ULI Virginia

WOODBERRY FOREST SCHOOL

Envisioning the Future Toward a Net Zero Campus

Technical Assistance Panel Report | DECEMBER 6 & 7, 2021

About the Urban Land Institute

The Urban Land Institute is a global, member-driven organization comprising more than 45,000 real estate and urban development professionals dedicated to advancing the Institute's mission: shape the future of the built environment for transformative impact in communities worldwide.

ULI's interdisciplinary membership represents all aspects of the industry, including developers, property owners, investors, architects, urban planners, public officials, real estate brokers, appraisers, attorneys, engineers, financiers, and academics. Established in 1936, the Institute has a presence in the Americas, Europe, and the Asia Pacific region, with members in 80 countries.

More information is available at uli.org. Follow ULI on Twitter, Facebook, LinkedIn, and Instagram.

About ULI Virginia

ULI Virginia serves Hampton Roads, Richmond, and Charlottesville and has over 400 members. As a preeminent, multidisciplinary real estate forum, ULI Virginia facilitates the open exchange of ideas, information, and experience among local, and regional leaders and policy makers dedicated to creating better places.

ULI District Council Leadership

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Director of Community Enhancement, Chesterfield County
District Council Chair, ULI Virginia

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Vice President, Schnabel Engineering

Sal Musarra, PLA (NC, VA) LEED AP
TAP Committee Chair, ULI Virginla
Consultant

Jane Milici
Executive Director, ULI Virginia

ULI Advisory Services: National and Global Programs

Since 1947, the ULI Advisory Services program has assembled well over 700 ULI-member teams to help sponsors find creative, practical solutions for complex land use challenges. A wide variety of public, private, and nonprofit organizations have contracted for ULI's advisory services. National and international panelists are specifically recruited to form a panel of independent and objective volunteer ULI member experts with the skills needed to address the identified land use challenge. The program is designed to help break through obstacles, jump-start conversations, and solve tough challenges that need an outside, independent perspective. Three- and five-day engagements are offered to ensure thorough consideration of relevant topics.

An additional national offering is the project analysis session (PAS) offered at ULI's Fall and Spring Meetings, through which specific land use challenges are evaluated by a panel of volunteer experts selected from ULI's membership. This is a conversational format that lends itself to an open exchange of ideas among diverse industry practitioners with distinct points of view. From the streamlined two-hour session to the "deeper dive" eight-hour session, this intimate conversational format encourages creative thinking and problem solving.

Learn more at americas.uli.org/programs/advisory-services/.

Distinct from Advisory Services panels, TAPs leverage local expertise through a half-day to two-day process.

Technical Assistance Program: (TAP)

Since 1947, the Urban Land Institute has harnessed

its members' technical expertise to help communities solve difficult land use, development, and redevelopment challenges. Technical Assistance Panels (TAPs)

provide expert, multidisciplinary, unbiased advice to

local governments, public agencies, and nonprofit organizations facing complex land use and real estate issues in the Tampa Bay area. Drawing from our seasoned professional membership base, ULI Tampa

Bay offers objective and responsible guidance on various land use and real estate issues ranging from site-specific projects to public policy questions. The sponsoring organization is responsible for gathering the background information necessary to understand the project and presenting it to the panel. TAP members typically spend two days developing an understanding of the problem, coming up with recommendations, and contributing those findings and recommendations to the sponsoring organization.

The focus of this TAP program for Woodberry aligns with the Urban Land Institute's Net Zero Imperative, a multiyear program providing research and technical assistance to public and private-sector leaders to accelerate decarbonization in the built environment through a combination of technical panels and long-term engagement. The goal of the effort is to help owners, cities, and other relevant constituents reduce or eliminate carbon emissions by providing concrete ideas and strategies to the beneficiaries of the panels and the general public.

Acknowledgments

ULI Virginia is grateful to the Woodberry Forest School for inviting ULI to explore with them the most critical issues and creative ideas to help guide the future of the School's commitment to environmental stewardship and a path to a Net Zero campus. Special thanks to School leadership and staff for preparation and assistance to the TAP team before and during the exercise including the following individuals:

- Matt Blundin - Athletic Director
- Matt Boesen – Dean Of Faculty
- Kenny Deane – Assistant Treasurer
- Reed Davis – Director Of Operations
- Ace Ellis – Chief Financial Officer
- Byron Hulsey – Headmaster
- Gene Lewis - Director Of Facilities
- Tabatha O'neill – Executive Assistant To The Headmaster
- John Rose - Maintenance Manager
- Ansel Sanders – Dean Of Students
- Catherine Wharton – Assistant Headmaster For External Affairs

Special acknowledgement to Board of Trustee members who engaged with the Panel during the program including incoming Board Chair Mr. Owen Thomas and the following current members:

- Sumner "Sandy" Finch, Chairman
- Ben Davis
- Nelson Fitts
- Ragan Folan
- Harley Garrison

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Technical Assistance Panel and Committee

ULI VA selected the panel members below from within its membership with subject matter expertise specific to this effort including the following areas of experience:

- University/Boarding School Campus Sustainability
- Technical engineering energy efficiency
- General green building concepts and technologies
- Fuel switching strategies (propane/fuel-oil to all-electric)
- Solar/renewables

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I. EXECUTIVE SUMMARY

A. CONTEXT FOR THE STUDY AND TAP OBJECTIVES

The ULI Virginia Technical Assistance Panel was asked to offer guidance toward developing a prioritized plan for implementing solutions to minimize energy usage, shift to more environmentally responsible energy sources, and reduce or eliminate its carbon footprint, while considering the feasibility to achieve a carbon neutral status. Woodberry is embarking upon development of a new Strategic Plan to be completed in the Spring of 2022 and will consider the results of this study as a framework for possible incorporation into the plan. The Panel was asked to focus on the five specific questions that follow related to energy savings and environmental stewardship:

1. What set of actions or capital improvements are likely to yield the largest reductions in energy usage across all facilities and equipment?
2. What opportunities might there be to convert to more economical or environmentally sensitive energy sources?
3. Should Woodberry consider investments in its own renewable energy production capabilities?
4. Are there other carbon footprint reduction areas beyond energy consumption that the School should consider?
5. What, if any, downstream vendor or supplier/partner commitment to environmentally sensitive practices should the School consider implementing?

B. WOODBERRY CULTURE, MISSION, AND THE STRATEGIC PLAN

1. Culture and Mission - It is all about the Boys: There is a consistent message from all corners of the School that actions and decision-making is first and foremost about achieving the best outcomes for students.
2. Fiscal Responsibility - Energy and Building Performance: Improved financial performance and fiscal responsibility is a key driver for developing a plan.
3. Land Use and Environmental Stewardship: The Woodberry campus is a sacred place, a uniquely beautiful academic setting that is an integral part of the overall experience for students.
4. Educational Mission: A plan for enhanced sustainability and stewardship will offer new teaching opportunities and creative ways to harness renewable energy sources.

C. SUMMARY OF RECOMMENDATIONS AND CRITICAL PATH ACTION ITEMS

1.ENERGY EFFICIENCY - IMPROVED CONTROLS AND FACILITY MANAGEMENT

·Begin process of installing better controls and facility management scheduling to shave peaks and reduce heating/cooling/lighting during unoccupied hours. Consider the gym project as an early opportunity.

· Increase resident education and engagement

2.ELECTRIFICATION

·Get buildings off propane as mechanical systems are upgraded.

·Incorporate decarbonization (and electrification) opportunities as part of the multi-building retrofit RFP.

·Switch vehicles and equipment off of gas as they reach end of useful life

3.RENEWABLE ENERGY - Plan for implementation of an on-site solar project as follows:

·1-5 Megawatt ground-mounted solar array, carefully located to maximize solar potential, and minimize visual impact

·Allocate 2-8 acres for Photovoltaic array interconnected behind the main energy meter

·Consider integration with agricultural uses (livestock pasture, crop production)

·Consider retaining an owners' rep "solar broker" to manage the transaction and the competitive bid process

1.SEQUENCING ENERGY CONSERVATION MEASURES

A.INDEPENDENT ENERGY CONSERVATION MEASURES

-New heating controls and lighting controls, to help improve thermal comfort and save Energy

-Advanced sensors in dorm rooms to automate energy efficiency in these spaces

-Centralize a building management platform, to optimize start up and shut down, change setpoints, and control zones (especially when boys are not using buildings based on time of day or time of year.)

B.LOAD REDUCTION MEASURES

-Enhanced Building Envelope Systems

-Advanced Lighting & Daylighting Controls

-Demand-Controlled Ventilation

-Air System & Water System Energy Recovery

-Heat Recovery Chiller

C.HVAC UPGRADES

-Get buildings off propane & diesel (all-electric) at replacement of mechanical systems (next 1-20 years)

-Use heat pumps

D.RENEWABLE ENERGY

-1-5 Megawatt ground-mounted solar array

-2-8 acre PV array interconnected behind the main energy meter

2.VEHICLE FLEET- NET ZERO OVER TIME

a.Build a Better Baseline: vehicle miles per vehicle, and current fuel efficiency (MPG)

b.Starting today, convert to electric/hybrid for all cars, minivans, and light trucks at the end of useful life (should payback on average at 50,000 miles)

c.Add EV Infrastructure: first to back-of-house (fleet vehicles), then to front-of-house (select parking spots/lots)

d.Convert Maintenance Equipment (leaf blowers, chainsaws, lawnmowers) to all electric as cost-effective.

3.CAMPUS ENGAGEMENT

a.Reforestation - reforestation and sustainable land management that could generate carbon offsets

b.Cattle Management - consider holistic planned grazing (reference: Polyface Farms or White Oak Pastures)

c.Golf Course maintenance – implement best practices to reduce water usage, pesticides and fertilizer

d.Get recycling right – an immediate, visible way to engage and "walk the talk"

D.NEXT STEPS

1 Incorporate a statement of commitment to improved sustainability into the Strategic Plan update. Consider establishing benchmarks for realistic and achievable performance goals and timelines as follows:

•2027 Reduce building energy costs by 50%

•2032 Carbon neutral

•2050 Fossil fuel free

2 Undertake a more comprehensive greenhouse gas inventory that includes all fuels and electricity for calendar year 2021 to set a "baseline" year in pursuing net zero over time.

3 Incorporate key action items and strategies into the active RFP for building improvements.

4 Consider adding a sustainability champion role within an office of sustainability initiatives

II. INTRODUCTION

Woodberry is an all-boys, all boarding college preparatory School with approximately 400 students located in Orange, Virginia. Established in 1889, the School operates on a 1,200-acre campus supporting the full range of academic, athletics, and residential uses, plus limited agricultural operations. Woodberry's campus includes a 9-hole golf course, running and biking trails, athletic fields, and a small farm operation including a herd of approximately 125 beef cattle, in addition to the core residential and academic building and grounds facilities.

The Woodberry mission: The purpose of the School is to develop in its students, under Christian principles, a high sense of honor and moral integrity, a deep respect for sound scholarship, a full acceptance of responsibility, a love of excellence, and a will toward personal sacrifice in service to others. It is likewise its mission, based on these ideals, to develop its students into leaders, to train its students toward a useful contribution to the democratic society in which they live, and to give them thorough preparation for the best colleges and universities consistent with their individual potentials.

Inherent in the Woodberry's mission is instilling in its students a true sense of responsibility for the communities in which they live, work and play. This includes responsibility for the stewardship of the environment. Woodberry is seeking guidance through the ULI TAP program to improve the School's energy use efficiency and minimizing its carbon footprint toward development of a prioritized plan for implementing solutions designed to minimize energy usage, shift to more environmentally responsible energy sources and to reduce or eliminate its carbon footprint.

With this effort, Woodberry seeks to fulfill its institutional responsibility for minimizing or eliminating any adverse impacts it may be having on the environment, including considerations to global warming and to advance the School's educational program and student experience.The commitment toward greater environmental stewardship and energy efficiency will require a balance across four facets of campus life that are at times complimentary, and at times in a competing space relative to campus history, culture, energy consumption, and sustainability goals. A broad description of these areas evolved from stakeholder input and a review of the School's previous plans and mission statements, and are summarized here as follows:

1.Culture and Mission It is all about the Boys: There is a consistent message from all corners of the School that actions and decision-making is first and foremost about achieving the best outcomes for students. The conversation around carbon footprint reduction and reduced costs cuts across issues related to land use, building architecture, and fiscal responsibility.

Why this Matters: The path to Net Zero will involve many decisions about education, land use, behavioral patterns, or changes to the campus landscape to advance sustainability goals and achieve financial benefits. Each decision and action must be assessed with how it aligns with the core mission to enhance the educational experience.

2.Fiscal Responsibility Energy and Building Performance: Improved financial performance and fiscal responsibility is a key driver for developing a plan to Net Zero. It is a viable goal given the current state of the School's physical plant and the potential cost savings associated with achieving improved building performance, reduced energy consumption, and incorporation of renewable energy sources. The Board and administration stakeholders clearly articulated scenarios whereby planned actions projecting neutral, or

even negative, financial outcomes but positive outcomes relative to the overall educational experience for the boys could be deemed acceptable outcomes.

Why this Matters Reduced energy consumption, energy savings and the resulting financial benefits are more of a driver for the Board and School Administration than students, staff, and faculty. The potential for savings is significant given the age and nature of the physical plant and represents a sound approach to long-term asset management that may require a cultural shift and education effort for all stakeholder groups.

3. Land Use and Environmental Stewardship The Woodberry campus, as a physical asset, is a sacred place. The 1200-acre campus is a uniquely beautiful academic setting that is an integral part of the overall experience for students. The landscape is not ancillary to their education. It is a physical, visual, and emotional part of the education experience and the curriculum provides opportunities for the boys to interact with the landscape as part of their education experience. Additionally, the Woodberry Forest campus landscape is an important part of the legacy for its alumni, and preservation of that character will require respect and sensitivity when planning for the future.

Why this Matters Decisions around potential changes to land use that impact the visual character of the campus to advance sustainability and stewardship goals may involve impacts to the visual character of the campus that are important to current residents and alumni.

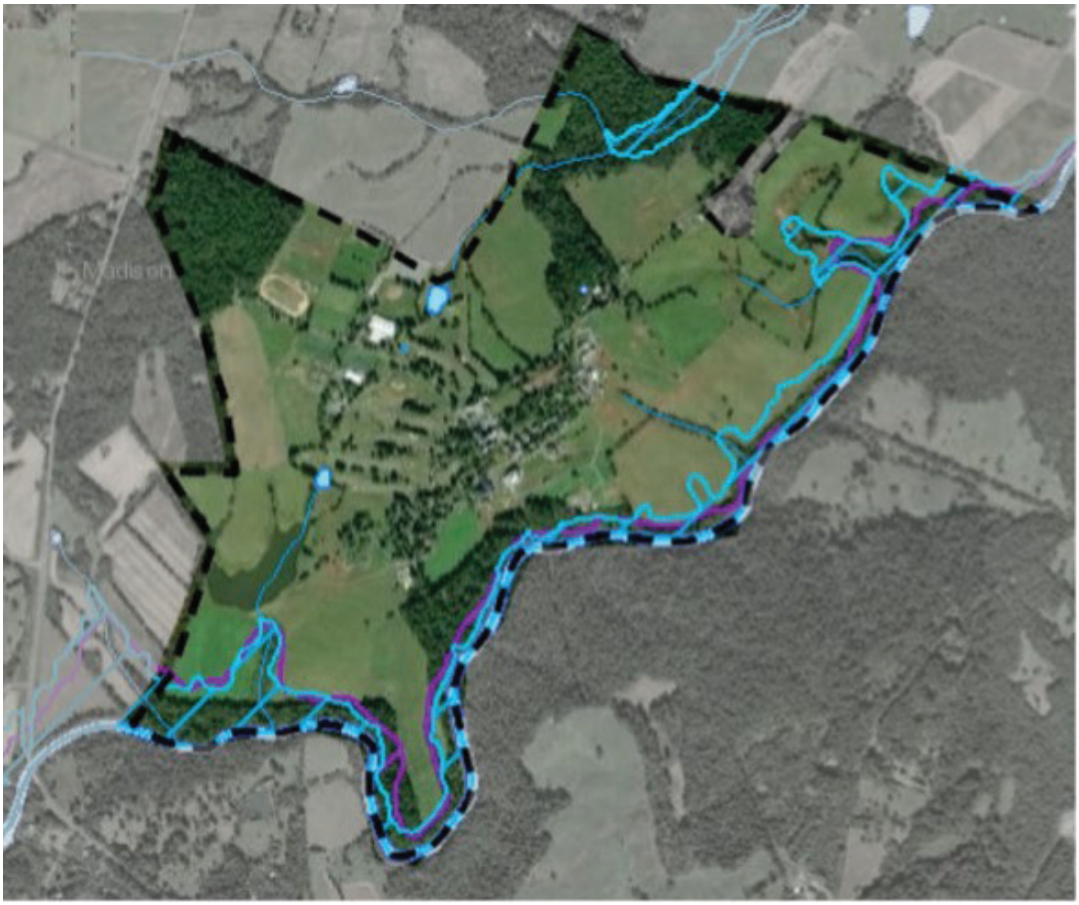
4.Educational Mission Incorporating educational opportunities related to stewardship of the land have always been a part of Woodberry Forest. A plan for enhanced sustainability and stewardship will offer new teaching opportunities around new technologies, economics, land use, maintenance practices, and creative ways to harness renewable energy sources.

Why this Matters In reality, actions associated with a path to Net Zero could be implemented without changes to curriculum and without resulting in a materially different education experience for the boys. The School should consider the cost and benefits associated with this opportunity to formally incorporate educational opportunities around these issues into the curriculum, while respecting the faculty's role and latitude to develop their own course curriculum.

Positive Intended / Unintended Consequences In the course of pursuing sustainability goals, there will emerge opportunities tangential to the primary objectives - some planned and some not anticipated. It is important to identify these outcomes as opportunities along the journey. Following are some examples:

- Healthier building environments: Better building performance can also produce cleaner, healthier building environments for higher productivity and a decrease in the occurrence of certain health issues.
- Teaching opportunities: This initiative can foster interest in new subject matter and curriculum tracks
- Recruiting: The panel heard some debate across stakeholders regarding this matter but a leadership role in campus sustainability could enhance faculty or student recruitment
- Community Outreach: Opportunities to leverage actions and results as a platform for reaching out, educating, and engaging the broader community at a local, regional, or even national scale.

III. THE CHALLENGE



A.FRAMING THE CHALLENGE AND THE WOODBERRY TAP PROCESS

The path toward sustainability is intricately tied to the learning experience and teaching opportunities at Woodberry to demonstrate good stewardship. Inherent in the School's mission is a goal to instill in its students a true sense of responsibility , leadership and contributions beyond the campus. These aspirations extend to a responsibility for sound environmental stewardship as represented by the fact that the catalyst for this effort was the work of former Woodberry Forest student Prefect Dillon Wamsley, who in 2019 presented a compelling study and challenge for the School to improve environmental stewardship. Thus, a primary driver for the study is grounded in the education mission and broader cultural commitment to leadership, education, and individual accountability to reduce the School's carbon footprint.

In Advance Of The TAP Program, Woodberry Forest Leadership Prepared The Following Questions For The ULI Panel As Guidance For Discussion And Recommendations:

1.What set of actions or capital improvements are likely to yield the largest reductions in energy usage across all facilities and equipment?

2.What opportunities might there be to convert to more economical or environmentally sensitive energy sources?

3.Should Woodberry consider investments in its own renewable energy production capabilities?

4.Are there other carbon footprint reduction areas beyond energy consumption that the School should consider?

5.What, if any, downstream vendor or supplier/partner commitment to environmentally sensitive practices should the School consider implementing?

The School Also Sought Guidance Through The TAP Program On The Following Related Topics:

1.How to improve the School's energy use efficiency and minimizing its carbon footprint. Woodberry seeks to complete a comprehensive audit of buildings, equipment, and transportation vehicles regarding the types of energy employed and energy usage in order to develop a prioritized plan for implementing solutions designed to minimize energy usage, shift to more environmentally responsible energy sources and to reduce or eliminate its carbon footprint.

2.How to fulfill the School's institutional responsibility for minimizing or eliminating any adverse impacts it may be having on the environment, including considerations to global warming and to advance the School's educational program and student experience.

3.Assess the feasibility of achieving a carbon neutral status, setting a positive example for its students and constituents.

4. Identify specific programs that have been developed independently or in connection with systems or practices that may be recommended for Woodberry that would provide direct opportunities for engaging students, educating them about environmental stewardship and social responsibility.

5.Identify specific programs that have been developed independently or in connection with systems or practices that may be recommended for Woodberry that would provide direct opportunities for engaging students, educating them about environmental stewardship and social responsibility.

WOODBERRY FOREST SCHOOL TAP AGENDA - DECEMBER 6-7, 2021

DAY 1 December 6

10:00 Welcome and introductions
10:30 Site Tour
11:30 Observations and briefing review with Woodberry Forest
12:00 Working lunch. Review observations, begin to formulate questions for stakeholders and approach to the problem statement
1:30 Stakeholder meetings. This augments the briefing books and provides an opportunity for the panelists to ask clarifying questions
6:00 Working dinner

DAY 2 December 7

8:30 Breakfast and discussion of panel objectives
9:00 Panel working session. Panel deliberation; formulating recommendations and responses for each of the sponsor's questions
12:00 Working lunch
4:00 Wrap-up and finalization of presentation of finding and recommendations
5:30 Presentation of recommendations to sponsor and guests

B.FRAMEWORK AND APPROACH FOR THE STUDY

Buildings are responsible for 40% of greenhouse gas emissions in this country and institutions of learning managing large real estate assets are increasingly more interested in improving their triple bottom line related to creating healthy environments for their people, improved financial performance, and achieving a lighter environmental footprint resulting from being good stewards of the environment. Globally, investors reflect these issues in their real estate debt and equity considerations, tenants are including it in their leasing decisions, and regulators are incorporating a path to net zero into their building codes and development regulations.

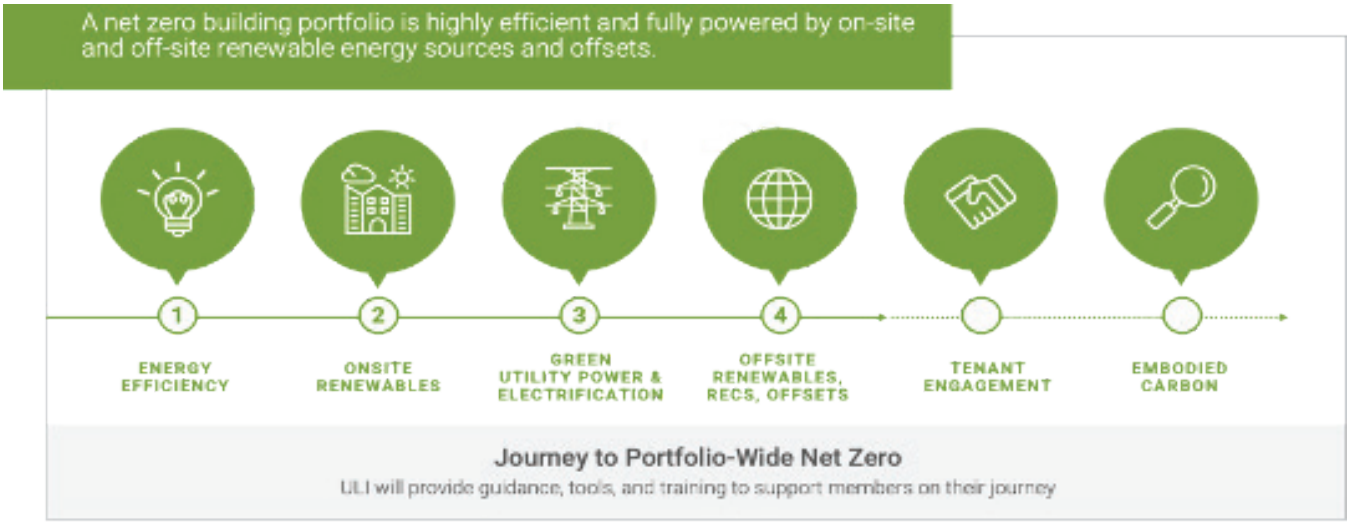
Many public and private institutions of learning are looking to take on leadership roles to achieve greenhouse gas reduction goals and likewise Woodberry Forest is proactively seeking to make their campus reflect a more aggressive and intentional approach to Net Zero. What makes Woodberry unique in this effort is the boarding school model, the age and architectural character of its buildings, and the immense value placed on the quality and beauty of the Woodberry Forest campus, a reality that is perhaps both an asset and a challenge to making key decisions along the path to Net Zero. A successful plan will prioritize needed capital improvements with consideration of the remaining useful lives of existing systems and the potential for efficiency improvements. The School seeks to identify key opportunities for energy use reduction opportunities that are financially attractive (ideally economically favorable or neutral) including improvements that entail greater costs, but yield significant, non-financial environmental benefits. This includes on-site land development opportunities that would support a more efficient operation, including potential solar or wind energy production capabilities and/or geothermal cooling and heating systems.

DEFINING NET ZERO ENERGY

The term Net Zero is used in a variety of ways relative to conversations around improved energy efficiency. The idea of net zero can be associated with specific goals and action items tied to assets at various scales from a single building asset, to a portfolio of buildings, to an entire community.

- NET ZERO CARBON campus- a campus that is highly energy efficient, and generates enough renewable energy (on-site and via the grid) or through the purchase of carbon offsets to offset its annual energy consumption.
- ZERO ENERGY BUILDING (ZEB) Zero energy buildings combine energy efficiency and renewable energy generation to consume only as much energy as can be produced onsite through renewable resources over a specified time period.
- OVERARCHING NET ZERO GOALL
  - ACCELERATE THE DECARBONIZATION OF THE BUILT ENVIRONMENT
  - CHART A COST-EFFECTIVE PATH TO NET ZERO
  - DO OUR PART TO REDUCE GLOBAL CLIMATE EMISSIONS – TO ACHIEVE A GLOBAL CARBON REDUCTION TARGET THAT HELPS US AVOID THE WORST IMPACTS OF CLIMATE CHANGE.

Specific to Woodberry Forest, and to this TAP effort, the focus is a goal of a Net Zero Carbon campus- a plan to reduce energy consumption and to mitigate the impact on climate change.



C.EXISTING CONDITIONS AND CONTEXT FOR THE STUDY

Some Key Variables Related To Existing Conditions That Inform The Approach And Expectations For A Plan Might Include The Following:

- CURRENT CAMPUS UTILITY INFRASTRUCTURE (ELECTRICITY AND PROPANE, AS WELL AS CURRENT CHILLER LOOP CONFIGURATION).
- BUILDING TYPES – AGE, CONSTRUCTION TYPE, CONTROL SYSTEMS, AND TYPE OF OCCUPANCY
- ACADEMIC CALENDAR - ACADEMIC YEAR, VACATIONS, AND SUMMER CAMPS
- BUILDING SUBMETERING (OR LACK THEREOF)

Some Key Characteristics And Components Specific To Woodberry's Physical Plant And User Profile Include The Following:

- 750,000 SQUARE FEET OF BUILDING WITH A WIDE VARIETY OF MECHANICAL SYSTEMS AND EQUIPMENT
- DIVERSE VEHICLE FLEET
- HISTORIC CHARACTER OF SOME BUILDINGS (ABSENT STATE OR FEDERAL DESIGNATIONS)
- APPROX. 400 STUDENT POPULATION; ALL BOARDING WITH SEVERAL SIGNIFICANTLY LONG BREAKS DURING THE YEAR
- ACTIVE SUMMER CAMPUS AND OTHER CAMPUS USES WHEN STUDENTS ARE AWAY
- APPROX. 90 FACULTY AND ADMIN HOUSED ON SITE - 230 STAFF TOTAL

According To The School, There Are No Plans For New Construction On Campus In The Foreseeable Future And Planned Decommissioning Of Existing Buildings As Follows:

- planned demolition: houses d and e
- planned re-purposing: infirmary
- planned renovations: dick gym (5 years to major renovation)

Beyond building inventory, the school has several land-related uses that factor into overall energy consumption including the following:

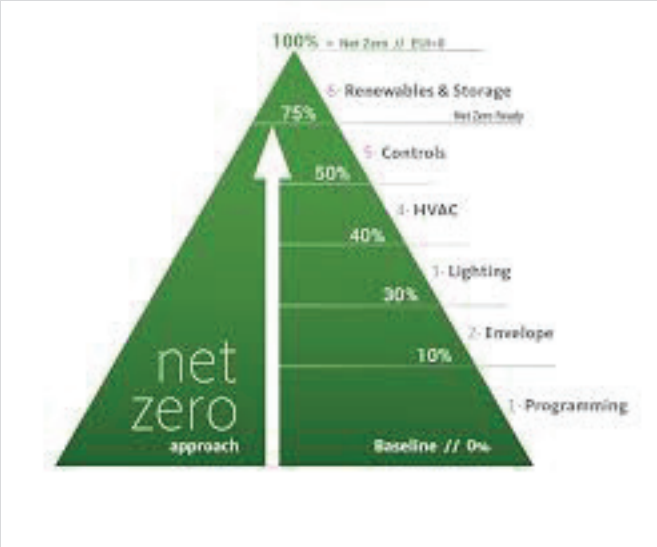
- cattle operation (150+)
- crop production (feed corn)
- golf course
- managed open space

Following is a very high-level estimate of Woodberry's current carbon footprint using only available information obtained for the TAP exercise. .

- 62% - electricity, 8.9 million kwh, 6300 tonnes
- 33% - building fuels. 260,000 gallons from wfs report (actually 266k in 2020-2021) variance was about 25% from 2018-2021. about 3,200 metric tonnes
- 5% - gasoline / diesel 30,000 gallons , 300 tonnes (some vehicles, some farm equipment, maybe the generator, leaf blowers , etc)
- 1.5 m / yr fuel and electric avg $65k / mo; 10k tons / yr most electric

This back-of-the-envelope assessment of the current carbon footprint / Greenhouse Gas (GHG) would suggest a total of around 10,000 metric tonnes CO2e. It is important to note that about 2/3 of the GHG emissions come from on-site fossil fuel use and 1/3 from electricity. About 95%+ of total campus emissions are associated with their buildings.

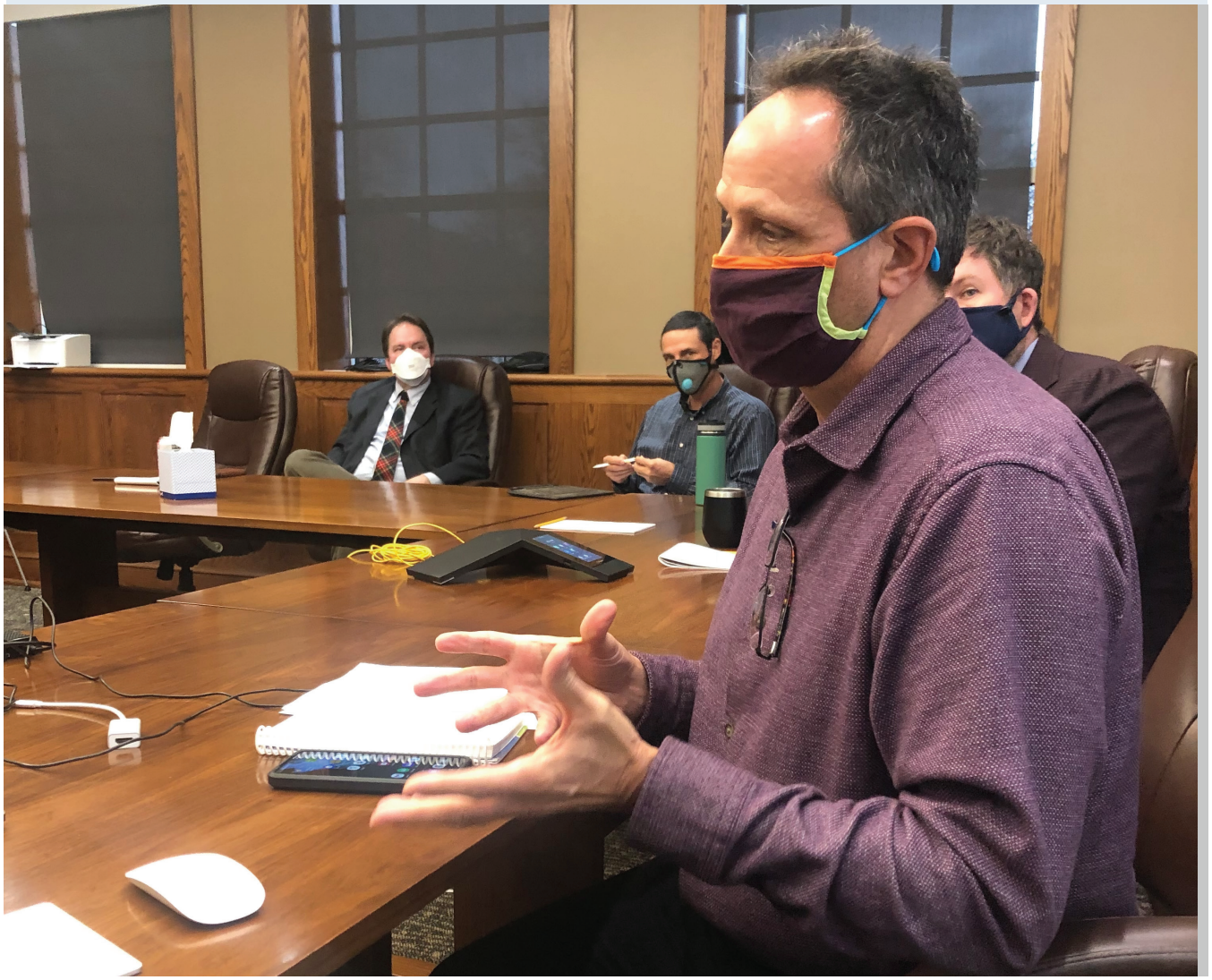
As part of the TAP exercise, the panel prioritized scope 1 and 2 emissions (on-site combustion and purchased electricity) because this is the boundary most companies use to report on and mitigate their carbon emissions, because these emissions are under Woodberry's direct operational control, and because these emissions represent what Woodberry can cost-effectively reduce and eliminate over time.



IV. ISSUE IDENTIFICATION

Issue identification for the ULI Panel is a two-part process involving exploration and discovery ("what we heard"), followed by processing what we learn to extract the most critical, underlying issues ("key takeaways from what we learned"). The exploration and discovery process for this effort included inputs from review of sponsor background materials, tour of physical assets, and stakeholder interviews. Following is a summary of what the Panel learned from the discovery process followed by a summary of the key issues extrapolated from that input to help inform the observations and recommendations in Section IV of this report. The key issues extracted from that input are generally organized into four broad categories as follows:

- **Culture And Vision: Planning For Change**
- **Facilities And Operations**
- **Land Use: Existing And Future**
- **Education: Energy And Environmental Stewardship**



A. BACKGROUND & STAKEHOLDER INPUTS

Observations from all inputs leading up to and during the Panel visit informed the identification of key issues for further exploration by the Panel and are organized below around the four broad categories referenced above. Within each issue is commentary on the various stakeholder perspectives relevant to these issues that clearly emerged from the interview process. These perspectives are logical given the defined roles and responsibilities for each stakeholder group. They are sometimes complimentary and sometimes reflect seemingly competing perspectives but are not by any means mutually exclusive points of view.

1. CULTURE AND VISION: IT'S ALL ABOUT THE BOYS

The Woodberry Forest culture is very well defined and consistently articulated across all stakeholder groups. Inherent in the School's mission is a goal to instill in its students a true sense of leadership and responsibility for the communities in which they live. This culture is supported by the belief that all decision-making should be focused on outcomes that are in the best interest of the students and their overall educational experience.

The commitment to being better stewards of the land, to create a more energy efficient campus, and for responsible management of school finances, are all interrelated issues requiring a coordinated effort by all stakeholders. The Panel asked stakeholders what terms like "sustainability", "energy savings", "environmental stewardship", and "net zero energy or net zero carbon" meant to them. Responses were overwhelmingly framed around land use issues as opposed to reduced energy consumption or building performance issues. This makes sense given that personal interaction with, and affinity for, the campus landscape and natural environment are familiar and visual parts of everyday life on campus. References to preserving the physical beauty of the campus, protecting the Rapidan River, and sound agriculture operations were common associations with sustainability issues. Students were especially articulate about a culture of good stewardship of the natural environment resulting from their intimate connection to the land as a visual amenity and through participation in various field studies or elective activities (i.e camping; River Committee; Beekeeping).

When pressed to comment on the relationship between sustainability and energy consumption stakeholders again defaulted to issues that are most intimate and immediate in their interaction with the built environment. This includes grounds maintenance practices, recycling practices, and the need for improved building systems controls to achieve more comfortable indoor living and working conditions. The relationship between open doors, windows, and thermostats to comfortable living and academic spaces are immediate and familiar but rarely extrapolated into a larger concern for energy production, energy consumption, or the environmental and financial costs associated with those conditions.

The one exception to a collective awareness driven by immediacy and proximity is the idea of renewable energy in the form of solar on campus. Many expressed an interest in solar installations on campus as something valuable that could provide a physical, visual touchstone to connect them to energy and sustainability issues. Of course, the implementation would have to be done carefully, so as not to degrade the campus aesthetic and perhaps could be integrated with outdoor classroom space, or agriculture under solar panels.

A plan to achieve Net Zero is a long-term endeavor and requires regular reviews as changes in the sub-culture on campus can emerge with each new student body class as a reflection of broader societal changes over time including views about reducing our carbon footprints. This applies to Woodberry Forest alumni as well. It should be noted that alumni (excepting Board members who attend the school) were not

part of the stakeholder interviews. However, there is a recognition that evolving world views and pressure from alumni to be more committed to sustainability and formulation of a strategic Energy Conservation Management plan is a very relative input to the conversation. Faculty stakeholders commented on the challenge to see beyond short-term goals and create momentum around actions or a change involving sacrifice now for the future benefit of others. One characterization of School culture as relates to sustainability issues suggested three broad perspectives described as follows:

- THOSE WITH A PRIMARY FOCUS AROUND THEIR JOB RESPONSIBILITIES, NOT ENVIRONMENTAL ISSUES.
- A "DUCKS UNLIMITED" GROUP WITH CONCERN REGARDING ENVIRONMENTAL STEWARDSHIP AS RELATES TO THEIR PERSONAL INTERACTION AND USE OF THE LAND.
- A MORAL IMPERATIVE GROUP MOTIVATED TOWARD IMPROVED STEWARDSHIP, RESOURCE MANAGEMENT, AND GENERAL AWARENESS OF THESE ISSUES GUIDED BY A NEED TO DO THE RIGHT THING.

The culture around environmental stewardship was generally characterized by a perception that only 10% to 20% of the student population, staff or faculty had any real motivation in improving the School's efforts to address environmental or energy efficiency issues. Furthermore, is the belief that there is limited concern or attention assigned to these issues beyond the campus into the broader community, and much less on a regional or global scale. Some associated this inward focus on the historically conservative and traditional values at Woodberry Forest, while others simply suggest it is a result of a logical focus on what is immediate and familiar in a place that does not rely on external inputs or interaction to achieve its core mission objectives. Many stakeholders described the School culture is one of isolation and insulation with little strategy for engagement with people beyond the campus boundaries. Not surprisingly, many characterized this isolation as both a benefit and a challenge. As one Board member stated, the School is fairly protected from the prevailing culture wars which perhaps allows for a more deliberate and balanced approach to change on campus. The perceived lack of initiative for external engagement would benefit from a more intentional strategy on part of School leadership and champions, within the School and from the community, to effect change. The School's actions to undertake this study and to consider addressing these issues within the upcoming Strategic Plan demonstrate some interest to show the larger community good stewardship through action on campus and for being a market leader among peer institutions.

The various stakeholder perspectives on these issues relates directly to the division of responsibility at the School that was characterized by one interviewee as "teachers teach, and administrators run the School". This view recognizes a heightened, and logical, concern and responsibility for the financial impacts related to sustainability issues attributed to school Administration and the Board than would be expected among staff and students. Understandably, it is the Administration and Board members that are most interested in the relationships between energy consumption, building performance and the impact of those on operating costs. That said, the students are quite aware of how Board and Administration actions impact them and will process and respond to what they see accordingly. In this sense, making strategies around energy consumption and sustainability visible and public facing could be important. There is also a very competitive culture at the School that might be harnessed to advance some objectives. For example, making building performance measures accessible and visible to all and reinforcing the importance of individual and collective habits on energy consumption might result in positive results and be educational as well. Staff and Administration also noted the need for influential champions for these

issues, including incoming Board Chair Mr. Owen Thomas, that could effect change and create a sense of urgency around these issues.

The Strategic Plan is a critical guiding document that ultimately reflects School culture. The forthcoming plan update will be initiated soon and the adoption of a plan or formal statement of commitment to achieve Net Zero will be up for consideration as part of that plan. A path to Net Zero is an appropriate element to reside within a strategic plan and, if included, will require transparency and collaboration from all stakeholders regarding how this effort aligns with the core values and educational mission of the School. School leadership is very conscious of the fact that the genesis of this effort and the challenge to formulate a plan, came out of the student body. The Board takes a long-term view of the matter including the responsibility to have good responses and results for prospective students and their families as more people are interested in these topics and how the School is addressing them. The Board seeks to be aggressive in this regard but also cautions about accelerating too quickly without a sound understanding of the risks, desired outcomes, and defined measures of success.

2. FACILITIES AND OPERATIONS

Board members interviewed for this study agreed that the number one priority in this effort was to achieve energy reduction and the associated cost savings resulting from those reductions. Aging infrastructure, inefficient building performance, high energy costs, and evolving and more cost-effective technologies suggest this is an appropriate time to formulate a roadmap to Net Zero and a formal Energy Conservation Management (ECM) plan for the school. The education mission notwithstanding, the pursuit of a Net Zero campus is driven by a desire to achieve long-term financial benefits associated with a successful move toward more energy efficient buildings and potential use of renewable energy sources. It is also simply a part of sound financial management as infrastructure and buildings age and trend toward higher maintenance and energy costs. Development of a strategy toward Net Zero must reflect total costs (capital outlay and ongoing) and the benefits of energy efficiency actions, including non-financial benefits and costs. That includes potential financial support from state or federal funding programs such as systems upgrades, EV charging, window film, etc. that change over time and are worth keeping track of. Cost savings can also be impacted by options to purchase energy credits, as opposed to actual energy reductions, and the use of vendors for various services. However, it is understood that the School has the resources and a stated preference to self-finance and manage operations internally with School staff to the maximum extent possible.

A 24/7/365 School is unique in that most facilities are continuously in use by a wide range of people. Beyond modifications in fuel sources and equipment solutions, there will also be opportunities to develop solutions rooted in modified user behavior, with an expectation that students, faculty, and staff will be active participants and supporters of initiatives to improve the School's carbon footprint. For most stakeholders, the connection to stewardship and energy consumption are framed by their every-day nteractions with various campus settings, such as the River, living spaces, recycling, the sound of maintenance equipment, landscape views and vistas, bees and cattle. Issues such as indoor climate control and excessive lighting make a direct cognitive connection and to the need for improved energy performance in older buildings, including changing the habits of the occupants of those buildings.

Existing energy consumption on campus is impacted by many factors including:

- Age And Construction Type Of Building Envelopes
- Fuel Sources And Distribution Infrastructure
- Age And Type Of Building Hvac Systems
- Building Systems Controls And Occupant Habits

Energy cost is relatively low relative to national benchmarks for both electricity and propane

The reliance on fossil fuels is costly, both environmentally and economically. With regard to electrification, the current cost of power from the utility provider (Dominion) is an interesting and an important input to formulating a plan. Currently, the utility rate schedule from Dominion for the School sets the highest rates at lowest demand times, a fact very much in favor of the School. According to Dominion representatives, there are no planned changes in this usage rate schedule from the Commonwealth in the near future.
This campus uses a large amount of propane and fuel oil (approximately two - 30K gallon propane tanks multiple times per month) so electrification conversions to move away from oil and gas will be a focus of this effort. While their propane cost is very low for propane, propane is far more expensive (on a $/BTU basis) than natural gas and electricity. The campus doesn't have natural gas infrastructure (and shouldn't build it), so the best strategy long-term will be to electrify everything that the campus cost-effectively can, in a timeline that works for the economics of the technologies and the campus.

Buildings are maintained and run very well, but some of the buildings have heating and cooling controls that don't work well for their occupants (example of residence hall with temps set by zone, so "hot" folks open windows, causing other rooms to get even hotter, leading to more open windows). Also, most buildings are run as if people are actively using them 24/7/365 which is not the case, suggesting some opportunities for more aggressive temperature setbacks.

Renewable Energy

Proposals for developing solar energy infrastructure have been evaluated internally in the past but not implemented, including a proposed 2-3 megawatt project discussed with Dominion within the past few years. Interviewees suggested that the challenge of evaluating solar proposals (and providers, and financing options) was a barrier to moving forward on this project, or others that may have been pitched by solar project developers in the past.

The current economics for ground-mounted solar in Virginia appear to be good for a 1-5 megawatt project at Woodberry, but the process for sizing and siting a project, and collaborating with the local utility (Dominion) to optimize the financial performance can be complicated.

Vehicle Feet Inventory

Woodberry has a vehicle fleet that meets the current needs of the campus and the resident population.
Virtually all vehicles are gas and diesel-powered. Farm equipment and other maintenance equipment to manage the campus is also primarily fossil fuel based (from leaf blowers to mowers and ATVs.) The campus has considered increasing the number of electric vehicles in some vehicle classes, but passed on the opportunity due to performance concerns (for ATVs and farm equipment), cost (buses), or lack of fueling/charging infrastructure (other classes), but was open to exploring alternatives again.

Vehicle Fleet Summary:

- 3 Large Busses
- 5 Mini Busses
- 30 Dodge Minivans
- 50 Facility Vehicles

a. For the period May 1 through September 30:

Day Classification	On-Peak Period	On-Peak Rate Per ES kWh	Off-Peak Rate Per ES kWh
A	11 a.m.- 9 p.m.	24.2414¢	2.6990¢
B	11 a.m.- 9 p.m.	2.0675¢	1.3453¢
C	7 a.m.- 10 p.m.	1.3453¢	0.9195¢

b. For the period October 1 through April 30:

Day Classification	On-Peak Period	On-Peak Rate Per ES kWh	Off-Peak Rate Per ES kWh
A	6 a.m.- noon & 5 p.m.- 9 p.m.	24.2414¢	3.1229¢
B	6 a.m.-noon & 5 p.m.- 9 p.m.	2.0675¢	1.4425¢
C	6 a.m.-noon & 5 p.m.- 9 p.m.	1.4425¢	1.1244¢

(NOTE: Classification A will apply for no more than 28 days during any calendar year, and classification C will apply for no less than 60 days during any calendar year.)

3. LAND USE ISSUES:

The pastoral 1200-acre landscape is much more than a physical location for education and boarding facilities. The commitment to providing the highest quality educational experience for the boys is uniquely and inextricably tied to the quality and aesthetic beauty of the setting that is home to the School. Sacred is the word most often heard by the TAP Panel during this effort and the connection to the land is embedded in the educational experience and teaching opportunities here. There is an intimate connection to this place not only for those actively studying or employed by the School but also for the alumni who spent their formative years in this beautiful place. This connection to place is central to culture at Woodberry Forest and a unique characteristic that presents both challenges and opportunities when considering potential changes to land and architecture that may be viewed as a threat to campus aesthetics. The challenge moving forward will be how to accomplish broader energy efficiency and stewardship goals while preserving the most valued characteristics of the campus.

A path to Net Zero for Woodberry Forest will include a very focused effort on building performance, energy consumption, and energy sources. However, the Panel heard a tremendous amount of interest in broader sustainability issues related to land use and management of the natural resources that are so intimately connected to the Woodberry Forest experience. Stakeholder input was very much aligned regarding discussions about current and future land use, including the following opportunities and challenges associated with land use and environmental stewardship.

LAND USE CHARACTER TYPES

The campus presents a wide variety of land use character types, each with its own impact on the natural environment and each carrying its own potential for new approaches to energy savings, generation, and land management.

- Open space The combination and organization of woodlands and maintained open spaces create the overall image that is the Woodberry Forest campus. While open space is a critical part of creating the visual canvas and overall sense of place, it carries an environmental cost associated with lost tree canopy, continual maintenance, and the energy usage associated with that maintenance. The potential to convert some open space to reforested land is a strategy that should be evaluated.
- River edge and tributaries The Rapidan River is an amazing natural resource for the campus and one the boys associate closely with their experience here. The edge conditions along the entire river frontage are critical to maintaining animal habitat and water quality through treatment of water runoff, sediment control, bank stabilization, and reduced water temperatures. Control of invasive exotics and limiting soil erosion and compaction resulting from human activity are important parts of managing the woodland environment associated with the river. While not part of the ULI TAP program scope, some study into the potential for creating a micro hydroelectric generation source using natural water features could be an interesting educational opportunity.
- Natural woodlands Roughly 30% of the campus is natural woodland, including the river edge. General control of invasive exotics and limiting soil erosion and compaction resulting from human activity are important parts of managing the woodland environment.
- Agriculture crops Actively managed productive landscapes on campus include roughly 15 acres of corn production for feed. This land use does carry some potential for negative environmental impacts, but those impacts can be mitigated through sound practices to minimize soil erosion, consider organic farming, reduced irrigation, and minimize chemical migration into natural water resources.

Land Use Issues

Cattle operations The presence of cattle on the campus provides an educational opportunity for the boys and in a larger sense is simply part of the legacy of the School and this property. The student perspective included statements to the importance of maintaining this use as part of the legacy of the School, but also expressed concern related to the environmental impacts associated with this use. Methane production, denuded vegetative cover promoting soil erosion, and nutrient loading in runoff to the river are impacts that should be evaluated for potential mitigation efforts.

Golf Course Like the cattle operations, the golf course is considered by many to be a legacy land use that should be preserved. The environmental concerns surrounding this land use include water usage for irrigation, fertilizer migration into surface and ground water, energy usage and emissions associated with maintenance equipment, and loss of native ground cover and tree canopy. On the positive side of the ledger, the course does provide a unique link to the broader community for a campus that is quite isolated, physically and socially. In addition, the course can provide some public-facing educational opportunities to demonstrate how to operate such a facility with heightened sensitivities to the environment including:

- Audubon Cooperative Sanctuary Program certification
- Integrated Pest Management practices
- Stormwater quality treatment measures
- Use of native grasses and reforestation to reduce the quantity of maintained turf areas
- Use of electric-powered maintenance equipment

Camping And Summer Camps Students have many opportunities to interact with the land as part of core curriculum or extracurricular activities. Camping by the River, hiking the Perimeter Trail, or participating in clubs focused on protecting River resources or farming operations bring the boys closer to their environment. Summer camps help forge a connection with the community beyond Woodberry Forest and include camps focused on interaction with the land or athletic facilities and instruction. Facilities like the climbing tower and Perimeter Trail have a very light footprint on the land and provide great opportunities to bring students and campers physically close to the natural environment. There is a stated interest by administration to expand the summer camp schedule. From a stewardship and energy perspective, those measures should always balance the impact on the environment to accommodate increased usage.

Potential For Renewable Energy Installations There was much discussion and interest around the potential for on-site solar energy systems as part of the long-term solution toward a Net Zero campus and elimination of fossil fuel dependency. The campus offers many physical locations that would be suitable for one or more solar installations in areas that are currently maintained as open space. This interest is uniformly qualified by the need to have such installations be sized and located in a manner that does not negatively impact the aesthetics of the campus as viewed by current residents, the Board and alumni. The same sensitivity would apply to conversion of any land on campus, or exterior building modifications, for other forms of energy generation or sustainable measures such as wind power, hydro-electric, or reforestation.

Grounds Maintenance The volume of maintenance activity, visually and audibly, prompts concerns regarding how much fuel is being consumed to maintain the campus aesthetic.

Protect the River Specifically trash collection and water quality from runoff, wastewater, and fertilizers.

Transportation impacts Find ways to minimize travel and reduce the associated energy use, to and from campus. The boarding school model helps in this regard but there is a perception that more could be done.

4.EDUCATION: OPPORTUNITIES AND CHALLENGES

Discussions regarding opportunities to integrating more environmental education in the curriculum exposed some of the natural biases among each stakeholder group. The students expressed a sincere interest in exploring new subject matter, suggesting such classes should be mandatory to overcome a perceived lack of interest in these issues. Both faculty and students would prefer project-based and field activities over classroom settings for this line of study.

Faculty stakeholders appreciate the teaching opportunities that may be afforded by new initiatives around energy and stewardship. However, they also value a certain amount of autonomy over development of the curriculum and expressed concern regarding pressure to modify course development given the realities of time constraints and core educational objectives. There are currently good opportunities within the curriculum and elective activities for students to engage with and study environmental sciences, but faculty would be concerned regarding efforts to incorporate more environmental education content. Understanding the importance of crafting an education that best prepares students for college and beyond, a curriculum track specific to environmental education may also be out of step with long-term career goals of the students as it seems that very few will pursue careers related to natural sciences, energy conservation issues, or environmental management.

Actions related to a path to Net Zero will inherently include a focus on building performance but influenced by the underlying education mission to recognize teaching opportunities associated with this effort. To this end, a potential scenario where actions taken might result in a neutral or negative return-on-investment but achieve a positive result for the education experience of the boys may be deemed an acceptable outcome. Similarly, a scenario where implementation of new strategies resulted in improved building energy performance and real cost savings, but with no real impact on campus landscape or curriculum could be a possible, and acceptable outcome as well. Ultimately, the Board acknowledged that near-term actions associated with a path to Net Zero could be implemented without changes to curriculum and without resulting in a materially different education experience for the boys and that might be a reasonable approach for the initial phases of this effort.

Some specific educational opportunities associated with a plan toward Net Zero were noted during stakeholder interviews including the following:

- Opportunities with the School's Community Service requirements (60 Hours) to include work with sustainability issues and community engagement
- Integrate sustainability subject matter into business classes and other interdisciplinary courses to connect core subjects to these issues with practical applications
- Seek opportunities within core classes for more hands-on engagement more with campus operations, which could include new forms of producing or managing energy consumption

B.Summary Of Key Issues, Opportunities, & Challenges

In consideration of the stakeholder input and background materials, the Panel extracted the following primary issues to be explored and addressed in the development of recommendations for this report:

CULTURE AND VISION

- Aligning School vision and values with sustainable goals across all stakeholder groups
- Need for a clear, intentional statement of value to pursuing Net Zero for possible

incorporation in the Strategic Plan update

- Desire for a plan with a long-term view with respect to actions and outcomes
- Need to characterize the extent and nature of acceptable modifications to land or buildings associated with a path to Net Zero
- Define what constitutes success and desired outcomes from a path to Net Zero
- Discussion around the need, desire, or responsibility for increased community engagement

FACILITIES AND OPERATIONS

- Overall need for improved building performance and reduced energy consumption
- Electrification
- Get all buildings off propane as mechanical systems are upgraded
- Improved building systems controls and improved user education, behavior, and engagement
- Use of automated building controls and monitoring systems
- Assessment of renewable energy options
- Consider creative options for final disposition of buildings to be demolished or re-purposed
- Opportunities to implement landscape and outdoor maintenance best practices to reduce energy usage, costs, and environmental impacts
- Deep energy efficiency retrofits for building renovations - energy efficient lighting, heating, cooling, ventilation, and building envelope - all at once as part of a major turnover.
- Switch vehicles and equipment off of gas as they reach end of useful life
- Renewable energy Sources: Install a 1-5 MW, ground-mounted solar array on site, self-financed if cost-effective (if the Schools qualifies for the 30% ITC)
- Purchase Energy Offsets: Consider for an off-campus project that aligns with the School's values, or for on-site applications (i.e. no-till agriculture, reforestation).

EXISTING AND FUTURE LAND USE

- Identification of viable on-site renewable energy infrastructure and acceptable impacts on the campus landscape
- Assess the value, sustainability, environmental impacts, and best practices associated with current land uses including:
  - cattle
  - crop production
  - golf course
  - managed open space
  - natural and managed woodlands

EDUCATION: ENERGY and ENVIRONMENTAL STEWARDSHIP

- Potential for introduction of new subject matter balanced against time constraints, faculty-driven curriculum, and relevance to students
- Potential to leverage the 60 hrs community service requirement toward energy and environmental stewardship issues
- Leverage a commitment to these goals to share success and challenges with the public beyond the campus

KEY CHALLENGES

The path to improved sustainability will present some challenges typical for this type of effort, and other challenges specific to Woodberry based on the unique physical and cultural aspects of the school such as the following:

1.Cultural landscape versus change The unique legacy of the landscape and architectural character of the campus will present some value-proposition

moments along the way between accomplishing broader energy goals and preserving physical or cultural characteristics of the campus most valued by all stakeholders, including alumni.

2.Alignment of goals across stakeholder groups Natural tension between various stakeholder roles and perspectives around change to daily habits, physical aesthetics of the campus, or curriculum associated with a Net Zero initiative will require honest conversations and communications across all stakeholder groups. Financial and educational goals need not be in competing spaces but may, at times, require compromise or restatement of core objectives to maintain the focus on the boy's education.

3.Self-Sufficiency Flexibility to partner with outside vendors or use alternative financing vehicles may be advantageous at times but counter to historical School preference to minimize reliance on external partnerships or resources

VALUE-ADDED OUTCOMES AND OPPORTUNITIES

There will also emerge opportunities tangential to the primary objectives - some planned and some not anticipated. It is important to identify and nurture these opportunities along the journey as teaching moments, possible enhancements to the process, and means to engage more stakeholders. Following are some possible outcomes related to the main objectives:

- Healthier Building Environments better building performance can also produce cleaner, healthier building environments that have been proven to result in more productive students, staff, and faculty as well as a decrease in the occurrence of certain physical or mental health issues.
- New Teaching Material research, actions, technologies, and implementation related to these issues may stimulate new teaching opportunities and curriculum tracks, impact faculty retention or recruitment, or simply embellish an already stellar brand for the School.
- Raising the School Profile Becoming a thought leader within the community and among peer institutions may provide a platform for reaching out, educating, and engaging the broader community at a local, regional, or even national scale.
- Enhanced Recruiting A heightened position of leadership among peer institutions for campus-wide strategies of stewardship and energy management could also have a desirable impact on recruiting both faculty and students.
- Increased Engagement Positive unintended consequences almost always arise from these efforts and may stimulate and motivate students, staff, faculty and others to be creative and find new ways to improve the overall Woodberry Forest experience related to stewardship and energy efficiency imperatives.

V. FRAMEWORK FOR ACTION: A PATH TO A NET ZERO CARBON CAMPUS

A PATH TO A NET ZERO CARBON CAMPUS INCLUDES SOME OBJECTIVES AND ACTION ITEMS THAT WOULD BE FUNDAMENTAL TO ANY SIMILAR EFFORT, AND SOME THAT ARE VERY SPECIFIC TO THE UNIQUE CONDITIONS AT WOODBERRY FOREST. THIS SECTION PROVIDES A FRAMEWORK FOR A PLAN INCLUDING GUIDING PRINCIPLES TO MEASURE THE PLAN AGAINST BROADER SCHOOL VALUES AND MISSION, AN OUTLINE OF STEPS AND ACTION ITEMS TO PROVIDE A MAP OF HOW TO GET THERE, AND RECOMMENDED ACTIONS ITEMS IN RESPONSE TO SPECIFIC CONDITIONS AT THE SCHOOL. FINALLY, THERE IS A LIST OF BIG IDEAS THAT, WHILE NOT ESSENTIAL, CAN HAVE A BIG IMPACT ON MAKING CHANGE VISIBLE AND REINFORCING A CULTURE AROUND ENERGY AND SUSTAINABILITY ISSUES.

A. GUIDING PRINCIPLES

Using the background information, on-site observations, and stakeholder input, the ULI Panel approached development of a plan with the following Guiding Principles in mind.

- A focus on a long-term plan and outcomes – avoid quick solutions and unrealistic exceptions
- Create a plan and goals that are realistic and achievable that can be achieved within a reasonable timeframe
- Consideration for the appropriateness of all land uses to relative to the campus aesthetic
- Respect for natural environmental assets, and improved stewardship measures for existing natural resource assets where possible
- Identification of BIG Ideas that represent value-added opportunities beyond the core objectives, including educational opportunities and community engagement

B. STEPS ALONG THE PATH TO NET ZERO

The fundamental steps along the path to Net Zero include a logical, ordered series of actions that are interrelated and build one upon the other toward the end goal. There is certainly some interdependency among actions depending upon the timing of things such as when systems or equipment fail or are upgraded and the timing of when funds are available for small expenditures versus large ones. However, some steps require some table setting or enabling projects in order to be implemented or effectively deliver the most benefits. In general, the path will focus on the following four sets of actions:

1. ENERGY EFFICIENCY

- Improved controls and facility management
- Increased resident education and engagement
- Deep energy efficiency retrofits for building renovations - energy efficient lighting, heating, cooling, ventilation, and building envelope - all at once as part of a major turnover.

2. ELECTRIFICATION

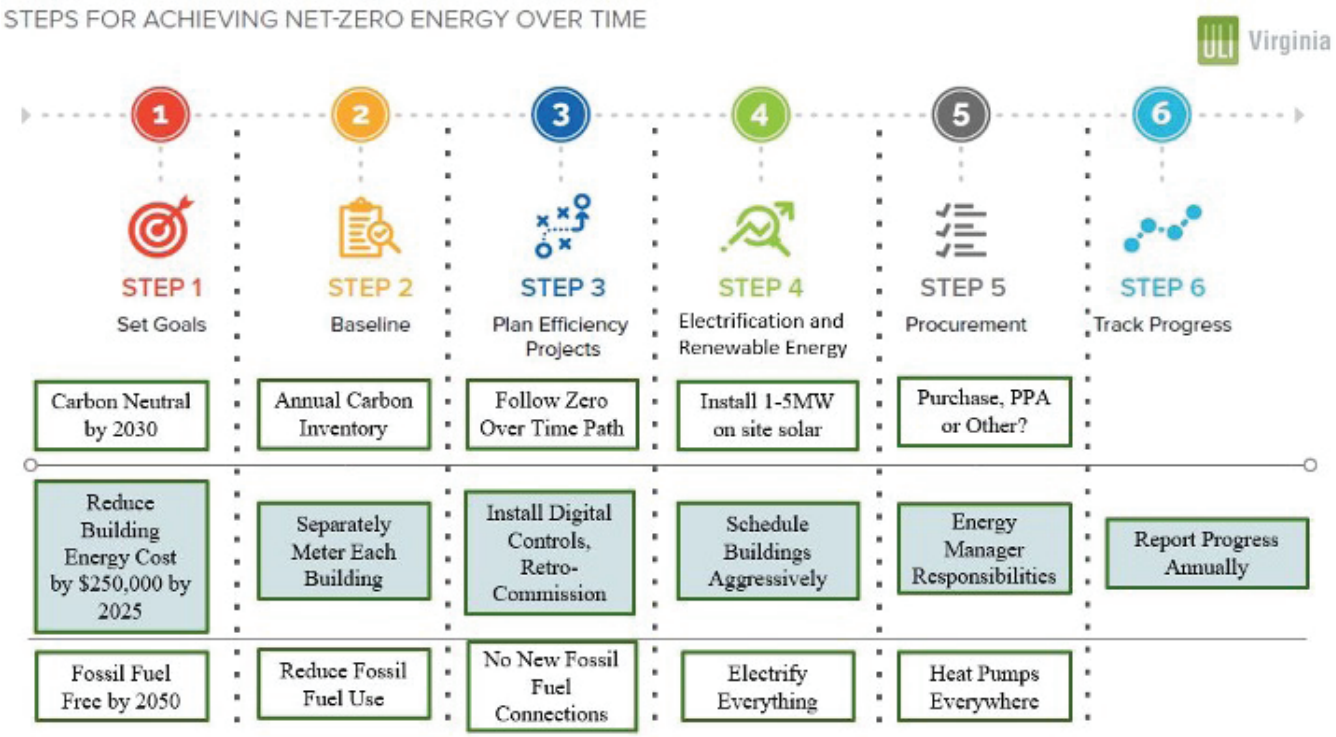
- Get all buildings off propane as mechanical systems are upgraded
- Switch vehicles and equipment off of gas as they reach end of useful life

3. RENEWABLE ENERGY

- Install a 1-5 MW, ground-mounted solar array on site, self-financed if cost-effective (if the school qualify for or monetize the 30% investment tax credit (ITC)
- Explore purchasing renewable energy through the utility grid, or investing in an off-site renewable energy project to maximize renewable energy consumption without taking up too much of Woodberry's own campus land.

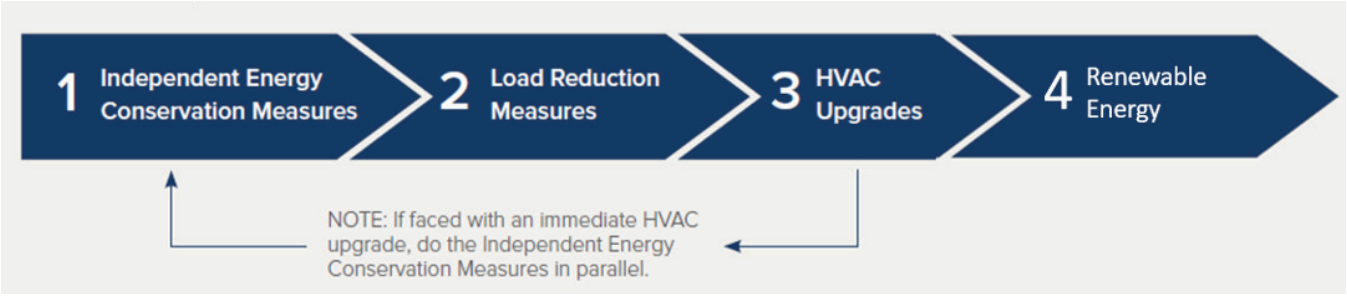
4.PURCHASE CARBON OFFSETS FOR REMAINING EMISSIONS

- Achieve the majority of progress to net zero through efficiency, electrification, and on and off-site renewable energy. Only consider offsets for the remainder of emissions after all cost-effective efficiency and renewable energy opportunities have been exhausted.
- When purchasing offsets, consider an off-campus project that aligns with the School's values (i.e. no-till agriculture, reforestation). Make sure offsets are 3rd party certified.
- Woodberry may be able to generate carbon offsets through sustainable land use on campus – it may be worth exploring with an offset provider whether Woodberry could certify its own carbon offsets through more sustainable livestock management, no-till agriculture, reforestation, or other strategies.



SEQUENCING ENERGY CONSERVATION MEASURES

Different Energy Conservation Measures (ECM) will have different reasons for implementing, different types of interventions, and different financial returns. The sequence that ECM's are implemented is critical and can greatly impact the types of upgrades required and payback for those upgrades. Following is the recommended process for best results and a brief description of each step:



1.CAMPUS-WIDE ENERGY CONSERVATION OPPORTUNITIES

- New heating controls and lighting controls, to help improve thermal comfort and save energy:
- All interior lighting on motion sensors where possible (nothing is on a switch except maybe dorm rooms)
- All exterior lights are on a timer (or photocell), and those that are not required for safety can turn off during part of the evening.
- All heating and cooling zones are controlled by programmable Building Automation Systems (BAS) or programmable thermostats with pre-programmed automatic setbacks, and can be set for the scheduled use of the building (dorm rooms at night, classrooms during the day, gyms based on practice and game schedules, etc…)
- Centralize a building management platform, to optimize start up and shut down, change setpoints, and control zones (especially when boys are not using buildings based on time of day or time of year.) One facility manager (via an online dashboard, if possible) should be able to update the start-up and shut-down of building mechanical systems and lighting and should be able to track the performance of these buildings in real time and spot performance-based maintenance issues as they happen.

2.LOAD REDUCTION MEASURES

Establish Guidelines for Current 12 Building RFP & Beyond

Publish Energy Use Index (EUI) Standards

- Enhanced Building Envelope Systems
- Advanced Lighting & Daylighting Controls
- Demand-Controlled Ventilation
- Air System & Water System Energy Recovery
- Heat Recovery Chiller

3.HVAC UPGRADES

- Get buildings off propane & diesel (all-electric) at replacement of mechanical systems (next 1-20 years)
- Use heat pumps for most current heating needs, and electric for water heating.

4.RENEWABLE ENERGY: SOLAR

- 1-5 Megawatt ground-mounted solar array
- 2-8 acre Photovoltaic array interconnected behind the main energy meter
- Solar can be integrated with agricultural uses (livestock pasture, crop production) if needed, or more concentrated to save space.
- Carefully located on campus to maximize solar potential, and minimize visual impact (ex: south of wastewater treatment area with gentle sloping south-facing hill hill and minimal obstructions to sun exposure.)
- To take credit for renewable energy in net zero goal, all Renewable Energy Certificates will need to be retired, not sold.
- Options to self-finance, use a Power Purchase Agreement, or hire an Agent to handle the transaction – panel recommends retaining an owners' rep "solar broker" to manage the transaction and the competitive bid process given the need for deep subject matter expertise, and can make a recommendation of select brokers if helpful.

MEASURES OF SUCCESS: REASONABLE AND ACHIEVABLE GOALS AND TIMELINES:

Establishment of realistic, achievable timelines for key objectives along the path to Net Zero are dependent upon many variables. General commitment to the goal. Commitment of funding to the effort. Decisions along the way regarding timing and types of improvements. Changes and improvements in technology over time. For example the decision to implement renewable energy in the form of solar power – when and how much - can have a significant impact on outcomes and timing. Of course, these targets can be reassessed along the journey to account for changing conditions, but following is a suggested timeline that the Panel believes to be reasonable for Woodberry based upon the information presented during the TAP program:

- 2027 Reduce building energy costs by 50%
- 2032 Carbon neutral
- 2050 Fossil fuel free

The graphic on the following page presents a visual example of how this schedule might be executed and the key performance benchmarks along the way.

C. SPECIFIC RECOMMENDATIONS AND OPPORTUNITIES

The framework above represents the fundamental steps along the path to Net Zero. Within those big steps are many supportive actions and opportunities important to the process. Following is a list of some recommend actions that speak specifically to the culture and physical plant conditions at Woodberry Forest.

Facility and Operations

a.Re-purpose Infirmary as Environmental Education center

b.Modify management of cattle operations to demonstrate a more environmentally sensitive approach to land management

c.Conduct some Energy Audits

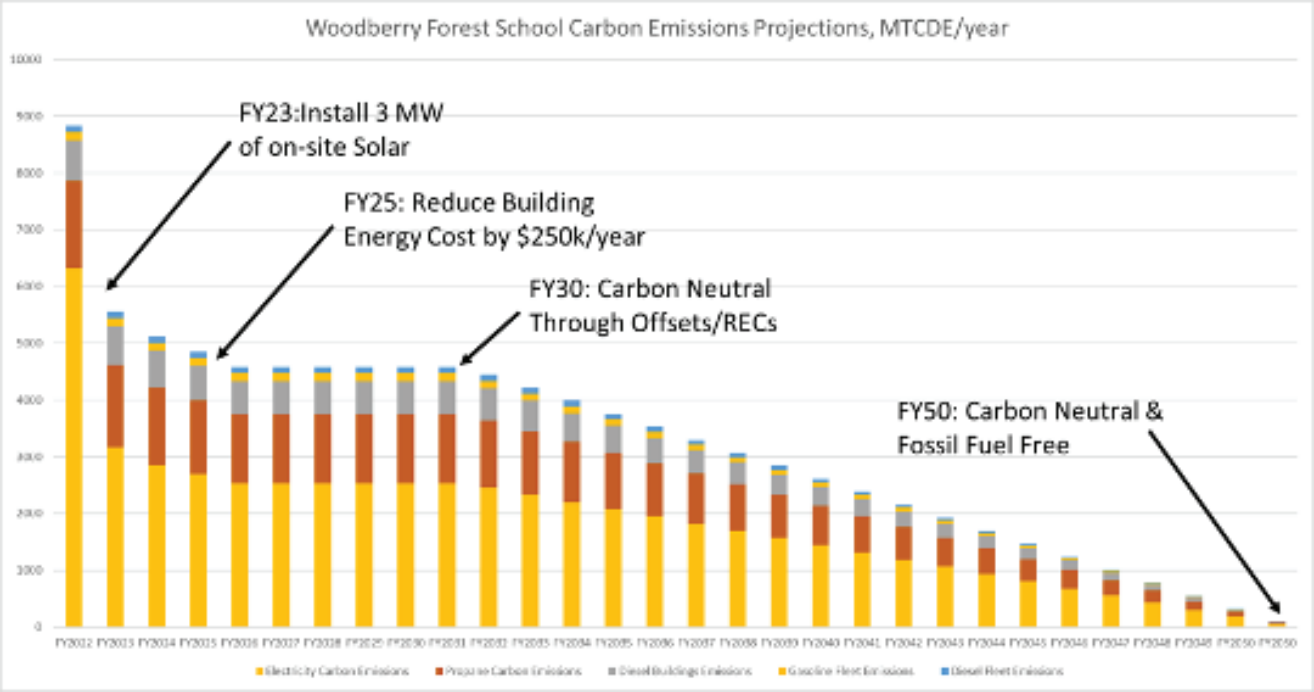
Create Design Standards

d.Establish building design and performance guidelines (sim to columns) for energy management

Create Roles for Champions and Leadership

e.Expand ops for more student leadership – create role for sustainability champions

f. Incorporate a path to Net Zero Carbon and target time horizons for the major goals into the upcoming Strategic Plan



G. Hire a sustainability manager – champion for energy manager

H. Hire faculty educator re; energy / sustainability

Create a plan for Community Engagement and Education

I. Create a more intentional program for community engagement beyond the campus borders. Create roles for community engagement with representation from each of the primary stakeholder groups: students; faculty; staff; administration competition between users and building types using performance metrics ; public-facing energy performance displays kiosks

Vehicle Fleet – Net Zero Over Time

J. Build a Better Baseline: vehicle miles per vehicle, and current fuel efficiency (MPG)

K. Convert to electric/hybrid for all cars, minivans, and light trucks at the end of useful life (should payback on average at 50,000 miles)

L. Convert larger buses, heavy duty trucks, and farm equipment to electric, as technology develops and cost comes down

M. Add EV Infrastructure: first to back-of-house (fleet vehicles), then to front-of-house (select parking spots/lots)

N. Convert Maintenance Equipment (leaf blowers, chainsaws, lawnmowers) to all electric

Agriculture and Farming

O. Solar + Agric: Not sure they work great with cows, but probably OK…there's some really compelling benefits for some types of agriculture (helps with temperatures, evaporation rates, wind protection, etc)

P. Explore no-till, integrated biodynamic, and regenerative agriculture

Education

Q. Create curriculum around sustainability and stewardship action items and goals

DOWNSTREAM VENDOR, SUPPLIER, PARTNERS: POTENTIAL STRATEGIC ALLIANCES

- •Renewable Energy Agents:
- •Black Bear Energy
- •Customer First Renewables
- •Edison Energy

RENEWABLE ENERGY PROVIDERS:

- •Altenergy
- •Standard Solar
- •Sun Tribe Solar

D. ADDITONAL IDEAS

There are many other ideas that may warrant exploration as residual benefits to the process and opportunities to reinforce the culture of sustainability. The list below represents ideas from a combination of stakeholder suggestions, case study examples, and successful efforts from the professional experience of the ULI TAP members.

A.building Repurposing:

i. In lieu of demolition, transform a de-commissioned building to an off- the-grid building as a teaching laboratory

ii. re-purpose the infirmary as a campus sustainability and environmental education center; include new technology displays, lecture and presentation space, monitors tracking real-time energy consumption, etc

b. Make performance visible: Install technology and public-facing energy performance display kiosks with dashboard displays tracking performance around campus to provide visible cues to energy consumption and create tools and apps for online monitoring. Celebrate small victories when key milestones area reached.

c. Food consumption and production:

i. Identify vendors who source sustainable food to the school

ii. Develop an on-site farm to table program

d. Enhanced Campus Engagement: create opportunities for students to engage in more meaningful ways with sustainability issues.

i. Consider creating a student-led "sustainability squad" or "office of green initiatives" (reference case study #1 - Putney School in additional references)

ii. Create positive results and altered behavior through productive competition between users across building types using monitored performance metrics composting (to connect waste to land, agriculture, and climate change impacts)

iii. Water quality – make connection between water use and wastewater treatment to surface and river water quality, and plant and animal habitats

iv. Reforestation program – explore reforestation and sustainable land management to reduce managed open space and possible carbon offsets

v. Cattle management - switch to holistic planned grazing (ref. Polyface farms or white oak pastures)

vi. Golf Course Maintenance - Reduce Pesticides And Fertilizer Use; Reduce Water Consumption

vii. Get recycling right - a visible, low-hanging fruit means to "walk the talk

VI. FINAL THOUGHTS

It is fitting that this initiative began with the thoughts and challenge of a Woodberry Forest student. The School is committed to honoring its past, preserving the best of what makes the School a unique educational experience, and taking a proactive approach to the future. School leadership is seeking to demonstrate to its students, faculty, staff, administration, and alumni that responsible environmental stewardship aligns with the culture and mission of the School to enhance the educational experience, teaching opportunities, and overall financial performance of the School. This study provides a framework to pursue those goals but is simply a point of beginning. Many more detailed conversations, technical studies, and a continued commitment to progress over many years will be required to realize success.

This effort will require transparent and honest conversations between students, faculty, staff, and administration around action items required to achieve these goals and to understand the value propositions associated with potential physical changes to campus or behaviors in exchange for positive impacts to the environment and energy efficiency. The School has the resources and leadership to achieve some very realistic and measurable goals along a path to Net Zero, and in doing so assume a thought leadership role among its peers and in the community.

WHY TAKE THIS PATH NOW? THE TRIPLE BOTTOM LINE AT WOODBERRY FOREST SCHOOL

Personal Outcome	Reasoning and Justification
It's Good for the boys	The boys can have a better experience as a result of: • Healthier, more comfortable study and living environments improved infrastructure, • New educational opportunities • Increased awareness of issues and connectedness beyond the campus
It's Good for bottom line	Operation costs are reduced over time
It's Good for the planet	Woodberry becomes a leader in environmental sustainability, which could have a positive impact on recruitment and reputation

VII. ADDITIONAL RESOURCES

Several resources and case studies were referenced by the UI TAP panel during this exercise to identify successful programs at peer institutions toward a goal of Net Zero Carbon campuses. Following are a few examples that may be useful to the School in the preparation of detailed plan.

Best Practices for Achieving Zero Over Time For Building Portfolios | ULI Americas

https://sustainablecampus.cornell.edu/cornell-tech-nyc

Discovery Elementary: Arlington VA's second net zero School

Future Virginia College Building Designed for Net-Zero - School Construction News

How more colleges achieve carbon neutrality | (universitybusiness.com)

Carbon Neutral Universities in the United States | Earth911

Campus - Accelerating to Net Zero - Campus Matters

Cornell Tech - NYC | Sustainable Campus

CASE STUDY #1: PUTNEY SCHOOL
SUSTAINABILITY - THE PUTNEY SCHOOL

Features: "sustainability and stewardship are integral parts of the Putney experience"

- A Net-Zero Field House that consumes less energy than it produces - the first net-zero and LEED Platinum school building in the United States.
- growing a portion of our own food
- a Sustainability Squad made up of students with an advisor, What else would you expect from a school locate
- a 500-acre working dairy farm in southeastern Vermont

(Strategic Plan) Every student here is required to spend a semester working in the barn before graduation.

As far as the physical plant is concerned, our current strategic plan states that "A sustainable campus is both an educational and a financial goal."

(Community Outreach and Impact) Besides winning us accolades, which we appreciated but weren't pursuing, the Field House has been in many publications and has hosted visits from other educational institutions, businesses, and organizations who want to see how a building of this size can be constructed today, affordably, with current technology. We hope it will serve as an example to everyone planning a new building in the near future.

Students have designed our latest two-student cabin. It is superinsulated, oriented for maximum solar gain, solar powered, and heated with a yacht stove that burns twigs. Students built the cabin from donated insulating panels and many found parts.

Community Culture - The Sustainability Squad conducted a campus assessment of the school's recycling program and wrote a proposal to replace all of the old recycling and waste bins with new, more easy-to-use ones.

The metal bins with liners that are currently used across campus are the result of their work. This year, the squad is planning to revitalize the GreenGuard program, which will work to make daily habits around energy use, solid waste management, and other green initiatives more visible and effective, especially at the dorm level.

Master Plan - Our latest Master Plan describes the steps we're taking to become a net-zero campus. Our next step is to upgrade the efficiency of our current buildings while **keeping their bucolic appeal.**

Two students serve on the Master Plan committee. A few years ago a student made a "Student Guide to the Master Plan" pamphlet that highlights the most important features students would be interested in knowing about the school's campus and energy goals. Last year students worked on an electric school bus proposal, which resulted in transportation being included in the agenda for the new Master Plan, which is supposed to be completed by the end of this calendar year.

ESG (Environment, Social, Governance) investment - Students on the squad were at the heart of the move toward more environmentally and socially sound investment practices. This started with a call to divest from fossil fuels in 2013 and progressed through many conversations with the board and as a community. The school now invests its portfolio using ESG lenses with Glenmede. Students have captured this journey in a pamphlet that explains the different forms of investment and how The Putney School ended up where we are with our endowment portfolio.

Climate Justice Conference - Students planned and hosted a professional level conference on climate justice last spring for New England residents. Attendees were mostly high school and college students. The conference included three workshop blocks, with 20 different workshops facilitated by professionals working in climate change, racial justice, and food justice careers. There was also a Justice Fair with educational and community booths and a catered lunch. Majora Carter, an urban revitalization specialist, was the keynote speaker.

Net-zero Education - Students have designed and led tours at our net-zero field house to highlight the many sustainable features of that unique building. Students have also created videos highlighting some of the features of the field house like: PV solar power, composting toilets, and its air-to-air heat exchanger and energy recovery system, as well as videos about new and evolving net-zero features on other parts of campus, like the new solar array.

CASE STUDY #2: KENYON COLLEGE

SUSTAINABILITY & GREEN INITIATIVES | KENYON COLLEGE

The Office of Green Initiatives (OGI): coordinates sustainability efforts on and off campus with an emphasis on curricular engagement and connecting students to their sustainable programs. Student Interns work as leaders in several areas including programs and events, outreach, and carbon neutrality planning.

Outreach: Students with the OGI are the primary voice of the office and routinely generate content to inform the campus about ongoing efforts and opportunities.

Carbon Neutrality Planning: OGI Interns are the force behind emissions tracking and reporting and manage data required for an honest accounting of progress.

The Brown Family Environmental Center (BFEC): a 500-acre preserve established to conserve natural diversity and engage people with nature. The BFEC also provides opportunities for education and research.

Kenyon Farm: *"where pastoral meets academic"*

Students operate the 10-acre farm, living in a house on the property and managing the care of the animals including turkeys, goats and chickens, as well as the growing and harvesting of field crops including strawberries, onions, garlic, tomatoes, peppers, squash and more. Students who live at the farm learn to balance their full-time coursework with the chores that keep the place running. They participate in a more sustainable lifestyle and experience the full cycle of farming, from planting seeds to harvesting crops used in the dining hall, from incubating eggs and raising the chickens to delivering eggs to the Kenyon Inn for breakfast. Students also learn the value of recycling and repurposing by using materials from College building projects to construct chicken coops and turkey tractors.

Featured Courses

• Conservation Biology: How do various factors impact the population of a species, and how can better management practices ameliorate impacts on biodiversity in order to preserve our planet? Through the lenses of evolution, ecology and population biology, this course explores conservation-related issues in our rapidly changing world

• Solar Energy: The exigencies of peak oil, global warming and unsustainable growth in energy consumption have sparked a quest for clean, abundant, renewable energy to replace fossil fuels. This course explores the chemistry of fossil fuels and potential solar-energy alternatives, ranging from biofuels to solar panels to hydrogen.

• Environmental Economics: This course uses economic analysis to better understand the nature of environmental issues such as pollution and the allocation of natural resources. The relative strengths of alternative policies will be discussed using a series of case studies focusing on actual policies aimed at correcting environmental problems.

• Permaculture and Homestead Winter Farming: Our world faces a future of food insecurity and must be brought into balance with nature. This interdisciplinary course explores principles of permaculture that link biology, ecology, sociology, sustainability and community to farming. Get your hands dirty by assisting with planting and harvesting on the Kenyon Farm. (318)

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