, 257-bed **zero-net, carbon-certified Residence Hall** on campus.

The University of Virginia set a 2016-2025 Energy and Emissions Action Plan, and it has a staff of **three engineering technicians and several controls technicians** to develop and implement it. UVA's Delta Force program has invested $15.5 million in energy projects and has saved $25.6 million and 180,000 metric tons of carbon dioxide emissions (MTCDE) since 2009.

The University of Maryland set a goal for efficiency upgrades in existing buildings that will reduce campus electricity use 20% by 2020, and it invested $21.5 million to save $1.7 million/year to reduce campus energy by 6%. UMD utilizes an **Energy Dashboard and Solar Dashboard** to display accessible data for the campus community.

As a part of the Climate Action strategies and projects, Penn State University implemented many Energy Conservation Measures such as improving steam traps, reprogramming thermostats and upgrading control systems in buildings, **shutting down spaces that are not in use** for extended periods of time, and installing room occupancy sensors. In addition, around 350 buildings on campus have Building Automation Systems that control the buildings' climate and lighting based on the occupancy patterns.

According to their energy performance/Climate Action Plan, the University of North Carolina at Chapel Hill aims to minimize energy demand in their buildings by implementing various energy conservation measures such as improved standards for heating and cooling of campus buildings, **optimized occupancy schedules**, use of energy efficient equipment, **behavioral changes** among users of campus spaces, compliance of renovation and construction projects with the UNC Design and Construction Standards, NC State Building Codes and North Carolina General Statute 143-64, and overall better management of indoor spaces.

8.4 Energy Systems

As part of this review, we have researched and compiled the peer institutions listed in Table 8.3 below. This list includes exemplary institutions that have a diverse and resilient energy portfolio. Exemplar institutions are defined by their use of renewables and energy conservation. In our region, the

University of Virginia, Penn State University, and the University of Maryland stand out. In addition, University of California Berkeley and Stanford University are exemplars worthy of watching.

The following areas were analyzed during this research process:

- Key Climate Action Energy targets
- Implementation of renewables
- Designated energy management office

Exemplar universities were identified through their aggressive climate action goals and their plan to achieve those goals. The University of Virginia aims to be carbon neutral by 2030 and fossil fuel free by 2050. Penn State and the University of Maryland are committed to reducing GHG emissions through energy usage. Penn State aims to reduce GHG emissions by 35% by 2020 and UMD plans to reduce 60% by 2025. To achieve these targets each of these universities has a clear plan and completed projects. The University of Virginia and Penn State have incorporated Power Purchase Agreements into their climate action plans. Penn St's PPA is with a renewable energy contractor, Lightsource BP, while UVA's is with a utility, Dominion Energy. Penn St's contract with BP is for 70MW solar over 25 years and UVA's is for 32MW solar. These solar agreements will provide about 25% and 21% of electricity at these universities, respectively. These institutions have incorporated renewable energy throughout the campus, as well.

High visibility of solar projects is important to Virginia Tech's success. UVA, Penn State and UMD provide examples of successful renewable energy projects. Penn State has developed a solar array on campus, which powers 100% of its electric fleet vehicles. This represents how one renewable energy project can impact multiple campus entities. UMD has 9,000 solar panels on their campus, which is effective and illustrates the university's commitment to sustainability.

A **designated energy management office** is another key component of an exemplar institution. The University of Virginia and Penn State each have an energy center. UVA's Energy Working Group leverages campus and community resources to promote energy conservation at UVA. Penn State's Earth and Mineral Sciences Energy Institute aims to diversify campus energy sources and improve efficiency when generating and using energy. It is also important to note the tools used by the energy management office. The University of Maryland utilizes the **Energy Dashboard and Solar Dashboard** tools to manage its energy. Having a body dedicated to working with the community to promote energy research and implement renewable energy on campus is what sets these schools apart from the rest.

On the west coast, UC Berkeley and Stanford may offer useful lessons. UC Berkeley claims to be the first major university to pledge carbon neutrality by 2025. As mentioned in section 8.1, they include only GHG scope 1 & 2 emissions in this pledge and reduce emissions by 80% with the remainder addressed by carbon offsets; they aim to reduce scope 3 emissions to net zero by 2050. Among their interesting strategies is to rely on **biogas to replace natural gas**, which is their largest source of emissions mostly from their cogeneration steam plant owned by a third party. If they supplied 100% of natural gas with biogas they would achieve 91% of their 2025 goal.

Like Berkeley's, Stanford's cogeneration plant produced 90% of its GHG emissions. In 2012, after three years of study called the Stanford Energy Systems Innovations, it began construction on its new Central Energy Facility (CEF) which was completed in 2015. The CEF converted the central heating system from **steam to hot water** and incorporated **heat recovery from the cooling system** and both hot water and cold water **thermal storage**. Stanford also entered into a power purchase agreement with SunPower to build 78.5 MW of solar PV, 5.5 MW of which will be on the Stanford Campus. GHG emissions in 2017 dropped 68% from 2014 levels.

Table 8.3 Energy Opportunities Peer Universities

School	Carbon neutral goals	Renewable Energy Goals	Plan to achieve renewable goals	Renewable projects completed	% RECs	Energy Management Office	Energy Management Plan
UVA	1. Reduce greenhouse gas emissions 25% below 2009 levels by 2025. 2. As of CY 2015, a 7% reduction had been achieved. 3. UVA to be carbon neutral by 2030. 4. Fossil fuel free by 2050.	1. Increase the % of UVA's energy derived from renewable sources (2020)	1.About 21% of UVA's electricity comes from renewable sources.	1. Solar PPA, 25 Yr, 17 MW, with Dominion Energy (UVA Hollyfield Solar facility); 12% of electricity used at UVA. 2. Solar PPA…	Not buying RECs directly but through the PPAs	1. 2016-2025 Energy and Emissions Action Plan. 2. Three engineering technicians and several controls technicians.	1. UVA's Delta Force program has invested $15.5 million in energy projects and has saved $25.6 million and 180,000 metric tons of carbon dioxide emissions (MTCDE) since 2009.
Penn State	1. Penn State is on track to reduce its greenhouse gas emissions by 35% (from its peak in 2005) by 2020. 2. 85% reduction by 2050.	1. Diversify the university's energy portfolio by 2020.	1. Establish a 70 MW solar PPA w/ Lightsource BP	1. Solar PPA, 2 MW, On Site, 25 Yr - Alternative Energy Development Group (AEDG). 2. Solar array, 215, Main Office of Physical Plant Facility to provide power to charge its 100% electric vehicles. 3. Hydroeletric PPA, 2013, 10 Yr, Mahoning Creek Hydroelectric Company, 6 MW.	N/A	1. Energy Savings Program, 100 million invested to date 2. Continuous Commissioning (CCx), 2 CCx Engineers and (3) 2-person technical service crews. 3. Energy Conservation Measures (ECM), <5 Yr, Smaller Scope 4. Green Design, LEED	Utilize the Energy Enterprise Management tool. 20% reduction in building energy intensity by 2024 via DOE's Better Building Challenge.
UMD	1. In 2017, 49% reduction in net carbon emissions compared to 2005. 2. Goal: 60% reduction in carbon emissions (from 2005 levels) by 2025. 3. The university is committed to achieving carbon neutrality for all scopes of emissions by 2050.	1. 85% of UMD purchased power was renewable in 2017. 2. By 2020, all electricity delivered to campus by regional power plants will come from renewable sources.	1. 9000 Solar Panels on Campus 2. Campus buildings and parking produce ~1.5 million kWh, 3 MW		N/A	Utilize Energy Dashboard and Solar Dashboard.	1. Efficiency upgrades in existing buildings will reduce campus electricity use 20% by 2020. 2. Investing $21.5 million to save $1.7 million to reduce campus energy by 6%

8.5 Transportation

Peer Comparison — Outside Virginia

Four universities identified as **Platinum-Level Bicycle Friendly Universities** by the League of American Bicyclists (considers factors related to engineering, education, enforcement, encouragement, evaluation and planning, and equity), and that had a Climate Action Plan adopted within the last 10 years, were chosen for comparison on pathways being recommended for VT by the Transportation Opportunities Subcommittee. One of these universities is urban (Portland State University (PSU)) while the other three (Colorado State University (CSU), Stanford University (Stanford), and University of California, Davis (UC Davis)) have more suburban campuses. Data for the table (see Table 8.4) was gleaned from the most recent Climate Action Plans and the university websites.

Table 8.4: Comparison of Selected Recommended Pathways for Reducing Transportation-Related GHG Emissions Among Peer Universities*

Metric from VT goals/pathways	VT	CSU	PSU	Stanford	UC Davis	UVA	JMU	W&M
Sustainable transportation goal or strategy is part of most recent climate action plan	Y	Y	Y	N	Y	N	U	U
Freshmen prohibited from bringing cars to campus	N	N	N	Y	Y	Y	Y	Y
Cars restricted on campus roads	N	U	U	U	Y	N	Y	N
Utilizes parking demand management	Y	Y	Y	Y	Y	Y	Y	N
Remote discount parking available	Y	Y	N	N	N	Y	Y	N
Campus speed limit is 15 MPH or less	Y	N	N	Y	Y	Y	N	N
Major non-vehicle pathways on campus	F	Y	U	U	Y	U	Y	Y
Allows faculty/staff to telework	Y	F	Y	Y	Y	Y	Y	Y
Carpool/vanpool incentives offered	Y	Y	Y	Y	Y	Y	Y	Y
High-efficiency motor pool vehicles available	N	Y	Y	U	Y	Y	Y	N
Air travel offset program in place	N	F	Y	Y	U	U	U	U
Public EV charging stations on campus	N	Y	Y	Y	Y	Y	Y	Y

Y = Yes, N = No, U = Unknown, F = Future plans

Within their Climate Action Plan, three out of the four comparison universities included goals related to transportation (CSU, PSU, UC Davis). Of the three universities with transportation goals, the recommendations included increasing the fuel efficiency of campus motor pool vehicles (CSU, UC Davis), **increasing reliance on teleworking and teleconferencing** (CSU, PSU, UC Davis), **offsetting air travel** (CSU, PSU, UC Davis), **improving data on commute modal split** (PSU), improving carpooling (CSU, PSU), improving education on climate impact of travel (PSU), removing barriers in state system for choosing lower carbon forms of travel (PSU) as well as continuing/improving various programs such as **free public transport**, bike share programs, and bicycle parking/maintenance programs.

Data derived from their websites demonstrates that one university (UC Davis) **restricts freshmen from registering a car on campus**. One university (CSU) utilizes remote parking with a lower permit cost. Although all have some type of parking demand management, they varied in their specific options. For example, CSU and Stanford have parking options ranging from a daily charge

to an annual permit. The former is a strategy that may reduce total days driven to campus. PSU provides prime parking spots for those who utilize carpooling. Even more unique, UC Davis offers "**easy park personal parking meters**" (placed on a car's dashboard) that will charge for parking by the hour from a prepaid account. All four universities appear to have policies that allow teleworking but the use of these policies is unknown. UC Davis offers a "GoClub" membership that connects commuters with lower cost and stress commute options, transit subsidies, and 24 day parking passes. All peer universities have **electric vehicle (EV) charging stations**. It is free to park at CSU's EV charging stations. PSU has four EV charging stations on campus that have an hourly charge and a four-hour maximum. Stanford has 80 EV charging stations.

Peer Comparison — Within Virginia

In Virginia, three universities were used in peer comparisons. University of Virginia (UVA), William and Mary (W&M) and James Madison University (JMU) were reviewed to compare transportation programs aimed at reducing GHGs through promoting alternative transportation.

Virginia Tech and these three universities all have the following aspects: pre-paid transit through student fees, teleworking, carpool/vanpool incentives, and electric car charging stations. JMU was the only school that **restricted regular vehicle traffic on core campus** roads during heavy pedestrian periods. W&M was the only school that did not have bike share and remote discount parking. VT and UVA have some speed limits below 25 MPH, but W&M and JMU did not.

Virginia Tech does allow freshmen to have cars, which the other schools restricted. It is worth noting that of the nearly **10,000 on-campus residents, only 1,400 permits (14%)** were purchased. It is unknown how many of those residents are freshmen. It was unclear or hard to find metrics for aspects such as: parking demand management, air travel offsets, quality/quantity of non-vehicle pathways, or fuel efficiency of campus motor pool vehicles. In general, VT compared well against these Virginia schools.

8.6 Waste-Recycling-Composting

Using the Sustainability Tracking, Assessment, and Rating System protocol, we compared Virginia Tech's waste management program to that of eight land grant institutions, and six colleges and universities in the Commonwealth of Virginia (Table 8.5).

While we have made significant progress in the past two decades, clearly we have room for improvement. Institutions with very impressive waste management programs include North Carolina State University (NC State), The Ohio State University (OSU), Penn State University, and the University of Maryland (UMD). George Mason University (GMU) and the University of Virginia (UVA) have the leading in-state waste management programs. These universities offer a mix of urban and suburban campuses, providing a range of options for Virginia Tech to choose from to boost our waste management operations.

All of these universities have an updated climate action plan and STARS scores with the exception of NC State. The STARS scores of these universities provided rankings of waste management that were similar to Virginia Tech's, with only George Mason surpassing the university. GMU has the **Patriot Green Fund**, which offers $100,000 for campus innovation in several sectors, including recycling services. In addition, all of these universities have **zero waste plans for events**. In particular, OSU has selected zero-waste buildings on its campus and has devoted its football games that it hosts as zero waste events. Campuses such as UMD have backed this effort.

Virginia Tech has a unique opportunity to exemplify its leadership in waste management by adopting these efforts and striving to be a zero waste campus. Furthermore, Virginia Tech is presented with an opportunity to emulate more innovative leaders in waste management such as OSU through the university's pulping system to turn composted food waste into usable energy.

Many of these universities, such as UVA and Penn State, have sustainability student internship programs that treat the university as a living laboratory, similar to Virginia Tech. VT has an opportunity to expand its programs.

Table 8.5 Peer Institution Waste Management Comparison - 4/16/2020

Institution	Waste Management Organization	Student Population	Faculty and Staff	STARS Year	STARS WM Score (OP-18:21)	A Recycled Materials (tons)	B Composted Materials (tons)	C Landfill (tons)	D= A + B +C Total Waste (tons)	(A+B)/D Basic Recycle Rate (%)	Recycled Construction Waste (tons)	Landfill Construction Waste (tons)	Landfill Construction Diversion (%)	Notes of Interest
Virginia Tech	Office of Sustainability	34,000	7,700	2017	5.29	1,488	416	3,867	5,771	33	2,285.84	590	80	Using the Virginia DEQ formula, our Final Recycle Rate was 38% (5% above the Basic Recycle Rate).
Land Grant Institutions														
Penn State	Sustainability Institute - entire staff unit dedicated to sustainability	46,000	17,000	2017	4.81	2,529	4,780	5,895	13,299	56	18,298.00	3,256	85	Old ceiling tiles are recycled, "Recycling Roadshow", waste audits
Ohio State	Two offices: Energy Services and Sustainability and Office of Energy and Environment	68,000	27,000	2019	3.33	3,689	2,242	14,803	20,733	29	10,196,49	1,293	89	Zero waste facilities, zero waste football games, 50 tons of coffee compost
Auburn	Waste Reduction and Recycling Department	29,000	5,900	2019	4.42	845	0	4,408	5,263	16	31,580	2,505	93	GameDay Recycling challenge, RecycleMania
NC State	Program manager, operations manager, coordinators, operators, and interns	36,000	9,700	2016 (expired)	4.15	2,537	1,475	4,282	8,294	48	1,970	1,066	65	Zero waste event planning, zero waste guide, RecycleMania
Maryland	Office of Sustainability	39,000	10,000	2019	6.6	3,808	1,438	3,993	9,933	60	45,125	3,138	94	75% carbon neutral on 2013, green office program, waste audits, "Terrapin Trader", partners with Goodwill
Clemson	Recycling services program	23,400	5,000	2018	5.52	802	442	2,969	4,255	30	146	57	72	Carbon neutral by 2030
Florida State	Sustainable Campus Office	36,000	6,700	2019	4.58	1,323	406	3,244	6,439	50	6,212	7,487	45	Move out collection bank
Tennessee	Office of Sustainability	28,300	24,500	2018	3.52	1,635	1,572	7,935	12,138	35	534	398	57	Zero Waste campus by 2028
Virginia Colleges and Universities														
UVA	Office of Sustainability	23,000	16,000	2018	4.3	6,157	747	4,895	11,812	59	371	41	90	zero waste guides for events, waste audits, reusable office supply exchange, Hoos Reuse program
William & Mary	Office of Sustainability - Even less faculty than VT	9,500	3,000	2016	3.89	386	174	1,258	1,959	36	-	-	-	Very similar initiatives as VT with an intern program. In general, smaller scale.
VCU	Office of Sustainability - organized through coordinators	32,000	12,000	2018	4.75	2,985	0	3,101	6,183	50	95	37	72	Generally a smaller operation, one thing we could be doing from them is a garden program
JMU	Office of Environmental Stewardship and Sustainability	24,000	4,000	2018	4.95	807	493	1,939	3,257	40	1,621	203	89	Focused more around sustainability in courses
GMU	Slightly larger office than VT - 3 full time and 5 intern groups	45,000	6,000	2017	7.32	698	0.50	2,128	2,857	60	3,432	361	90	https://green.gmu.edu/
Radford	Office of Sustainability	11,000	2,000	2019	4.08	422	0.00	918	1,346	32	2,435	916	73	

8.7 Agriculture, Forestry, Land Use

8.7.1 Agricultural Operations and Tree Cover Policies

Agricultural operations provide challenges for sustainability due to, for example, contributions of greenhouse gas emissions from animal agriculture. Accordingly, **many peer institutions have omitted agricultural operations** from their climate action plans. Offset strategies include reduced emissions, carbon storage, and the implementation of alternative energy strategies.

Most VT peer institutions have adopted management practices that reduce the production of methane from agricultural animals and carbon storage approaches. Several peer institutions use **composting to reduce the impacts of food waste** (Table 8.6), which is often **co-composted or-digested with animal waste** (e.g., at Purdue and Ohio State). A noteworthy example is North Carolina State that just launched a compost facility using an aerated static pile composting system with capability to process 1,200 tons organic waste annually. Expected expansion will enable the university to meet its 70% waste diversion goal.

Increasing tree cover is another strategy to mitigate GHG emissions, with 20.9% of colleges and universities in the US currently achieving (8.7%) or developing (12.2%) campus tree cover goals (Table 8.6).

Table 8.6. Sustainable land use strategies of seven VT peer institutions which have adopted composting to manage wastes.

University	Alternative Agriculture practices	Waste management	Tree Cover
University of Washington	NA	Anerobic digestor Food waste >3k tons	20.9% goal of 23%
University of California, Davis	Active	Anerobic digestor Food waste > 20k tons Off campus	21% goal of 30%
Cornell University	Active	Windrow Food waste >4k tons	Goal 25%
University of Maryland	NA	Windrow Food waste 450-550 tons, Off campus partnership with local government	24% goal of 40%
The Ohio State University	Active	Anerobic digestor ~2k tons via 3rd party	13% goal of 26%
Purdue University	Active	Anerobic digestor Off campus, partnership with local government	14.2% goal of 20%
North Carolina State University	NA	Aerated static pile composting system with capability to process 1,200 tons organic waste annually. Expected expansion will enable university to meet its 70% waste diversion goal.	

8.7.2 Agrivoltaics: Co-use of farmland for solar arrays and agriculture

Exploring renewable energy sources leads most campus climate action plans. In this arena, agrivoltaics have arisen as a renewable energy source that is compatible with existing agricultural practices. Arizona State University is **coupling the use of solar panels with vegetable production** wherein the solar array reduces the negative impacts of high light and low moisture in the desert environment. Oregon State and Colorado State Universities are using **agrivoltaics in forage and pasture settings**, a strategy being considered by VT. Penn State is currently developing a 70 MW solar installation that incorporates **agrivoltaics with pollinator species habitat** for bee colony honey production and grazing sheep. Both crop and animal agriculture can co-exist under a properly designed solar array, resulting in little or no reduction in agricultural efficiency.

8.8 Sustainable Choices

As part of this review, we have researched and compiled for the peer institutions listed in Table 8.7 below. This list includes exemplary institutions that have committed to Climate Action and engaging their university community. Exemplar institutions are defined by their "top down" approach to climate action projects, strong engagement and cross-campus partnerships.

The following areas were analyzed during this research process:

- Key Climate Action **Behavior targets**
- **Cross-campus collaboration** partnerships
- **Student engagement** strategies
- **Sustainability curriculum integration**
- Examples of how the university is **measuring its success**

8.9 Climate Justice

Virginia Tech has the opportunity to become a leader among peer institutions by incorporating climate justice goals into its Climate Action Commitment. Currently, there are **very few examples of peer institutions that have formally acknowledged the importance of climate justice**, let alone organized their sustainability initiatives around it. Most climate justice efforts at universities have been initiated by students, and sometimes by faculty, but we were unable to find any institutions of higher education that have included climate justice in a university-wide climate commitment. As a result, our comparison to peer institutions focuses on student and faculty-led climate justice initiatives.

Students at the University of California-Berkeley initiated a Student Environmental Resource Center (SERC) that operates under the framework of environmental justice. Like the recent climate action commitment, SERC was founded as a result of student activists' calls for the university to take issues of environmental injustice and climate change seriously. The students' leadership is the primary reason SERC became an **award-winning environmental justice organization** within the first two years of its founding and continues to be a leader in tackling issues of environmental injustice. Another example is the Environmental and Climate Justice Studies Research Hub at the University of California-Santa Barbara, which works to "advance scholar-activism across the horizon of globalization, in defense of vulnerable human communities, fragile environments, and a just climate future." Other top-tier universities with climate justice programs include University of Washington, University of Colorado, and University of Arizona.

Table 8.7 Sustainable Choices Peer Universities

Peer University	Key Climate Action Behavior Targets	Cross-campus partnerships	Student engagement strategies	Sustainability curriculum integration	Examples of measuring success	Website links
University of Maryland	Integrate sustainability into education, Use the university as a living laboratory	Energy Innovation Institute,	Sustainability Studies Minor, First year students must enroll in a sustainability class, Funds available for sustainable learning programs,	20 Sustainability Teaching Fellows, 200 Courses include sustainability	undergraduate and graduate students participate in a Sustainability Literacy Assessment every three years	Sustainability Goals Climate Action Plan
UC Berkeley	Achieve buildings and fleet vehicle carbon neutrality by 2025	UC Berkeley Extension Education, UC Sustainability Fellowships	Sustainability Walking Tour, Local restoration volunteer projects, Student Environmental Resource Center,	600 sustainability courses Sustainable Extension courses (sustainable design and energy in sustainability)	Monitor energy usage in conjunction with energy saving programs (2015 Cool Campus Challenge)	Student Engagement and Student Environmental Resource Center
University of Michigan			Student Sustainability Ambassadors, Sustainability Showcase in the fall, Zero waste,		Developing programs to track behavior change	
University of Virginia	Foster public service related to sustainability initiatives, utilize orientation programs, establish the "Sustainability Fellows" program	Energy Working Group, Partnership with Dominion Power	Environmental Stewardship and Civic Engagement Subcommittees of the Sustainability Office.	Teaching & Research Subcommittee, Sustainability Summer Internships, Sustainability Course Development Grants	"Smart Labs" program which measures sustainability in research labs,	Sustainability Committees Curriculum Integration Engagement Projects Monitoring Sustainability

There are also many models of **university-community partnerships** focusing on specific environmental or climate justice issues. Groups like Shield the People and UPROSE are community groups that center the people most affected by environmental injustices and who work with public institutions, like universities, to address these injustices. Furthermore, national groups like the Climate Justice Alliance work on applying specific strategies of environmental justice, such as "just transition" or "energy democracy," alongside universities to provide economic relief in areas that have traditionally relied on fossil fuel industries. Additionally, many environmental justice groups have worked to connect the harms of climate change to the recent outbreak of COVID-19, which demonstrates how environmental justice is a broad approach that can positively inform almost all operations of a university—even those not immediately and obviously connected to the environment. This is to say that, despite the small number of comparisons available, there are successful models that can guide the way for incorporating environmental and climate justice into sustainability efforts and university planning.

Despite these examples of community-campus partnerships for environmental and climate justice, we have not found examples of other universities that have incorporated climate justice goals into their climate action plans. Thus, **Virginia Tech is poised to become a leader among peer institutions by establishing climate justice as one of the core values** of the Climate Action Commitment.

8.10 Community Engagement

As part of the Climate Action Commitment update process, we have researched and compiled information on peer and/or exemplary institutions to get a better sense of best practices. The institutions profiled have committed to Climate Action in ways that engage their respective university and wider communities. Additional information is available in the Community Engagement subcommittee report.

The following areas were analyzed during this research process:

- Key Climate Action Behavior targets
- Cross-campus collaboration partnerships
- Student engagement strategies
- Sustainability curriculum integration
- Examples of how the university is measuring its success

8.10.1 The University of Virginia **https://sustainability.virginia.edu/engage**

The University of Virginia (UVA) communicates its work around sustainability and climate action via its webpage. A subpage focuses specifically on engagement activities. This subpage describes the various efforts the university takes to engage students, faculty & staff, alumni, and community partners. Relevant highlights from their work in engaging the community include:

1. ***Establishment and prominent placement of clear engagement goals on their community engagement webpage***
   - ***a.*** The University will educate and engage its students, faculty, staff, and the larger community; contribute to knowledge through research; promote health and well being; and foster public service related to these sustainability principles.
   - ***b.*** Partner with the community to accelerate collaborative initiatives to advance sustainable, equitable, and healthy places for all.
2. ***Development and support of student groups for sustainability***

   a. *Sustainability advocates program* - A program to develop student leaders for sustainability by supporting sustainability projects that engage the UVA community.
   b. *Sustainability student organizations* - Over 30 groups that include sustainability initiatives in their mission.
3. ***Creation of cross campus committees engaging faculty, staff and students to develop and lead sustainability efforts***
   a. Environmental Stewardship Subcommittee
   b. Civic Engagement Subcommittee
   c. Teaching and Research Subcommittee
4. ***Dispersing grants to faculty, staff, and students that engage the community in sustainability efforts***
5. ***Partnerships with local sustainability and climate action efforts***
   a. *Climate Action Together*- City, county, and UVA effort to engage and inform the community around GHG reduction and the development of community wide climate action plans.
   b. *LEAP* - Local non-profit focused on energy efficiency and the expansion of solar energy within residential spaces. LEAP partners with the University by providing audits of campus housing and residential spaces.
6. ***Previous year hosted 92 events to promote sustainability with over 5000 attendees.***
7. ***Integration of three pillars of sustainability: equity, economy, and the environment into over 150 undergraduate courses***
   a. *Key examples:*
      - Within a green engineering course, students evaluated 500+ rooftops on campus for the potential placement of solar panels.
      - Students in a Solid Waste Management course contributed directly to the University's Waste Action Plan.
8. ***Development of academic programs, minors, and certificates:***
   - Global Studies - Environments & Sustainability | BA
   - Environmental Sciences | BA, BS, MA, MS, DMP, Ph.D.
   - Environmental Thought & Practice | BA, DMP
   - Civil & Environmental Engineering | BS, ME, MS, Ph.D.
   - Urban & Environmental Planning | BUEP, MUEP
   - Environmental & Land Use Law | JD
   - Innovation for Sustainability | MBA
   - Global Studies - Environments & Sustainability | Minor
   - Environmental Sciences | Minor
   - Technology & the Environment | Minor
   - Sustainable Business | Online Certificate
9. ***Utilization and prioritization of the grounds as a living lab to allow students to directly implement engagement and stewardship efforts within the immediate environment.***
10. ***Support of various research centers and groups across disciplines that focus on sustainability:***
    a. Creation of a teaching and research subcommittee within the Committee on Sustainability provides oversight for the disbursement of seed grants on a semester by semester basis.
    b. Highlighted research groups:
       - Alliance for Research on Corporate Sustainability
       - Biophilic Cities
       - Center for Design and Health
       - Convergent Behavioral Science Initiative
       - Environmental Humanities at UVA
       - Green Building & Public Health Innovation Partnership

- Institute for Environmental Negotiation
- Nitrogen Footprint Network
- Virginia Coast Reserve Long-Term Ecological Research

11. ***Measurement and communication of success efforts***
    - ***a.*** Case studies are developed and shared to highlight successes and describe replicability and scalability of efforts.
    - ***b.*** Sustainability reports on quarterly and annual basis

8.10.2 University of California Berkeley https://sustainability.berkeley.edu/engage

The University of California Berkeley campus has a dedicated webpage for climate action and sustainability efforts (sustainability.berkeley.edu). Efforts to engage the various community stakeholders are described in a subpage focused on engagement. Relevant highlights regarding UC Berkeley's approach to engaging the community in their climate action and sustainability efforts include:

1. ***Engagement in efforts to encourage behavioral change activities***
    - ***a.*** *Cool campus challenges* - A UC-wide competition to reduce carbon emissions across the system of campuses. Engaged 4215 participants or 7.5% of campus community. Reduced 2026 metric tons CO2 emissions according to self-reported actions.
    - ***b.*** *Real-time energy dashboards* - These energy dashboards were installed in 137 buildings to help community members monitor energy and water usage. This allowed the community to easily visualize the savings in energy and water through behavioral change efforts.
    - ***c.*** *Development and strategic placement of tips and strategy guides* - Booklets focused on energy saving strategies specifically for labs, offices, residence halls, and homes.
2. ***Easily accessible communication channels via social media and newsletter sign-up links***
    - Facebook, Instagram, Newsletter-sign up
3. ***Campus wide engagement to assess sustainability efforts in submission to the Sustainability, Tracking, Assessment, and Rating System (STARS).***
    - ***a.*** This effort culminated in the 11th highest rating of 349 universities with active STARS ratings. See engagement scores for UC Berkeley in Community Engagement SC report.
4. ***Extensive integration of sustainability into curricula***
    - ***a.*** The catalogue of courses includes over 600 offerings focused on environmental, social, and economic sustainability. This constitutes 18% of all campus courses.
    - ***b.*** The cross-disciplinary nature of these courses is indicated by the fact that they represent over 45 different departments.
5. ***Development and promotion of degrees focused on sustainability***
    - 30 graduate programs, 25 undergraduate programs, 20 minors
6. ***Establishment of grant funds to support student and campus sustainability projects***
    - The Green Initiative Fund (http://tgif.berkeley.edu/) provided $2.8 million in grants to 208 grant projects. 350 student internships were created through these grant projects.
7. ***Community education promoted through Green Campus Walking Tour***
    - This walking tour exists virtually on the dedicated webpage. There is also a printable map to engage in the highlighted destinations available on their dedicated webpage.(https://sustainability.berkeley.edu/engage/green-campus-walking-tour)
8. **Office of Sustainability certification for labs, departments, and events, recognizing their sustainability efforts:**
    - Green Labs: Green Labs Checklist, Green Studios Checklist, List of certified and prospective labs, Green Labs Guide, Green Labs Newsletter: Summer 2018 Edition, Green Labs in Sustainability News, Green Labs Product Guide: Sustainable Alternatives

- Green Departments: Green Department Checklist, Green Department Profiles
- Green Events: Green Event Checklist, Sustainable Food Flyer, Green Events Resource Guide, Healthy Meeting and Event Guide, Zero Waste Caterer Guidelines and Certification

9. ***Development of a Student Environmental Resource Center***
   - There are over 50 organizations and clubs focused on sustainability efforts.

8.10.3 University of Michigan https://ocs.umich.edu/sustainability-goals/community-engagement/

University of Michigan's Office of Campus Sustainability consolidates its sustainability efforts. The department has its own dedicated webpage at https://ocs.umich.edu/. Their efforts for community engagement are described on a focused subpage for community engagement at https://ocs.umich.edu/sustainability-goals/community-engagement. Highlights of their community engagement efforts include:

1. ***A well defined and visible goal on their community engagement focused webpage:***
   - Invest in programs to educate our community, track behavior, and report progress over time toward a campus-wide ethic of sustainability.
2. ***Identification of sustainability cultural indicators to assess attainment of community engagement goal***
   - ***a.*** A cross-campus collaboration to measure community sustainability behaviors and attitudes.
   - ***b.*** Indicators include waste prevention behavior, conservation behavior, travel behavior, and awareness of sustainability initiatives.
   - ***c.*** Two annual surveys sent to the faculty & staff community and student community since 2015. More than 3500 students and 1500 F&S respondents annually.
3. ***Establishment of the Planet Blue Ambassador program to enlist community members to support and participate in sustainability efforts***
   - ***a.*** 6500+ community members are designated as Planet Blue Ambassadors
   - ***b.*** Entry into the program requires an introductory training and then further commitments are individual selected and not required.
   - ***c.*** The program distributes a monthly newsletter
   - ***d.*** Ambassadors are also engaged via monthly meetings and book club discussions.
4. ***Designated sustainable workplaces on campus***
   - ***a.*** Online assessment to request designation as a sustainable workplace: Sustainable Office Assessment, Sustainable Lab Assessment
   - ***b.*** Over 380 sustainable workplaces on campus, involving 20,400 staff
5. ***Annual community engagement event known as Earthfest*** taken place for 25 years.
6. ***Utilize campus as a living/learning laboratory to advance student led sustainability efforts***
   - Examples: Michigan Dining has partnered with 140 student sustainability projects annually; ENVIRON 391 course led to the creation of the Campus Farm.
7. ***Establishment of a wide range of organizations and fellowships to encourage and support sustainability projects (http://sustainability.umich.edu/students).***
   - Planet Blue Student Leaders: peer-to-peer sustainability behavior change
   - U-M Sustainable Food Program: student led program that supports sustainable food
   - Student Sustainability Coalition: manages the Planet Blue Student Innovation Fund which provides up to $50,000 annually to sustainability projects.
   - Undergraduate Sustainability Scholars: fosters sustainability leadership & engagement. Participants receive up to $3500 and training.
   - Dow Sustainability Fellows: graduate students engaged in solutions to sustainability concerns
   - Sustainable Living Experience Theme Community: dedicated living community

8. ***Orientation modules focused on the university's commitment to sustainability principles***

8.10.4 University of Maryland https://sustainability.umd.edu/progress/climate-action-plan

As with other institutions, the University of Maryland has a dedicated Office of Sustainability with their own webpage at sustainability.umd.edu. There is not a dedicated webpage for their community engagement goals and efforts, but the respective efforts are acknowledged and described throughout the Office of Sustainability site. Highlights of their community engagement efforts include:

1. ***Engagement goals focus primarily on education rather than community engagement***
    - Integrate sustainability broadly across the curriculum and student life so that all students demonstrate skills and knowledge related to the Sustainability Learning Outcomes.
    - Use the campus as a living laboratory by enhancing opportunities for students, faculty, and staff to work together to develop and implement solutions to campus sustainability challenges.
    - Adhere to strategies outlined in the Education for Sustainability Report.
    - One greater community engagement goal stated as: Expand sustainability knowledge and collaboration through demonstration and outreach projects, joint agreements, professional conferences, and participation in university-agency initiatives.
2. ***Partnerships for Action Learning in Sustainability (PALS) established to integrate action learning within the local community focused on cross-discipline approaches to sustainability***
    - In 2017-2018, 23 PALS courses included 350 students in disciplines including Business, Architecture, Agriculture and Natural Resources, and Public Health
3. ***Dedicated social media pages for sustainability efforts*** Facebook, Instagram, Twitter, YouTube
4. ***Dedicated majors, minors, and graduate programs that specifically address climate and sustainability issues:*** 15 Undergraduate Majors, 13 Undergraduate Minors, 20 Graduate programs
5. ***The university has 14 research centers with missions to find solutions to environmental issues***
6. ***Establishment of a Sustainability Teaching Fellows program***
    - The program provides training and mentoring for faculty in their pursuits of integrating sustainability issues into their courses.
    - Since its inception, 210 professors participated leading to the revising of 217 courses to integrate sustainability topics across 71 disciplines.
7. ***Support a Student based Lead, Educate, Act, Facilitate (LEAF) program:*** In 2017-18, 14 students reached 3,229 students via 77 events promoting sustainability.
8. ***Evaluative criteria to measure their education efforts around sustainability include:***
    - First year sustainability education (% of students engaged)
    - Sustainability studies minor students (# of students)
    - Sustainability teaching fellows participation (# of faculty)
    - LEAF outreach team impact (# of students reached)
    - Green housing program participants (# of students)
9. ***Creation of a Green Office Certification program***
    - A tiered certification program for individual offices to achieve sustainable principles/practices.
    - Stated goals of the program:
        - Engage campus community in activities to strengthen position as a leader in sustainability, Recognize and reward leadership in sustainability; Educate participants about how and why to take action; Support the University's Climate Action Plan and Strategic Plan; Further integrate sustainability into campus culture; Conserve water, save energy, minimize waste and save money; Promote campus policies that support sustainability

8.11 Budget and Finance for Climate Action

The 2020 VT Climate Action Commitment calls for investment in energy efficiency and climate action. Those investments are consistent with what many peer universities are doing. Let's review some of the examples.

Renewable energy. Considering other universities with respect to renewable energy generation, we identify three exemplary schools in our region: the University of Virginia, William & Mary, and Penn State. One common trend with all three of these schools is the use of **Power Purchase Agreements (**PPA). These agreements enable the schools to have little to no upfront costs, which makes them attractive options. The universities then pay for the power that comes from the renewables, in all three of our cases solar farms.

Buildings. The University of Virginia set a 2016-2025 Energy and Emissions Action Plan, and it has a staff of **three engineering technicians and several controls technicians** to develop and implement it. UVA's Delta Force program has invested $15.5 million in energy projects and has saved $25.6 million and 180,000 metric tons of carbon dioxide emissions (MTCDE) since 2009. The University of Maryland set a goal for efficiency upgrades in existing buildings that will reduce campus electricity use 20% by 2020, and it invested $21.5 million to save $1.7 million/year to reduce campus energy by 6%.

Energy systems. A **designated energy management office** is a key component of an exemplar institution. The University of Virginia and Penn State each have an energy center.

Transportation. Parking demand management varies among peer universities. For example, CSU and Stanford have parking options ranging from a daily charge to an annual permit. The former is a strategy that may reduce total days driven to campus. UC Davis offers "**easy park personal parking meters**" (placed on a car's dashboard) that will charge for parking by the hour from a prepaid account. All peer universities have **electric vehicle (EV) charging stations**. It is free to park at CSU's EV charging stations. PSU has four EV charging stations on campus that have an hourly charge and a four-hour maximum. Stanford has 80 EV charging stations.

Waste-Recycling-Composting. GMU has the **Patriot Green Fund**, which offers $100,000 for campus innovation in several sectors, including recycling services. Several universities have composting facilities for their food and other organic wastes. North Carolina State that just launched a compost facility using an aerated static pile composting system with capability to process 1,200 tons organic waste annually. Expected expansion will enable the university to meet its 70% waste diversion goal.

Agriculture/Forestry/Land Use. Related to waste management, composting and/or waste digestion are used at seven peer universities evaluated.

Community Engagement and Sustainable Choices. The many examples reviewed in these areas indicate the innovative programs by our peer institutions, ranging from student initiatives, living laboratory programs, green lab upgrades and certification, green office certification, sustainable workplaces certification, community partnerships, student organizations, sustainable academic program development, and others, all supported financially by the university

9. Conclusion and Proposed Immediate Actions

This chapter provides some concluding comments and identifies actions that can be taken in the short term (2020-2022) to get us going and demonstrate right away the university's commitment to climate action.

9.1 Concluding Comments

In January 2020, with great hope and opportunity, the Working Group began its task of evaluating Virginia Tech's current position and future role in addressing climate change. The stars seemed to align with growing promise for a new and bold Virginia Tech climate action commitment. Student Climate Strikes and activism raised awareness of the existential threat, faculty and staff senates and student government passed resolutions in support of the student demands, our Facilities staff showed remarkable interest, the university had available resources, our peers UVA and William & Mary were taking bold steps, the Virginia Governor and General Assembly were initiating major policy changes, and, in the words of President Sands, "Virginia Tech had a duty to respond."

Six weeks later, as the Working Group completed its Interim Report in early March, the world dramatically changed. The Covid-19 pandemic closed the university campus and, at this writing in late June, continues to be a global crisis and poses great uncertainties for the university.

Still, the climate crisis has not gone away, and during this time we are learning important lessons. People are learning to trust science and use it to inform policy-making, shape responses, and guide action. This public health crisis has exposed uneven vulnerabilities in our economy and society, raising calls for recovery efforts to redress inequities. Similarly, our actions to combat climate change and strengthen our community's resilience must be guided by an equitable transition to sustainable action. As a new world dawns, we must bounce "forward," not "back," to seize the hope and promise of this moment.

Our work focused on the smart ways the university can advance genuine climate action, even in this age of uncertainty. And through the multitude of working group, subcommittee, and community zoom meetings, our discussion has reflected on the opportunity for Virginia Tech to reinvent itself, not only in its commitment to climate action, but also in its responsiveness to the needs of the world around us.

Our recommended climate action commitment is bold, aggressive, and comprehensive. Its 15 goals and pathways to achieve them aim to engage the entire university.

- They include restructuring our operations and governance of climate action and sustainability through a new university-wide **Climate Action and Sustainability Office**, **Chief Climate Action & Sustainability Officer**, and governance **Climate Action, Sustainability & Energy Committee**.
- They require necessary upgrades to the campus physical plant and operations to reduce GHG emissions to achieve **carbon neutrality by 2030**, including steam plant and chiller energy systems, new building energy efficiency, efficiency retrofit of existing buildings, improved agricultural operations, sustainable mobility, and better management of waste and recycling.
- They include partnering and investing our way to **100% renewable electricity by 2030** through 15 MW (~100 acres) of solar PV capacity on Virginia Tech buildings and lands and

130 MW (~650 acres) of solar PV farms developed by utility or 3rd-party firms with our own utility, Virginia Tech Electric Service (VTES), the power purchaser.

- They include integrating these improvements into the educational mission through a **Climate Action Living Laboratory**, which engages colleges, departments, faculty and students in experiential learning using the campus physical plant upgrades as a focus for instruction, research, and outreach.
- They include **engaging everyone in climate action** through better and more visible information on campus progress and enhanced involvement in CAC annual reviews and updates.
- They include creating a **culture of sustainability** by making sustainable choices by students, faculty, and staff easier and more desirable through social media campaigns and structural changes, including campus procurement policy.
- They include assuring that climate action considers not only financial, environmental, and reputational effects, but also the **social equity and justice** impacts and benefits of our goals and pathways.

In several areas, our VT 2020 CAC sets the stage for Virginia Tech to shine as an exemplar and leader in university climate action. Beyond our climate neutrality and zero-waste campus goals, **six areas of the 2020 CAC can place Virginia Tech above other universities:**

1. The detail and **specificity of the pathways** developed to achieve the CAC goals
2. Our own **unique utility VTES** leading our way to 100% renewable electricity, while most other universities are totally dependent on private utilities and companies
3. Using our considerable **land resources** not only to manage our agricultural impacts, but also to sequester carbon and develop renewable energy
4. Incorporating in our carbon neutral goal **scope 3 GHG emissions relating to behavior** (e.g., commuting, waste/recycling, water/wastewater, business travel), while most others include just scope 1 & 2
5. Integrating our physical climate action into the **university's educational mission** through the Climate Action Living Laboratory (CALL).
6. Specifically addressing **community engagement, sustainable behaviors, and social equity and justice** as core elements of our climate action.

9.2 Climate Action Project/Initiatives for Near Term (2020-2022)

Although the 2020 VT Climate Action Commitment focuses on 2030 as the target date for most of its goals, the pathway to those goals begins the day the CAC is adopted, if not before. The Working Group has identified a number of initiatives and projects that can and should be acted on in the short term from now until 2022 to get a jump start on necessary action and to demonstrate the university's commitment, with full understanding of the university's current budget constraints and uncertainties.

These proposals are listed below sorted by (a) low-cost/no-cost/revenue-neutral initiatives, (b) ongoing and budgeted projects, and (c) new priorities in need of funding and/or approval.

9.2.1 Low/no cost/revenue neutral project/policy/planning initiatives

- **GHG Software Platform**
  Purchase an annual license to a formal GHG assessment software platform. SIMAP (Sustainability Indicator Management and Analysis Platform) is a carbon and nitrogen-accounting platform that can track, analyze, and improve your campus-wide sustainability. This platform is the most widely used method of analysis by Universities for their carbon and/or nitrogen footprints. It has customizable carbon emissions coefficients, flexibility in data import and export, and includes a third-party data review, which provides additional points in the AASHE STARS Rating System.

- **Reconstitute the Energy & Sustainability Committee (E&SC) in governance to the Climate Action, Sustainability, and Energy (CASE) Committee.**
  Broaden the mission of E&SC to provide governance oversight of CAC implementation; rename E&SC the Climate Action, Sustainability, and Energy (CASE); modify the charge, membership, and reporting lines, and establish new subcommittees including Climate Action Living Laboratory, Climate Justice, Climate Action Engagement, Sustainable Choices, among others.

- **Establish an alternative mobility subcommittee of the Transportation and Parking Committee**

- **Establish framework for Climate Action Living Laboratory (CALL) through Provost's Office, College Deans, and Facilities Department**
  One of the most important goals of the 2020 VT CAC is integrating the goals and pathways into the educational mission of the university. Many of the CAC goal pathways focus on the opportunities for the Climate Action Living Laboratory (CALL) including renewables, energy systems, buildings, agriculture/forestry/land use, waste/recycling/composting, transportation, climate justice, sustainable choice, and community engagement. What is needed is a framework for designing, implementing, and operating the CALL to take full advantages of the opportunities.

- **Promote VTES-PEC partnership as part of Climate Action Living Laboratory**
  VTES and the Power and Energy Center (PEC) have collaborated and agreed on a partnership to use VTES as a testbed for research projects on what may become the VT Smart Grid. The **VT Smart Grid** can also be supported by VT solar development and VT battery storage as key components of the initiative currently being discussed with APCO.

- **Initiate partnership with APCO on renewables**
  The best opportunity for growing our renewable electricity base, especially before the power purchase contract expires in 2027, is to partner with APCO as they must grow their renewables in response to new state mandates. This mutually beneficial partnership should be initiated immediately.

- **Initiate community relations with VTES Town customers**
  Virginia Tech is closely tied to its Blacksburg community in many ways. One important way is through VTES, the electric utility for 6000 Blacksburg customers. As VTES moves toward 100% renewable electricity, it should engage its town customers, both to be part of the discussion of prospective changes and be part of the development through rooftop and community solar projects.

- **Develop plan for resilience/redundancy in steam plant for full conversion to natural gas by 2025**
  Based on the new natural gas contract, develop a plan for steam plant backup fuel and boiler redundancy by 2025.

- **Develop a Utility Master Plan**
  The 2020 CAC provides a set of goals and pathways that should be incorporated into a Utility Master Plan, which describes a long-term vision of Virginia Tech energy systems and identifies initiatives and projects.

- **Adopt Campus Tree Policy**
  The proposed Tree Policy will ensure that a sustainable urban tree canopy is maintained on the Virginia Tech campus and will contribute to our national recognition as a Tree Campus USA. Projected results if a 25% urban tree canopy goal is achieved include: an increase in annual carbon sequestration to help offset University operations, and lower energy use, cleaner air, more pleasant summer air temperatures, and enhanced stormwater mitigation.

- **Implement and Evaluate Sustainable Procurement Policy 2020-2022**
  Implement the April 2020 Sustainable Procurement Policy, which is based on the 2009/2013 CAC. Over two years, the Procurement Department in conjunction with the E&SC will evaluate the policy in light of the 2020 VT CAC https://www.procurement.vt.edu/. The Policy:

- **Engage VT Foundation in energy management plan for buildings in Blacksburg leased to VT department operations**
  The Foundation operates on a revenue neutral basis, so that any investment it makes in energy efficiency improvements in its leased buildings must be recovered by increasing rent. With prudent efficiency investment, that increased rent for the university should be more that offset by a decrease in its utility bills. The Foundation CEO is willing to engage in energy retrofit under these terms on a pilot basis, starting with the Corporate Research Center when a new CRC president is hired.

- **Identify candidates for Zero-Net-Energy building on campus and develop fundraising plan**
  If a signature marque ZNE building is to be completed on campus by 2026, project identification and fundraising need to commence in 2020-21.

- **Seek external funding for agrivoltaics test array at Catawba Sustainability Center and/or Kentland Farm**
  Co-use solar and farmland agrivoltaics provides educational and research opportunities. The best sites for agrivoltaic projects are at Kentland Farm and Catawba Sustainability Center (CSC). Because siting studies and community engagement for a CSC solar project has already taken place in Catawba, the CSC is the best initial site for such a project.

- **Student Project for Fishburn Forest Wind Energy Assessment**
  Although Blacksburg has limited wind resources, one prospect is Virginia Tech's Fishburn Forest atop Price Mountain. This would make an excellent student project in conjunction with James Madison University's wind resources program that leases necessary equipment and provides technical support.

9.2.2 Ongoing budgeted projects

- **Implement ongoing projects to improve steam plant and upgrade chiller system.** Steam plant upgrades including additional of boiler #12 will provide sufficient natural gas boiler capacity to eliminate coal boilers. Chiller upgrade project, when complete in 2023, will reduce cooling energy use by 20%.

- **Evaluate new natural gas contract on implications for CAC goals and pathways**
  The new natural gas contract was effective July 2020. It affects several factors related to the CAC goals and pathways for steam plant operation. The new contract has favorable terms for natural gas availability, price, prospects for renewable gas, and need for steam plant backup fuel and boiler redundancy.

- **2020 RECs for 30% Renewable Electricity**
  Done. Virginia Tech purchased RECs from Apco for $1/MWh for 20% of its electricity in 2020 to achieve 30% renewable electricity. The 2020 RECs purchase makes a serious statement about our climate commitment, and we achieve the Governor's E.O.43 requirement to procure 30% of their electricity from renewable sources two years early for state agencies like VT (by 2022) and ten years early for utilities like VTES (by 2030).

- **Implement Building Design and Construction Standards in light of CAC Goals**
  The comprehensive Building and Construction Design Standards were adopted in May 2020 and provide an exceptional resource to streamline the design process. The standards incorporate compliance with the basic elements of the CAC.

- **Fill the VT Energy Manager Position and supplement staff as needed**
  This position has been vacant for more than one year and is critically important for implementing the entire Climate Action Commitment. The new energy manager should have sufficient staff.

- **Implement budgeted projects in Parking & Transportation Plan**
  Several projects are under various stages of development and should be developed, including the Multi-Modal Transit Facility, the Kent Street bicycle lane towards the Drillfield.

9.2.3 Priority projects requiring funding/approval

- **Create University-wide Climate Action and Sustainability Office (CASO)** led by a **Chief Climate Action and Sustainability Officer (CCASO).**
  Convert the current Office of Sustainability in Facilities to the university-wide CASO, which would be responsible for VT 2020 CAC implementation. The CCASO would report to the Senior Vice President and Chief Business Officer and the Executive Vice President and Provost.

- **Develop the University Compost Facility at Kentland**
  Developing and operating the University Compost Facility at Kentland will reduce net animal waste GHG emissions, support soil health, relieve the need to purchase new land for future land application of animal wastes, and support sustainable agriculture education and research. The Facility will also provide significant benefits in management of campus organic wastes from dining halls, athletics, the vet school, and campus tree trimmings. Capital cost is estimated at $1.4-1.8 million with net operating cost of about $165,000/year.

- **Initiate the 10-year Energy Management Plan**
  This plan to retrofit existing buildings and energy systems will have significant effects on reducing energy and GHG emissions while providing a financial return on investment of 10-15%. It's a no-brainer. Let's get on with it. The first step is to formulate projects for Year 1 of 2021-30 plan focusing on electricity efficiency to meet Governor's goal of reducing agency electricity consumption by 10% from 2006 by 2022.

- **Develop solar projects on campus: 2.35 MW by 2022**
  Finalize plans for addition of solar projects on campus buildings and lands, evaluating options for university-owned and operated systems or 3rd party-owned and operated projects with VT power purchase agreements (PPA). Because of Covid-19 impacts on university financial resources, a preferred option may be PPAs that would preserve university capital for other needs including funding the 10-year energy management plan.

- **Contract Zero-Waste Consultant to conduct VT Waste Audit**
  We propose the university hire a zero-waste consultant to conduct a waste audit to objectively evaluate waste management organization, staffing, procedures, and equipment for administration and academic facilities, and auxiliary enterprises, and to identify opportunities to streamline operations, maximize efficiencies and reduce costs.

- **Implement Campus-wide Green Lab Program**
  Because of the energy and economic savings potential of the Green Lab improvements, Virginia Tech should officially develop a Green Lab program to ultimately achieve Green Lab certification for 80% of VT science and engineering labs.

- **Implement current transportation infrastructure plans**
  Construct green bicycle lanes in strategic areas where known safety problems exist, the green link from the Perry Street area to Burruss Hall, replacing the 16 remaining substandard bicycle racks, improving lighting and accessibility of existing trails, sidewalks, and crosswalks, install/improve bicycle lanes on Washington Street and Kent Street.

- **Require University fleet vehicle purchases to emphasize fuel efficiency** through zero-emission, hybrid, and electric vehicles.

- **Parking permit restructuring**:
  Prohibit on-campus freshmen from purchasing a parking permit. Increase the price of a faculty/staff parking permit and implement an income-based sliding scale for permit fees.