University of New Hampshire

WILDCAP (CLIMATE ACTION PLAN) UPDATE

WRITTEN BY THE UNH ENERGY TASK FORCE

www.sustainableunh.unh.edu/wildcap

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the sustainability institute

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Executive Summary

This report is an update to the first version of the University of New Hampshire Durham's Climate Action Plan, WildCAP. The report describes policies and projects the university has undertaken -- and new ones it can consider -- to meet its goals of reducing greenhouse gas emissions (GHGE) 50% by 2020 and 80% by 2050 en route to climate neutrality by the end of the century, as compared to a 2001 GHGE baseline.

UNH's Scope 1 GHGE are expected to continue their downward trajectory in coming years as a result of on-campus energy efficiency projects tied to our Energy Efficiency Fund (EEF). As we lower Scope 1 emissions, Scope 3 emissions -- in particular faculty and staff commuting and air travel -- become more prominent pieces of our overall emissions portfolio. As a result, while UNH will continue to invest in policies and practices that lower Scope 1 emissions, the university also will put a stronger focus on policies and practices that help faculty, staff and students lower emissions in their daily lives on campus.

All recommended policies and practices are listed below and in Appendix A, with more detail on each in the full report. More information can be found at www.sustainableunh.unh.edu/wildcap.

Category	Action
Campus Buildings	• Install Lighting and Lighting Controls • Continue Retro-Commissioning Program • Review Demand Controlled Ventilation • Review Feedback Mechanism to Modify Heating Controls (Central Plant HW) • Install Occupancy Controls • Explore Distribution Piping Insulation (Mechanical Spaces) • Research Remote Building Energy Management Systems • Explore Mini Back Pressure Steam generation • Pursue Fuel Conversions to Natural Gas from Oil and Propane
Information Technology and Plug Loads	• Promote Energy Smart Purchasing and Working Guidelines for Faculty and Staff • Research Projects / Case Studies to Assess Plug Loads • Identify and Act Upon Easy Wins / Higher Draw Plug Loads • Implement IT/Plug Load Awareness Campaign • Investigate Network Based Energy Monitoring • Create and Implement and EPEAT Purchasing Policy Across Campus • Create Enterprise IT Energy Guidelines for Labs, Servers and Data Centers
Transportation	• Submit for FTA Bus-Livable Community Grant Funding • Fine-tune and promote NextBus (real-time transit systems) • Expand use of targeted email, social media, and UNH application suite for promotion of Wildcat Transit and other alternative transportation services at UNH • Redesign western Campus Connector routes to use West Edge Connector Road • Submit Pettee Brook/Quad Roundabout CMAQ grant application • Pursue Wildcat Transit Fleet Replacement • Develop South Drive Transitway • Expand Bicycle Facilities and Route Accommodation in Repavement and Reconstruction Projects • Expand CNG Station Storage and Backup Power

Category	Action
	• Introduce Pay and Display Technologies to UNH Parking Facilities • Enhance Fiscal Sustainability of the UNH Transportation System Through User Revenue Enhancements and Value-Based Pricing Strategies • Continue evaluation of opportunities to modernize the UNH parking permit system • Implement an incentivized Infrequent User parking permit program • Evaluate electric vehicle (EV) charging infrastructure and UNH EV niche fleet • Expand Cat Cycles and or other projects to improve bike culture at UNH • Strengthen anti-idling provisions • Increase allocated funding for UTS annual marketing program of transit and other non-SOV alternatives • Build Out the Intermodal Transit Center • Review the Possibility of a Wildcat Transit: East-West Connection (UNHM and Concord • Pursue ongoing streetscape improvements to improve the mobility of the campus with a focus on transit, walkable and biking modes.
Energy Production and Renewables	• Explore Solar Thermal • Explore a Wood Chip/Bioreactor Heating System at Fairchild Dairy • Explore Photovoltaic/Wind at Offsite Locations • Research Energy Storage/Load Shifting • Explore Mini Back Pressure Steam Generation • Explore Fuel Conversions to Natural Gas from Oil and Propane • Explore Hydropower
Behavior/Culture	• Expand and Improve Bike, Carpool and Transit Schedules and Outreach • Establish an Employee Air Travel Policy • Expand Power Down Outreach • Expand and Improve Waste and Recycling Signage • Explore Infrequent Parking Permits • Expand Faculty and Staff Engagement through Partnerships with Other UNH Offices • Expand Student Engagement Online and Through Student-Focused Offices • Conduct a Cost/Benefit Analysis of and Outreach around Bottled Water • Integrate Sustainability Information into Other Campus Communications
WALRUS (Waste and Recycling, Offsets/Sinks, and Land Use)	• Finalize Waste and Recycling Audit and Develop a Management Plan • Institutionalize Trash 2 Treasure • Maintain and Expand the UNH Composting Program • Research Offsets and Sinks
Adaptation	• Form a cross-campus adaptation subcommittee of the ETF. • Research and write a report detailing the climate change impacts UNH may face and suggested policies and actions for how to address them.

Introduction

In 2009, the University of New Hampshire (UNH) finalized its first climate action plan. Called "WildCAP" (combining the acronym for a climate action plan (CAP) with the UNH wildcat mascot), the plan laid out ambitious greenhouse gas emission (GHGE) reduction goals and suggested policies and projects that could be implemented to put the university on the path towards meeting them.

This report is an update to that first version of WildCAP. The report describes policies and projects the university has undertaken -- and new ones it can consider -- to meet the goals of reducing GHGE 50% by 2020 and 80% by 2050 en route to climate neutrality by the end of the century.

Projects and policies are grouped into the following broad categories:

- Campus Buildings
- Information Technology and Plug Loads
- Transportation
- Campus Energy Production and Renewables
- Behavior/Culture
- Waste and Recycling, Offsets, Sinks and Land Use
- Curriculum, Research and Engagement
- Adaptation

Each section contains not only prioritized actions but also how best to implement and evaluate those actions. A final Overall Implementation and Evaluation section discusses how as an integrated plan that cuts across the entire university WildCAP will be implemented and evaluated.

According to the university's Fiscal Year 2010-2011 GHGE inventory, UNH's Scope 1 GHGE are expected to continue their downward trajectory in coming years as through the campus's Energy Efficiency Fund (EEF) more efficiency projects on campus are completed. As we lower our Scope 1 emissions (e.g., cogeneration electricity/steam, non-cogeneration energy production, and the UNH vehicle fleet listed in Table 1), our Scope 3 emissions become a more prominent piece of our overall emissions portfolio. According to UNH's Fiscal Year 2010-2011 GHGE inventory, the largest contributors to UNH's Scope 3 emissions are faculty and staff commuting (25%) and faculty and staff air travel (14%). As a result, this revision of WildCAP includes a major focus on lowering Scope 3 emissions, specifically those from air miles, commuting, and other behaviors. More broadly, we will use WildCAP as a way to educate the entire campus community about the importance of lowering emissions and adapting to climate change in their civic and professional lives -- from how they get to and from campus to what they purchase for their research or departmental needs.

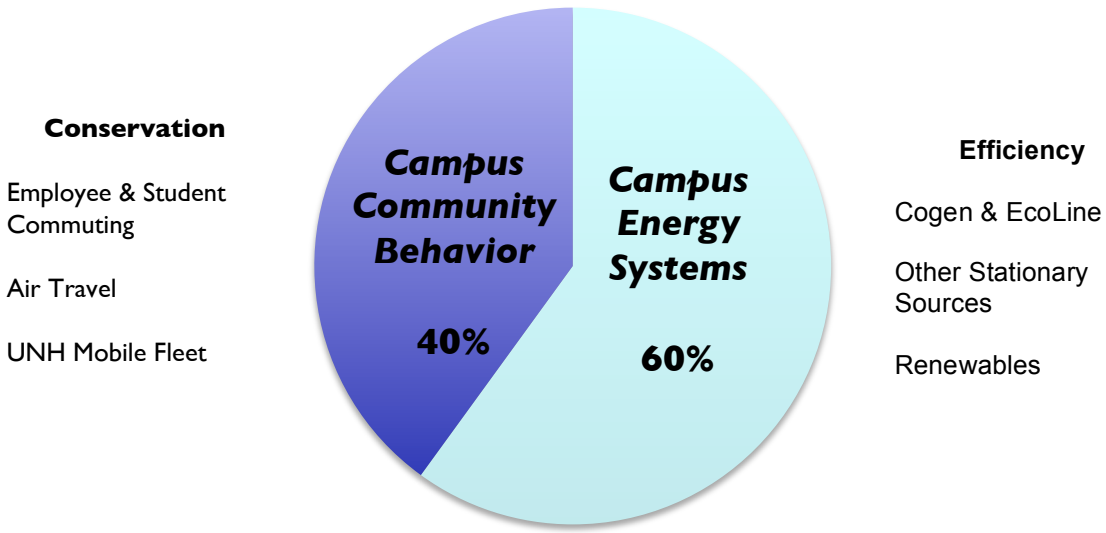
Table 1: UNH Net Carbon Footprint: Emissions Sources for FY10-11**

Cogeneration electricity/steam	42%
Faculty, Staff and Student Commuting	25%
Air Travel	14%
Non-cogeneration energy production	10%
Purchased Electricity	6%
UNH Mobile Fleet	3%

***** These percentages differ from those of gross emissions, illustrating the impact of REC sales.***

As evidenced in the Campus Buildings, Information Technology and Plug Loads, Transportation, and Campus Energy Production and Renewables sections of this update, UNH will continue to invest in policies and practices that lower Scope 1 emissions. At the same time, however, the university will put a stronger focus on policies and practices that help faculty, staff and students lower emissions in their daily lives on campus. While the aforementioned sections focus on the infrastructure side of campus, the Behavior/Culture section focuses on the people using this infrastructure. Sections are separated by categories, but they clearly overlap.

Figure 1: UNH Greenhouse Gas Emissions Breakdown



This WildCAP update was written by members of the UNH Energy Task Force (ETF) under the coordination of the UNH Sustainability Institute (UNHSI). ETF members come from UNHSI, the Energy Office, Campus Planning, Information Technology (IT), Purchasing and Contract Services, University Communications and Marketing, Cooperative Extension, faculty, and students, including an undergraduate Student Sustainability Ambassador (a paid internship position at the UNHSI). More information on the UNH Energy Task Force can be found at sustainableunh.unh.edu/etf.

WildCAP is one piece of UNH's climate leadership across curriculum, operations, research and engagement. And that climate leadership is an integral piece of the university's overall sustainability leadership. Learn more at sustainableunh.unh.edu.

Campus Buildings

Achievements to Date

Energy Efficiency Fund (EEF)

Through the early 2000's, energy efficiency improvements had been made as the campus leveraged its own funds with rebate programs offered by local utility companies. However, UNH lost its eligibility to apply for utility rebate programs when the university invested in an on-campus combined heat and power plant. Although renovation and new construction projects continued to install high efficiency lighting, motors and heating, ventilation and air conditioning (HVAC) systems, investment in pure energy efficiency projects stopped. As a result, campus energy use intensity (total energy per gross square foot (GSF)) started to climb— an unacceptable trend for a campus with a strong sustainability ethic.

Campus energy managers, UNHSI, and the ETF recognized that a dedicated funding stream for energy efficiency improvements was needed if the trend was to be reversed, and the concept of an Energy Efficiency Fund (EEF) was developed. The fund would invest in energy efficiency improvements and the estimated energy savings would be captured through the utility rate charged to the campus. (UNH Utilities operate as a cost center and charge campus units for utilities consumed.) This would replenish the fund and allow further investments. However, an initial source of funds needed to be identified. After several unsuccessful initiatives, in 2009 UNH was able to secure a $650,000 grant from the American Recovery and Reinvestment Act (ARRA) to provide the initial funding.

The EEF is a "revolving" fund: savings from energy efficiency projects are estimated using a combination of sub-metering and engineering estimates that follow the International Performance Measurement and Verification Protocol, and the savings are captured through a System's Benefit Charge (SBC) included in the utility costs charged to campus units. Our SBC is similar to how gas and electric utilities recover similar costs from their customers. The SBC is assessed to offices and departments based on all the energy used on campus (e.g., electricity, gas, steam, hot water heat, oil, and propane), and the campus sees no impact on utility costs as a result. The UNH Energy Office targets an average five-year payback on projects funded. Project selections are approved by the ETF, which is comprised of administrators, faculty, staff, and students from across campus. Table 2 lists projects the EEF has funded to date.

Table 2: Energy Efficiency Fund (EEF) Projects Funded To Date	
Project	**Description**
Campus Lighting Upgrade	Replacement of inefficient lighting fixtures in over 15 buildings with more efficient replacements and the addition of sensors to turn off the lights when a room is vacated yet the lights are left on.
Kingsbury Aircuity	A demand-control airflow system installed in 2010 addresses the efficiency and conservation side of Kingsbury's energy needs. The system comprises sensors in each lab that "sniff" for contaminants in the air -– chemical or particulate –- then adjust the flow of fresh air into the room appropriately. The system will increase or reduce the amount of airflow needed based on sensor data from the space, while the constant monitoring shows that the baseline ventilation needs could be dramatically reduced, reducing energy usage.
Building Automation System Installs	Installation of the campus building automation system (BAS) in areas that had previous local HVAC controls that were not adequately turning back the temperatures and ventilation systems at night and on weekends when there is less need. The systems will also include occupancy sensors that will allow for reduction of airflows when the space is detected to have less than fully occupied status.
Retro-Commissioning: Gregg Hall	Installation of occupancy sensors and photo sensors for the laboratory spaces, along with updating the existing fume hood controls, all integrated with the existing building automation system (BAS). This measure will adjust lighting levels in the laboratory spaces based upon space occupancy. Additionally, the photo sensors will allow for further lighting level adjustment using daylight harvesting. Replacement of existing electronic ballasts with electronic dimmable ballasts will be necessary in order to reduce the lighting levels with the existing fixtures. Fume hood controls will be upgraded to include zone presence sensors that will adjust fume hood exhaust rates based upon whether an operator is standing in front of the hood or not. Supply airflow adjustment will be accomplished by installing space pressure sensors within each of the laboratory spaces. The supply airflows will modulate up and down to maintain the space static pressure setpoint. Additionally, the lighting occupancy sensors will allow the BAS to lower airflows for the entire lab if nobody is present. Currently, lighting levels and airflows within the laboratories remain at occupied levels all day long regardless of whether anyone is actually inside the spaces or not.

Retro-Commissioning: Dimond Library	Air-Side Economizer Modification: This Energy Conservation Measure (ECM) predicts the potential energy savings resulting from modifying the existing dry-bulb economizer controls to comparative enthalpy economizer controls. The existing dry bulb economizer control sequence calls for using outside air for "free-cooling" whenever the outside air dry bulb temperature is below 51.5 degrees F. This ECM estimates the additional cooling potential that can be realized by using outside air (OA) for free-cooling whenever the OA temperature is greater than 51.5 degrees F and the OA enthalpy is less than the return air enthalpy. The calculation assumes that the AHU mixing dampers will position to use 100% OA whenever the outside air temperature and enthalpy are in the range noted above. The potential savings calculation is based on the additional OA quantity above the minimum quantity required for ventilation at full occupancy (min. OA at full occupancy = 31,700 CFM). Savings of this ECM would be greater if coupled with CO_2 control. Heating Pump VFD: This Energy Conservation Measure (ECM) predicts the energy reduction associated with converting existing constant-volume heating pumps to variable-volume operation. The ECM entails installation of Variable Frequency Drives (VFDs) and differential pressure sensors to modulate the speed of the pumps to match the heating water demand of the building. Conversion of existing primary chilled water pump (serving CH-1E) to variable-volume operation during free-cooling is also included in this ECM. This pump should only operate variable-volume during free-cooling operation. The speed of the pump would be controlled to maintain the temperature of the water in the de-coupler line equal to the temperature of the primary chilled water supply (i.e., maintain primary chilled water flow greater than the secondary chilled water flow). Note that pump motors may need to be replaced to be compatible (or more compatible) with VFD operation. AHU Static Reset: This Energy Conservation Measure (ECM) predicts the energy reduction associated with adding static-pressure reset control logic to control sequences of the existing variable-volume air handlers, AHU-1 & AHU-2, to reduce the speed of the supply fan whenever possible. The ECM entails implementation of new programming logic to monitor the position of the associated VAV dampers and reduce the speed of the supply fan as appropriate to maintain at least one VAV box damper nearly 100% open. FCU Cycling: This ECM estimates the electrical savings associated with implementing fan cycling control logic to change fan coils from continuous operation to cycle on/off based on space load requirements (thermostat call). Fan cycling is already active in the areas where it can be used. Fan cycling had to be disabled in large spaces where the FCU fans have to run all the time during occupied mode in order to circulate

	air around the space and not have uneven cold/hot spots in the space. CO_2 DCV Upgrade: This ECM compares the energy consumption of two ventilation scenarios. The base case reflects ventilating the building in accordance with the "Ventilation Rate Procedure" as described in ASHRAE Standard 62.1-2010, Section 6.2. This case assumes that outside air is provided in quantities to meet the requirements of the Standard for a fully occupied building for all occupied hours of the day (8:00 AM to 12:00 AM). The ECM case assumes that Demand Control Ventilation (DCV) control logic is implemented to reduce outside air via CO_2 control to match the requirements for the actual occupancy of the building while also maintaining the required ventilation rate for the building area.
Retro-Commissioning: Rudman Hall	Provide retro-commissioning for Rudman Hall to include the laboratory spaces only. The retro commissioning will include verification of code minimum fume hood and laboratory airflows, verification of operation for air handlers AHU-1, AHU-2 and AHU-3, and associated exhaust systems EAHU-1, EAHU-2 and EAHU-3. Retro-commissioning also includes all terminal units associated with the previously mentioned air handlers and exhaust systems. The retro commissioning scope of work includes verification that control valves and damper actuators operate as intended, DDC temperature, pressure and humidity sensors are calibrated, review of sequence of operation for building systems associated with the laboratories and verification of sequences of operation including any recommended changes. The improvement will also include rebalancing all airflows within the building and re-certifying of all fume hoods in accordance with ASHRAE 110 Standards. Installation also includes quick responding ceiling mounted occupancy sensors within the laboratory spaces; magnetic switches at fume hood sashes; fume hood presence sensors; replacement of failing duct mounted DDC sensors; and audible alarms to remind occupants to close the fume hood sashes when the fume hoods are not in use. The existing fume hood controllers will be reused and integrated with the existing building automation system (BAS). This measure will setback supply and exhaust airflows within the laboratory spaces when fume hoods are not in use.

Temperature Set Point Policy

UNH established the following building temperature set point policy for all of campus.

Occupied hours

During scheduled hours, occupied offices in buildings with centrally controlled systems:

- Are heated to keep temperatures from going below 68° F during the winter;
- Are cooled to keep temperatures from rising above 78° F in centrally air-conditioned spaces during the summer (may have temperatures variations of up to 2° F).
- Thermostats in individually controlled spaces are set at 68° F during the winter and 78° F during the summer during occupied hours. Classrooms, laboratories, libraries, athletics facilities, dining halls, and residence halls are maintained at these temperature set points when open for business or occupied.

Unoccupied hours

During unoccupied hours, including weekends and holidays, the temperature is set at a level that allows the university to efficiently and economically conserve energy. Individuals controlling their own thermostats are asked to set them at 55°F in the winter during nights, weekends, vacations, and other times when the space will be unoccupied. Air conditioners are to be turned off during all unoccupied times. Exceptions to these temperature targets are in laboratories, experimental areas, animal areas, or other spaces where there is a demonstrated work requirement for maintaining higher, lower, or more consistent temperatures.

Conversion to absorption cooling to better utilize byproduct steam

To better utilize byproduct steam from the campus cogeneration system, UNH has added multiple air conditioning systems that use steam as the primary fuel for producing chilled water for delivery to campus buildings. These systems would otherwise use electricity for operation, causing both an increase in overall campus energy use as well as adding to the campus peak energy use during critical periods in the summer.

Building metering

UNH has installed over 700 meters at its buildings to account for consumption of electricity, natural gas, water, steam and condensate, hot water heat, chilled water, and other utilities. These are all cataloged at least monthly for historical consumption reporting; most meters are equipped to be read as frequently as every hour. The ability to track the consumption of the energy used at these buildings allows for better management of the facilities as well as the ability to track savings from energy reduction projects. UNH has also added a public portal for viewing energy metering data on the UNH Energy Office website (energy.sr.unh.edu/graph/), educating campus on how energy is consumed by buildings.

Fume hood airflow reductions

Using recent changes to the federal guidelines for laboratory ventilation standards, UNH has been working to reduce the minimum flow settings at all of the fume hoods that utilize a variable air system tied to fume hood sash position. By allowing less flow when fume hood sashes are fully closed, there is less conditioning of the outside air that is required to provide adequate ventilation for the space. As these lab spaces are the most energy intensive on campus, the reductions can yield tremendous energy savings for both heating and cooling.

Priority Goals, Actions and Timelines

Short Term Goals:

Install Updated Lighting and Lighting Controls

Technology has been improving at a fast pace for the latest types of lighting products and the ability to control when the lights are on and at what level of output. UNH has been updating its existing stock of lighting infrastructure while also looking to innovative designs for new construction projects. It is anticipated that over the next decade, LED technology will overtake the current standard of linear fluorescent lighting as the normal product for lighting. LED offers both lower operating costs for energy consumption as well as a much longer product life: for example, it has the ability to turn off lights as soon as they are not needed and to dim to meet the minimum levels required for illumination at the surfaces below the lights. Working along with these new lights are updated controls that can be assigned down to the individual fixture level, which provides more demand level operation and therefore results inboth lower energy use and improved comfort control.

Continue Retro-Commissioning Program

When a building is initially commissioned it undergoes an intensive quality assurance process that begins during design and continues through construction, occupancy, and operations. Commissioning ensures that the new building operates initially as the owner intended and that building staff are prepared to operate and maintain its systems and equipment. Retro-commissioning is the application of the commissioning process to existing buildings. Retro-commissioning is a process that seeks to improve how building equipment and systems function together. Depending on the age of the building, retro-commissioning can often resolve problems that occurred during design or construction, or address problems that have developed throughout the building's life. In all, retro-commissioning improves a building's operations and maintenance (O&M) procedures to enhance overall building performance. The UNH Program seeks to focus on the retro-commissioning of existing buildings to get them to function as they were once designed. The benefit of having years of operations is the ability to also look at how re-commissioning of some systems within the building may allow for more efficient operation than that of the original design.

Review Demand Controlled Ventilation

A demand controlled ventilation system is a ventilation system capability that provides for the automatic reduction of outdoor air intake below design rates when the actual occupancy of spaces served by the system is less than design occupancy. Sensors are used to detect when conditions allow reductions in the amount of ventilation air required to heat or cool a space, saving energy. UNH will review the installation of demand control ventilation where feasible for all systems that have a substantial ventilation requirement.

Review Occupancy Controls

Occupancy sensors were once only considered as inputs to minimize energy consumption from lighting. Using more advanced occupancy controls, we can automatically adjust and reduce the energy consumption from HVAC systems as well as lighting and other technologies like opening and closing blinds. These technologies and other occupant triggered sensors (i.e., using window magnetic switches to shut off HVAC systems if opened) can lower heating and cooling costs while also prolonging equipment life by requiring it to run only when there is a need from the occupant.

Install Distribution Piping Insulation (Mechanical Spaces)

Many areas are still under-insulated within the main utility entrances of a building. When these areas are repaired, it often requires the insulation from steam, hot water, and chilled water piping to be stripped for repair of the pipe. If the insulation is not adequately reinstalled, the energy loss can compound quickly and lead to a large source of heat loss for a building. The UNH program will require more frequent inventorying of systems and re-insulating after repairs.

Intermediate Goals:

Explore Remote Building Energy Management Systems

UNH has a number of older, smaller agricultural buildings off the main campus and disconnected from the main central heating and power plant. These buildings are fed from traditional fossil fuel heating systems that are not able to be managed remotely for assurance that campus standards are met for heating and cooling set points and schedules. Utilizing a more complex thermostat and control system for buildings that are not connected to the campus Building Automation System (BAS), these systems would replace standard programmable thermostats to take into account outside air temperatures, additional zone temperatures, and schedules to turn off equipment when not needed. Just providing the ability to turn equipment on and off will provide tremendous savings and allow for better remote management of the energy systems.

Long Term Goals:

Research Feedback Mechanisms to Modify Heating Controls (Central Plant HW)

As more data are readily available on conditions within building spaces, UNH intends to be able to use real-time conditions to modify larger utility distribution heating loads. For example, if a building is already comfortable, the central heating plant may be able to reduce the

temperature it is trying to achieve for heating all water that will be sent out to campus. More efficient operations of the plant system will allow for energy savings and added capacity for other buildings served from the main system.

Explore Mini Back Pressure Steam Generation

For areas needing a reduction in steam pressure within a building, the ability to create low-pressure steam while allowing for electricity production using a steam driven induction generator could be added. Already employed at the campus cogeneration facility, other areas that have steady year-round steam use could add smaller versions of turbines that are coming into the market. The technology for these smaller turbines is new and currently experimental. A good payback potential makes the possibility worth investigating as soon as the technology has been tested more in the field. Once UNH is satisfied with the potential applications, we will start our own internal reviews for potential sites. Already analyzed for steam flows, the first installation could occur at Rudman Hall, which uses steam for heating as well as air conditioning in the summer months. The constant use provides a good test location. UNH expects to begin pursuit of this technology before 2020 and will need to work with the local electric utility to perform a power study on all implications of adding another onsite generation source on campus. The ETF and campus energy staff will evaluate the performance of the project through metering directly.

Pursue Fuel Conversions to Natural Gas from Oil and Propane

Where applicable, UNH will look to move away from petroleum-based fuels to cleaner, natural gas. The local gas distribution company, Unitil, has expanded its service to run past more remote UNH facilities that currently use heating oil and/or propane for space heating. While it is a high priority for UNH to move away from these fuels, current capacity in the natural gas lines has been met. For UNH to expand use of the fuel, system enhancements will need to occur. The ETF and energy staff will continue to work with Unitil as the system expands. Once capacity becomes available, UNH will pursue these conversions to natural gas. It is unknown at this time when the system enhancements will occur, if ever.

Implementation and Evaluation

As listed with each priority action, implementation of these initiatives will fall to the ETF, research faculty, students, and staff, including Energy Office staff, to develop, install, and track progress. UNH energy staff has extensive metering in place for both energy production projects as well as energy reduction initiatives, like efficiency improvements and conservation measures. Through design improvements, UNH energy staff continuously review new building systems to determine the possibility of using any of the technologies mentioned in this section, and UNH retrofits up to 10% of the total square footage of the campus in a given year. In addition to updating building systems as part of major renovations, UNH has installed energy production systems as part of system efficiency upgrades, which can utilize the campus Energy Efficiency Fund (EEF) to lower annual operating costs. Looking to renewables, state

and federal incentives and grant programs can help leverage funding to make the installation of these systems more feasible given current campus budget constraints. The ETF will need to champion these initiatives as sound investments that consider life-cycle costs and help UNH reach its campus climate targets.

Information Technology (IT) and Plug Loads

Achievements To Date

Data Center Management

Started in summer 2010 at the UNH Information Technology (IT) Data Center, improved conservation and efficiency through data center management have reduced power needed to support the facility by approximately 30%. Specific steps taken have included server consolidation, retirement of legacy systems, cooling upgrades, and virtualization.

PrintSmart Program/Default Printing Settings/Networked Computers

The university's PrintSmart print management initiative began in the summer of 2012 and took nearly a year to fully implement. Through the program, all copiers and a significant number of laser and desktop printers, fax machines, and scanners were removed and replaced with more energy-efficient, Energy Star labeled, multi-function devices (MFDs) capable of all four functions. The new units come from the supplier with the equipment's highest level of energy savings settings already set as the default. The PrintSmart program also requires most printing devices be moved onto the university's main network in order to track and combine institutional volumes. This allows the PrintSmart administrators to locate low usage equipment, which can be combined elsewhere or eliminated to further promote cost and energy savings. Very few areas retain non-networked equipment. As a result of the more efficient units and the overall reduction in the number of copiers, printers, scanners, and fax machines, energy usage for this equipment has decreased from 311,227 kWh in 2011 to 175,247 kWh in 2013, a 56.31% reduction in energy usage. The related energy cost savings for this time period is approximately $23,117.00 per year.

Eliminated Screen Saver Usage

Completed as of May 2013, UNH IT is no longer configuring screen savers on UNH IT-managed workstations and has instead adopted the practice of using computer power management settings to shut screens off or go into "sleep mode" when not in use.

End of Life Management for Electronic Equipment

The UNH IT Safe Electronic Equipment Disposal (SEED) Program, which began in early 2010, provides for the safe disposal of employee-purchased UNH surplus equipment with data storage capabilities, including computers and mobile devices as well as other equipment that may contain circuit boards or other electronic parts, such as monitors, printers, peripherals, scientific equipment and audio-visual equipment. Even the occasional office toaster has found its way into the SEED Program rather than the landfill. Revenue generated by the SEED Program has resulted in actual funds being returned to UNH ($28,374.85 from March 2010 to May 2013), which in turn are used to fund the program. In addition, more than 16 tons of electronic equipment that would have been headed for the landfill have been either reused or recycled properly. UNH's student recycling initiative, Trash-2-Treasure, began working with

UNH Housing and the SEED Program in 2012 to deal with student e-waste. The collaboration was expanded in summer 2013 to include a large quantity of other types of UNH surplus property.

Power Down Events

Since 2006, the UNH Energy Office and Sustainability Institute have provided outreach (email and notices in campus publications) to students and employees to "power down" electronics during Thanksgiving and winter break. This is now a regular communication in *Campus Journal.*

Priority Goals, Actions and Timelines

Short Term Goals:

Promote Energy Smart Purchasing and Working Guidelines for Faculty and Staff

The UNH/USNH Purchasing and Contracts Services Office, which oversees purchasing functions at UNH, currently offers purchasing training to new employees and those changing to a position that requires them to make purchases for the department or the institution. Part of the training includes a discussion and handout on purchasing Energy Star equipment. The training materials should be updated to include additional information on other ways to save energy through buying decisions. In addition, new UNH Procurement Card (Pcard) users are given Pcard-specific training by the USNH Controller's Office prior to receiving their card. Purchasing will request that recommendations for Energy Star purchasing are promoted during Pcard training.

Intermediate Goals:

Research Projects / Case Studies to Assess Plug Loads

The ETF should engage one or more professors and groups of students in creating and conducting a limited study of the campus community in order to better understand plug load as a percentage of overall campus energy usage.

Identify and Act Upon Easy Wins / Higher Draw Plug Loads

Over the next 18 months, ETF could research and focus on the following areas that are considered to be "low hanging fruit" in terms potential energy savings across campus:

- **Vending Machines**: Engage Purchasing as well as applicable departments to work with vending suppliers to provide more energy-efficient, fewer and more centralized drink and snack vending machines.
- **Water fountains**: Due to the many drink refilling stations that have been placed in campus buildings in recent years to encourage the use of refillable water bottles, there

is no longer a need for the older, traditional wall-mounted, electric water fountains still run in many of the older buildings. The ETF could locate and unplug the units, which could result in an energy savings of approximately 8-10KWhr/week per unit.

Implement IT/Plug Load Awareness Campaign

The ETF could enlist one or more professors and students to create an awareness brochure that could be placed in the packets distributed to new employees by UNH Human Resources and by the Admissions Office for incoming students. The brochure would direct recipients to links/pertinent information on the UNH Sustainability, IT, Purchasing, and other websites. We could also provide a statement from UNH leadership showing and encouraging support to bolster success. The brochure might include information such as:

- Brief explanation of current sustainability energy and climate goals of the institution
- Illustration of one person's energy usage in "real" terms (e.g., gallons of gas, tons of coal, barrels of oil, etc.)
- Common Myths Busted: e.g., power strips don't work, screen savers save energy, etc.
- What Can I Do To Help?: e.g., "Do's and Don'ts of Energy Usage at UNH & Beyond….."
    - Screen Savers
    - Power Strips
    - Projectors and Large Screens
    - Phantom Power usage
    - Refrigerator set temps
    - Space Heaters
    - Personal Window AC units
    - Power down over weekends and overnight.
    - Make a distinction between students and faculty/staff as their usage patterns are quite different

Long-Term Goals:

Investigate Network Based Energy Monitoring

UNH IT is looking into the possibility of using network-based tools to monitor power usage of network-enabled devices.

Create and Implement and EPEAT Purchasing Policy Across Campus

The ETF should begin the process of working with others across campus, including but not limited to UNH IT and USNH Purchasing, a formally adopted institution-wide stated preference to purchase computers and/or other electronic products that are EPEAT registered or meet similar multi-criteria sustainability standards for electronic products. EPEAT is a comprehensive global environmental rating system that helps purchasers identify greener computers and other electronics and is run by the Green Electronics Council. The policy could state that those who purchase electronics like computers (including UNH IT, the UNH Computer Store, and UNH purchasing card holders) purchase only EPEAT-rated products except in certain circumstances, such as a need for a particular piece of scientific or laboratory equipment that isn't EPEAT rated.

Create Enterprise IT Energy Guidelines for Labs, Servers and Data Centers

Over the next 2 years, the ETF could bring groups across campus together to develop energy smart guidelines for areas that have high concentrations of computers, servers, monitors and other supporting IT equipment. Equipment in such environments is often “always on” and typically has high power density, ensuring that conservation and efficiency advances made here will have a big impact. These guidelines could include the following:

Computer Labs

- Use available management tools to manage power in labs and apply policies where not in place already.
- Use Virtual Desktops and thin clients where possible.

Servers

- All new and replacement servers should be virtual unless it is not technically possible or there is a compelling business case to do otherwise.
- Physical servers and IT equipment should be configured and ordered with highest efficiency power supplies, low power processors, and SSD drives where practical available. (Similar to EPEAT but for servers).
- Physical servers should be retrofitted with high efficiency power supplies.
- Servers should be hosted in Campus Data Centers to maximize cooling efficiency, consolidate supporting network infrastructure, and capture energy usage.

Data Centers

- Lights off when not occupied.
- All new branch circuits provisioned in higher voltage where possible – ex. 208 vs 120.
- Main power monitoring should be installed in data centers and computer rooms.
- IT facility operators should use latest ASHRAE TC9.9 temp and humidity set points.
- Temperature sensors should be placed at IT equipment air inlets and should be moved out of return pathways.
- IT facility operators should consider aisle containment and segmentation of supply and return air. They should also correct air leakage and eliminate short cycling.
- When replacing AC, buy high efficiency CRAC units and use high efficiency filtration in those units.
- Consider cooling economization and free air cooling when and where possible (seasonal efficacy).
- Regularly balance UPS and panel electrical loads to free stranded capacity and reduce average load.
- Reduce frequency of backup generator tests (e.g., monthly rather than weekly)
- Record and report energy usage on a regular basis

Implementation and Evaluation

As listed with each priority action, implementation of these initiatives will be encouraged and overseen by the ETF and its IT and Plug Load committee, with the assistance of research faculty, students, and staff, including Energy Office staff, to develop, implement, and track impacts. We would also recommend that the ETF (or another source) provide additional "incentives" to students, faculty, and staff, to encourage and reward participation in campus-wide initiatives such as Thanksgiving and winter break power downs. Such incentives could be as simple as small individual items directly related to energy savings, larger group items, or one large item. Incentives can promote greater participation and a sense of fun and competition between groups, and the UNH community deserves to be recognized for helping the institution achieve its energy goals.

The success of these initiatives will be measured through:

- Measurable energy reductions in targeted locations through the use of baseline- to-final comparisons.
- Measurable cost savings in targeted locations through the use of energy use reductions and applicable before-and-after energy costs.
- Measurable emissions reductions as captured by the university's greenhouse gas emissions inventories.
- Increased participation in events such as holiday power downs.
- Responses to a formal survey of the campus community to determine whether or not the initiatives are working from their vantage points.

Transportation

Achievements To Date

The "Walking Campus"

The fundamental framework for transportation demand management (TDM) at UNH is the "walking campus." That term is deliberately chosen to actively reflect and describe our overarching goals of enhancing the walkability, bikeability, and transit accessibility of the campus per the program set forth in the UNH Campus Master Plan and adopted transportation policies. Included in that mission is a fundamental goal to reduce private vehicle and single occupancy vehicle (SOV) traffic while improving access to core campus for all visitors.

Specific successes include:

- Decade long expansion of the Wildcat Transit/Campus Connector transit systems, which are free-fare to UNH Durham community members. The system now connects nine communities and carries over 1.2 million passenger trips per year. The fleet runs on Biodiesel (B20) and compressed natural gas (CNG), and is one of the cleanest in New England.
- Renovation of the UNH Durham train station to host Amtrak Downeaster passenger rail service and intercity bus services. Combined it is estimated that these services replace over 80,0000 long distance intercity trips per year.
- Introduction of ZipCar car-sharing to campus in 2010.
- Reconstruction of key streets (Main Street, College Road) to include full bike lanes and improved transit and pedestrian accommodations.
- Introduction of NextBus™ real time transit information in 2013.
- 2013 Pettee Brook/Quad roundabout: traffic and air quality (AQ) modeling completed in advance of Congestion Mitigation and Air Quality Improvement (CMAQ) Program (CMAQ) grant application.
- Ongoing sidewalk enhancements/replacements and bike rack installations.
- Award of Federal Transition Administration (FTA) Bus Livable Community funding ($190,000) to expand bike infrastructure, study final build out of the UNH Transit Center, and develop new bus pullouts and sidewalk connections on Main Street West. (Projects to be completed in 2014.)
- Increased utilization of compressed natural gas (CNG), representing just over 40% of transit fleet fuel and 23% overall fleet fuel use.
- Development of a town-wide UNH Durham traffic and Air Quality model used to determine project traffic and air quality impacts (2008).
- Six-year trend of reduced parking permit sales and increasing transit usage under a Transportation Demand Management (TDM) framework adopted in 2003.

- Introduction of B20 as primary diesel fuel in 2009 and incremental expansion of CNG fuel infrastructure, culminating in the 2011 construction of a fast-fill fueling station and storage on campus. In 2013, CNG represented just over 47,000 gasoline gallon equivalents (gge) of fleet fuel use.
- Introduction in 2013 of the EcoCat Vehicle Selection Calculator, which provides a standard life-cycle cost and emission evaluation of select vehicles for UNH purchase.

Clean Fleet Program

UNH is incrementally institutionalizing a comprehensive program to affect procurement of new vehicles, improve fuel efficiency, and reduce emissions of the existing on-road and off-road vehicle fleet. The program encourages overall motorized fleet reduction, improved utilization, and right-sizing through proactive promotion of high efficiency, low emission vehicles to replace existing fleet. The university is adopting coordinated polices and practices affecting procurement and operations that ensure UNH meets or exceeds all federal and state fleet emissions rules and that demonstrate a leadership role in the use, management, and growth of clean and alternative fueled fleet vehicles. This program will include expansion of EcoCat, rightsizing, and efforts to maximize fleet efficiency and to minimize operations cost, petroleum fuel use, motorized vehicle-miles-traveled (VMT), and emissions.

In 2013, UNH developed the EcoCat Vehicle Selection Calculator. The online, downloadable spreadsheet tool is updated annually with a pre-screened set of vehicles across vehicle classes. The calculator offers standardized efficiency and emissions ratings as well as life-cycle cost evaluations for a menu of UNH-recommended (or user input) vehicles. In addition, standardized methodologies and fiscal year reporting for mileage, fuel consumption, and alternative fleet composition is underway, including the first step of moving towards average miles per gallon (mpg) for sedans.

UNH fleet management –- handled through the maintenance garage and Transportation Services -- has fleet management staff who participate in the development and implementation of these goals and are familiar with fleet efficiency technologies, U.S. Environmental Protection Agency (EPA), U.S. Department of Energy (DOE), and U.S. Department of Transportation (DOT) funding programs and state air quality and energy initiatives. Campus Planning collaborates with this fleet management team. As an active participant in the Granite State Clean Cities Coalition, UNH strives to demonstrate best practices in the introduction of alternative fuel technologies. The university also seeks to identify underutilized vehicles for culling and/or replacement with non-motorized mobility or transport options for goods and people. UNH Facilities also works to identify new or modified infrastructure needs for continued expansion of a mixed alternative fuel fleet portfolio. This coordinated team, in conjunction with UNHSI, also develops standardized data metrics for fuel efficiency, fleet mpg, and other statistics used for national and comparator benchmarking.

UNH publishes annual reports on transit ridership and fuel consumption (including specific biodiesel (B20), compressed natural gas (CNG), and overall fleet fuel and mileage) statistics. These are produced by UNH Facilities with the cooperation of the NH Department of Transportation (NHDOT) and University Transportation Services. The reports show usage back to Fiscal Year 2006 and future FY projections.

Expanded Transition to Compressed Natural Gas (CNG) Fleet

In 2011, UNH completed a significant milestone: upgrading its compressed natural gas (CNG) station to fast-fill with storage capacity and completing renovation of its vehicle maintenance facility for CNG equipped vehicles. In addition, UNH staff were trained in CNG safety and tank inspection procedures. These steps were the culmination of a 10-year plan of incremental upgrades. In Fiscal Year 2013, the first year after completion, the CNG station dispensed over 47,000 gge of natural gas for UNH and other public agency fleets. The most recent new vehicles purchased in January 2013 for the UNH transit fleet were CNG powered, and the UNH transit fleet is now over 40% CNG powered (the remainder is B20). UNH has over 30 CNG powered vehicles on campus. This effort represents UNH's most significant clean fleet venture and provides a solid foundation for future expansion of CNG as a focus fuel for the alternative fuel vehicle fleet.

Completed Transition to Ultra Low-Sulfur B20 (ULSD)

UNH transit completed its transition to year-round biodiesel (ultra low-sulfur B20). UNH transit diesel vehicles are now 100% B20, and non-transit vehicles are near 85% compliant (pre-1990 and new warranty vehicles prevent 100% compliance). In Fiscal Year 2013, this represented consumption of over 86,000 gallons of B20, a net reduction of over 17,500 gallons of petroleum diesel.

Wildcat Transit and Campus Connector Transit System Service Enhancements

The UNH Wildcat Transit and Campus Connector transit systems provided over 1.2 million passenger trips in Fiscal Year 2013. This is estimated to represent over 5 million total passenger miles of travel. It is the largest transit system in the state based on ridership and runs one of the largest alternative fueled fleets in northern New England. The system connects 10 communities to UNH Durham and operates four regional and six on-campus routes, all open to the public. UNH is also a direct FTA recipient with funds used primarily for capital equipment. The vast majority of UNH transit operations are locally funded by the university community. Other successes to date include:

- NextBus: In 2013, UNH released real-time transit systems information via the web, mobile and text apps, and digital signage. The effort was CMAQ funded.
- Automatic passenger counting systems were implemented in Wildcat Transit vehicles.
- Increased frequency on the Wildcat Transit Route 4 was added with five years of NHDOT funding.
- New Wildcat Transit Route 125 Rochester service was added with three years of federal support.

Employee Telecommuting

In 2012, UNH put in place a new Workplace Flexibility policy for staff after a campus-wide Flex Work Task Force crafted a policy and implementation recommendations throughout 2011. Staff can meet with their supervisors to discuss the appropriateness of several types of workplace flexibility depending on their position and type of work: compressed work week, flex-time, part-time/reduced time, flex-year, and teleworking/remote work**.** Emissions reductions are generated in two areas: lower commuting emissions and reduced electricity use.

Priority Goals, Actions and Timelines

The following policies and practices influence the university-owned fleet and related transportation infrastructure and programs in coordination with the Transportation Policy Committee (TPC) and UNH Campus Master Plan.

Short Term Goals:

Submit for FTA Bus-Livable Community Grant Funding (Fiscal Year 2014):

- Morse Circle Bike Parking Hub.
- Main St West bus pullouts; extended Main Street West pedestrian/bike path system.
- Rail Station/Transit Center North Canopy Development Study (architectural and engineering alternatives).

Fine-tune and promote NextBus (real-time transit systems).

Expand use of targeted email, social media, and UNH application suite for promotion of Wildcat Transit and other alternative transportation services at UNH.

Redesign western Campus Connector routes to use West Edge Connector Road.

Submit Pettee Brook/Quad Roundabout CMAQ grant application in FY 2014.

Pursue Wildcat Transit Fleet Replacement: ongoing. CMAQ Grant application in FY 2014.

Develop South Drive Transitway*:* Ongoing efforts to complete final designs and secure funding for this high priority in the UNH Campus Master Plan. CMAQ 2014 Application.

Expand Bicycle Facilities and Route Accommodation in Repavement and Reconstruction Projects.

Expand CNG Station Storage and Backup Power: CMAQ Grant FY 2014.

Introduce Pay and Display Technologies to UNH Parking Facilities: the introduction of pay and display kiosks by UTS (expected in 2014) offers the opportunity for UNH to modernize its parking rate systems to promote TDM principles, enhance revenues, and improve core campus accessibility.

Enhance Fiscal Sustainability of the UNH Transportation System Through User Revenue Enhancements and Value-Based Pricing Strategies consistent with University principles, environmental strategies, and community access and mobility needs.

Long Term Goals:

Continue evaluation of opportunities to modernize the UNH parking permit system consistent with adopted principles and labor agreements, to expand visitor access, and to enhance the financial sustainability of the UNH transportation system.

Implement an incentivized Infrequent User parking permit program for those who opt out of purchasing an annual permit.

Evaluate electric vehicle (EV) charging infrastructure and UNH EV niche fleet (FY 2015).

Expand Cat Cycles and or other projects to improve bike culture at UNH

Strengthen anti-idling provisions: In coordination with the NH Department of Environmental Services determine targeted internal and external client education campaign to increase compliance with no-idle rules for campus and visiting vehicles. Campaign will include directed outreach, signage and enforcement.

Increase allocated funding for UTS annual marketing program of transit and other non-SOV alternatives.

Build Out the Intermodal Transit Center – Final Phase: Based on findings of a feasibility study to be completed in 2014, the university should fund or seek grant partnerships for final build out of the Transit Center/Dairy Bar facility to enhance this intermodal hub.

Review the Possibility of a Wildcat Transit: East-West Connection (UNHM and Concord): Funding needed; potential pilot service or public-private venture connecting with NH 101 Portsmouth-Manchester Flightline service which began in fall 2013

Pursue ongoing streetscape improvements to improve the mobility of the campus with a focus on transit, walkable and biking modes.

Implementation and Evaluation

- Led by Campus Planning, University Transit Services and UNH Facilities
- Involvement of Transportation Policy Committee (TPC) and ETF and collaboration with Town of Durham and NHDOT
- Regular transportation surveys and annual data reporting. Ongoing presentations to the TPC and ETF.

Campus Energy Production and Renewables

Achievements To Date

Energy Efficiency Fund (EEF)/Public Utilities Commission (PUC) Grant

Kingsbury Solar Preheat Ventilation

The installation of 2,600 square feet (sf) of solar heated air system was completed in 2013. The system is installed over the south facing wall of the rooftop penthouse and is connected to the existing fresh air intake louvers of two air handling units (AHUs). When the AHU's draw significant volumes of fresh air into the building during winter, the fresh air passes through the solar wall system where it is heated by the sun as it travels through the wall cavity. This increase in temperatures significantly reduces the amount of energy required by the AHU's to heat the air back up to the supply temperatures. Since it is simple in concept, the system has no moving parts other than a bypass/cooling damper that will open in the summer months or as needed when temperatures from the solar wall system are higher than what the building needs. The wall system therefore becomes like a custom wall mounted “glasshouse” with a continually re-occurring volume of warm air.

Conversion to Natural Gas

In Gregg Hall and the Chase Ocean Engineering building, petroleum based fuel systems were converted to systems using cleaner natural gas.

EcoLine™

EcoLine™ is a landfill gas-to-energy project that uses purified methane gas from a Waste Management landfill to provide up to 85 percent of campus power. When EcoLine™ started in May 2009, UNH became the first university in the nation to use landfill gas as its primary fuel source. EcoLine™ is a partnership with Waste Management’s Turnkey Recycling and Environmental Enterprise (TREE) in Rochester, where the naturally occurring by-product of landfill decomposition is collected via a state-of-the-art collection system consisting of more than 300 extraction wells and miles of collection pipes. After the processed landfill gas (PLG) is purified and compressed at a UNH processing plant at TREE, it travels through a 12.7-mile-pipeline from the landfill to UNH’s cogeneration plant, where it replaces commercial natural gas as the primary fuel source. In operation since 2006, UNH’s cogeneration plant captures waste heat normally lost during the production of electricity and uses this energy to heat campus buildings. UNH is selling the renewable energy certificates (RECs) generated by using landfill gas to help finance the overall cost of the project and to invest in additional energy efficiency projects on campus. To handle any additional landfill gas that is generated by the project, a second turbine runs solely on extra landfill gas for power to be exported for sale to the New England power grid. PLG is also the primary fuel for the backup heating plant that

serves the campus when the cogeneration facility cannot meet maximum load or if that system is offline.

Additional Output Modification to Steam Turbine in Boiler Plant

An existing steam induction generator at the campus central plant had been in operation for 15 years converting high pressure steam to low pressure, while allowing for generation of up to 400 kW. Recent modifications have increased the output potential of that system to 595 kW for year round production utilizing the same amount of byproduct steam created from the campus cogeneration system. Equivalent to an average solar panel installation at 100 homes, this additional 195 kW becomes available without having to modify any of the existing system's operation.

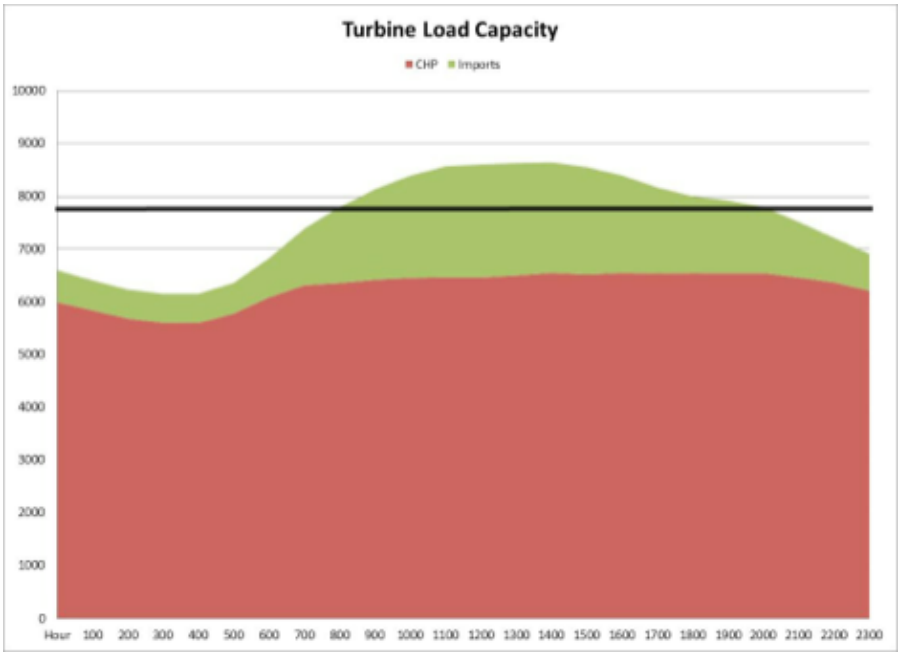
Solar Process How Water at Parsons

During renovation of Parsons Hall, a new solar hot water system was installed for hot water production for lab processes. The system contributes to supplying the overall process hot water load in the building for year round use.

Priority Goals, Actions and Timelines

The current capacity of onsite generation at UNH hovers around the 8,000 kW level, while the demand on campus averages just below that. Unfortunately, the combined heat and power generation cannot meet energy demand at peak times, so the university must buy power from the electric grid – coincidentally at the times when energy costs are highest. The annual average load profile in Figure 2 illustrates when we have ample capacity available to meet the total campus average demand, but the emphasis will be reducing the power imports that occur during the middle of the day.

Figure 2: Annual Average Load Profile for UNH Durham



Short Term Goals:

Explore Solar Thermal

UNH will look at using solar energy to heat both air and hot water systems to lower the fossil fuel demand needed to heat these systems in buildings. A simple approach that has already had multiple installations on campus will continue to warrant investigation during any renovation and new construction design. Working with the campus standards and design team, new projects will be assessed to determine the potential for using solar thermal energy. The overall impact will be smaller than other strategies, but the implementation will be continuous on a case-by-case basis. The campus design process, utilizing in-house staff and contracted design professionals, will continue to evaluate solar thermal technology and how it can be incorporated more often in campus heating projects.

Intermediate Term Goals:

Explore a Wood Chip/Bioreactor Heating System at Fairchild Dairy

The project is a combined approach taking advantage of multiple technologies to serve a common cluster of buildings for various space heating and domestic hot water demands. As part of the university's College of Life Science and Agriculture (COLSA), the cow barn facilities currently collect manure from 125 milking cows. Many years ago, an anaerobic digester was installed as part of a research project that never became operational. This proposal looks to revamp the system to allow for space heating while combining additional renewable technologies to serve the same cow barn facility and up to seven additional buildings all located in a cluster surrounding the cow barn building. One of these buildings is a newly constructed dairy research and teaching building and another is a childcare facility. Combined, we will refer to the area as the Dairy Teaching and Research Complex (DTRC). The digester system is capable of providing 187,000 btu/hour year round. Another component of the project is an additional 500,000 btu/hr wood chip boiler to provide space heating for winter operations (approximately 6 months per year) using 300 tons per year of UNH owned wood waste (a low cost product) – an amount equivalent what's needed to run the boiler for the 6 month operation. The last component is a solar air system that will preheat the outside air required for the lone research building that requires more ventilation air to maintain indoor air quality levels and multiple fume hoods. Using all technologies and connecting the buildings via a buried distribution piping system, the new heating plant will supplant all fossil fuel heating systems that currently supply the facilities. This equates to over 2,500 MMBTU of heating oil and propane. Already designed preliminarily, the project can be implemented at any time. The installation is awaiting funding and has been proposed as an educational facility that would enable other agricultural providers to track the data of the project's performance as it operates. The ETF will continue to seek funding for the project, leverage sources that would show the benefits of the technology, and evaluate project's ability to reduce Scope 1 emissions.

Explore Photovoltaic/Wind at Offsite Locations

UNH owns properties that are not connected to its cogeneration system and therefore would be more cost effective for offsite renewable generation, i.e., Kingman Farm, Burleigh Demeritt Farm, Browne Center, Jackson Lab, Fort Constitution, TSAS Sawmill, etc. UNH research faculty and students have taken the lead on these innovative technologies. While no serious installations have surfaced to date, there is continuous evaluation of these technologies as efficiency improvements and cost reductions have been moving quickly with these technologies. It is expected that some installation will occur in the next decade.

Long Term Goals:

Research Energy Storage/Load Shifting

Although the emissions from power production on campus have dropped dramatically with the investment in onsite cogeneration and fuel switching to use processed landfill gas instead of natural gas, one of the largest remaining portions of campus emissions is imported power purchases. A top priority is to shift the use of energy from the middle of the day, when power costs are high and we need to buy from the grid at higher emission factors, to early morning hours when we have the most capacity to use our own lower emission processed landfill gas fuel source. This strategy can be accomplished using energy storage techniques like making ice for air conditioning systems at night then slowly cooling the chilled water supplies to campus buildings during the day. Another technique involves sizing a small hydro power facility that can generate power during the day at peak levels then using pumping power at night to replenish the water reservoirs that act as the power supply during the day. These strategies do not lower total energy use but shift the time it is used, which has the double benefit of using a cleaner fuel source and reducing the higher cost, more polluting power that is available during the day.

UNH students have taken the lead on researching some options for this approach. While these strategies will be capital intensive, the paybacks can be impressive depending on the resource availability and spatial opportunity. Expecting a longer than normal research phase, it would be likely that any implementation would occur farther out on the horizon. Working with students and faculty, the ETF will continue to evaluate this strategy's potential and push for implementation when the system poses positive returns.

Explore Mini Back Pressure Steam Generation

For areas needing a reduction in steam pressure within a building, UNH will explore adding the ability to create low pressure steam while allowing for electricity production using a steam driven induction generator. Already employed at the campus cogeneration facility, other areas that have steady year-round steam use could add smaller versions that are coming into the market. The technology for these smaller turbines is new and currently experimental. A good payback potential makes the possibility worth investigating as soon as the technology has been tested more in the field. Once UNH is satisfied with the potential applications, we will start our own internal reviews for potential sites. Already analyzed for steam flows, the first installation could occur at Rudman Hall, which uses steam for heating as well as air

conditioning in the summer months. The constant use provides a good test location. We expect to begin pursuing this technology before 2020 and will need to work with the local electric utility to perform a power study on all implications of adding another onsite generation source on campus. The ETF and energy staff will evaluate the performance of the project through direct metering.

Explore Fuel Conversions to Natural Gas from Oil and Propane

Where applicable, UNH will look to move away from petroleum-based fuels to cleaner natural gas. The local gas distribution company, Unitil, has expanded its service to run past more remote UNH facilities that currently use heating oil and/or propane for space heating. While it is a high priority for UNH to move away from these fuels, current capacity in the natural gas lines has been met. For UNH to expand use of the fuel, system enhancements will need to occur. The ETF and energy staff will continue to work with Unitil as the system expands. Once capacity becomes available, UNH will pursue these conversions to natural gas. It is unknown at this time when the system enhancements will occur, if ever.

Explore Hydropower

Hydropower facilities are typically found in areas that have high flow or high head (the distance of falling water from higher elevations to low). While UNH has its own water supply plant that supplies both the university and the town of Durham, the total flows from the plant average less than a million gallons a day. Currently, the reservoir that feeds the Oyster River is inconsistent with flows that may not warrant investigation into a hydro facility. Future plans have begun for a new water plant facility, which may lead to reviewing different sites that could include some small amount of hydro generation. The ETF and energy staff will continue to investigate the potential during the design phase of the water plant project. The plant will be online within the decade, and any evaluation will occur prior to the commercial operation date. If an opportunity presents itself, the use of hydropower will be monitored using onsite metering.

Implementation and Evaluation

Implementation of these initiatives will fall to the ETF collaborating with research faculty, students, staff (including the Energy Office) to develop, install, and track the technologies used on campus buildings. UNH energy staff has extensive metering in place for both energy production projects as well as energy reduction initiatives, like efficiency improvements and conservation measures. Through design improvements, UNH energy staff review new building systems to determine the possibility of using any of the technologies mentioned in this section. That process is continuous as UNH retrofits up to 10% of the total square footage of the campus in a given year. UNH has installed energy production systems as part of major renovations and system efficiency upgrades, which can utilize the campus Energy Efficiency Fund (EEF) to lower annual operating costs. Looking to renewables, state and federal incentives and grant programs can help leverage funding to make the installation of these systems more feasible. The ETF will need to champion these initiatives as both sound

investments looking at the life-cycle costs of an energy system as well as a main way to reach our campus climate targets.

Behavior/Culture

While other sections of WildCAP focus on the infrastructure-side of campus – from buildings to turbines to fleet vehicles – this sections focuses on the people-side of campus, including the daily actions of UNH faculty, staff and students while on campus or getting to, from and around campus. The GHGE from these behavior/culture aspects are the largest growing section of UNH Durham's overall GHGE inventory. Examples of UNH faculty, staff and student behavior include commuting to, from and around campus; purchasing and use of office and individual electronics and equipment; waste creation and recycling; use of bottled water; and participation in climate and energy related classes/teaching, research, and co-curricular activities.

Every recommended action in this section must be developed, implemented and evaluated in adherence to UNH's commitment to shared governance and in close collaboration with the entire campus community.

Achievements To Date

Printing and Computing

UNH has made great strides from a systems approach to eliminate personal printers and reduce wasted energy from computers, especially in staff and faculty offices. See the PrintSmart information in the "Information Technology (IT) and Plug Loads" section.

Commuting

UNH's Wildcat transit system connects eight communities to Durham and provides over 1.2 million trips per year. Wildcat Transit is free to any UNH ID holders and $1.50 for the general public. Routes run to and from Portsmouth, Dover, Newmarket, and Rochester/Lee. Wildcat Transit has also begun expanding routes to offer more times to get employees and students to and from their homes and major destinations in the area. The Campus Connecter is a free, on-campus shuttle system open to all in the UNH Durham community and runs on compressed natural gas (CNG). Wildcat Transit has released the NextBus program in fall of 2013. The program is a live tracking system that allows riders to see when the next bus will be at their stop. It is built in to the UNH mobile app and has LED screens at stops on campus displaying the times. WildCat transit has increased its ridership on average 8% annually since 2000, and has doubled ridership since 1999. This is attributable mostly to student ridership, however, and less to faculty and staff ridership. The 2011 UNH Transportation Survey found that 85% of faculty and 77% of staff drive alone as their primary commute mode to UNH in a typical week.

Sustainability Stewards

The Sustainability Stewards, a program that UNHSI managed in partnership with the ETF from 2009 to 2013, were a group of staff across campus who volunteered to learn about sustainability at UNH and share the information with others in their building and/or department. The goal was to have at least one person from each building on campus be a Sustainability Steward. Meetings entailed education and guest speakers during a monthly one-hour time lunchtime slot, during which members would learn about a different facet of sustainability on and off campus.

For two years, the Sustainability Stewards hosted a transportation challenge, a month-long event to challenge staff and faculty to bus, bike or carpool on their commute. UNH also participates annually in the Seacoast Bike/Walk to work week every spring and has consistently won the regional prize for most participation for an employer of its size.

The Sustainability Stewards are no longer a working group due to poor attendance and fear from some members that sharing sustainability information with colleagues would be considered “spamming.” UNHSI efforts have shifted to print and media-based outreach to faculty and staff. For example, a sustainability section of the weekly *Campus Journal* (an online newsletter for UNH employees) has been added to share a sustainability tip or fact each week.

Waste and Recycling

UNH’s recycling program is now 100% single stream, eliminating the need for sorting, making it easier for everyone on campus to recycle. Recycling bins are located in a variety of indoor and outdoor locations on campus. Employee-purchased electronic waste (e-waste) is recycled through UNH’s Safe Electronic Equipment Disposal program (SEED) run by UNH IT. SEED recently partnered with UNH Trash-2-Treasure, a student group that collects student waste during annual move-in and move-out, to safely dispose of student e-waste before major breaks during the academic year. To handle excess furniture and other equipment, UNH has a surplus property website where departments can sell or donate items to other departments or non-profits.

Bottled Water

UNH Dining has eliminated bottled water in the dining halls, except for what’s called “carry-out” locations like Wildcatessen, a convenience store on campus. Hydration stations have been slowly added to campus in both academic and residential buildings. These are filtered water stations that allow for a large water bottle to fit underneath. They are extremely popular with students, and UNH Housing has begun adding them to all of their buildings, doing so as other water fountains need repair or replacing.

Student Engagement

Student Sustainability Ambassadors

Various student organizations have had representation on the ETF since its inception in 2005. A variety of student representations ranging from student organization members to student senate members to graduate assistants of professors have been a part of the ETF. In 2012, UNHSI began a Student Sustainability Ambassador program based on a student suggestion. Undergraduate students apply and four are chosen to work with each of the four sustainability task forces: the Ecosystem Task Force, Energy Task Force, Sustainable Food System Task Force, and Culture and Sustainability Task Force. The Ambassadors are paid an annual stipend to work on projects assigned by the task force, to write on the UNHSI blog, and to organize an annual student sustainability summit on campus. The ETF Student Ambassador was involved in writing this update to WildCAP.

Student Sustainability Alliance

UNHSI started the Student Sustainability Alliance in 2012 as a pilot project to bring the leaders of various student sustainability related organizations together to network, cross-promote projects and events, and collaborate on sustainability efforts. The program lasted one year and brought together leads from student organizations on campus like Slow Food, the Real Food Challenge, the Organic Garden Club, NetImpact, the Student Environmental Action Coalition (SEAC), Trash 2 Treasure, the Climate Action Network (CAN), and others. Due to poor student attendance, the Student Sustainability Alliance program was not continued in 2013.

Environmental Advocates

Environmental Advocates are elected Residential Life hall council positions in every residence hall on campus. They are elected by their fellow students. These students receive regular updates of information from the Sustainability Institute to bring to their meetings and share with other students, from sustainability events to class announcements to initiatives on campus to conserve energy.

UNH Unplugged

Begun in 2006 by a UNH graduate student, UNH Unplugged is an annual competition for on-campus students to lower their energy use and GHGE. In one year, UNH dorms alone emit almost 19,000 metric tons of GHGE, the equivalent of nearly 30,000 barrels of oil. The competition is run by student volunteers with support from UNHSI, the UNH Energy Office, UNH Housing, and UNH Residential Life.

RecycleMania

RecycleMania is a 10-week waste minimization, recycling and composting competition between hundreds of schools nationwide during the spring semester. Participating in the “Waste Minimization” competition is one of UNH’s commitments under the American College & University Presidents’ Climate Commitment (ACUPCC.

Student Sustainability Column in The New Hampshire

Students have written sustainability news stories and columns in *The New Hampshire,* the UNH student newspaper, on and off since UNHSI's founding in 1997. In 2013, the weekly "Scope on Sustainability" column was written by different students from student organizations and classes and discussed a variety issues related to sustainability. The column and other sustainability news stories often appear in *The New Hampshire* depending on student author interest and availability.

Priority Goals, Actions and Timelines

As UNH continues to lower its Scope 1 GHGE from on-campus energy production and use, Scope 3 GHGE become a larger part of the university's overall emission portfolio. The biggest sources of Scope 3 emissions are faculty and staff commuting and air travel. Therefore, the top two Behavior/Culture recommended actions in this update to WildCAP are around commuting and air travel. In addition, more outreach is needed in all areas, from recycling to purchasing.

Short Term Goals:

Expand and Improve Bike, Carpool and Transit Schedules and Outreach

Wildcat Transit is underutilized by UNH staff and faculty: faculty and staff commuting to and from campus represents 25% of UNH's overall GHGE, significantly impacting air quality and our climate. Anecdotal evidence has pointed to a number of barriers that staff and faculty have when it comes to utilizing transit on campus. These obstacles should be addressed by the ETF, the Transportation Policy Committee, UNH Facilities and others to increase faculty and staff commuting outside of single occupancy vehicles. Suggestions include:

- ***Expanded Wildcat Transit schedules:*** The biggest obstacle is scheduling: Wildcat Transit follows the academic year schedule and caters to students. This means reduced service over winter, spring and summer breaks when students are gone and daily runs at peak class times, which don't necessarily coincide with an 8 AM to 5 PM, Monday-Friday workday schedule. For some staff and faculty, this reduced service does not fit with their work schedule, so they drive to campus. As of early 2014, UTS has been considering "less reduced service" during student breaks, and began piloting a change in service on the Portsmouth route due to road construction. UTS has seen a positive response from those that take transit on that route.
- ***Expanded information sharing and outreach***: While the information on carpooling, ZipCar ridesharing, Guaranteed Ride home, and other initiatives are readily available on various UNH websites, there is still a gap in how this information reaches the campus community. With student transit ridership at high levels, outreach to faculty and staff is the key target market for growth. UNH's free transit service makes us an employer of choice, and transit service should be marketed more strongly as an employee benefit. UNH should emphasize to employees the true cost of driving a car. Most commuters

only calculate the cost of gas, when the EPA's cost is currently at $0.55/mile, a number with significant savings if driving is reduced a few days per week.

Establish an Employee Air Travel Policy

The ETF will work with the TPC, BSC's on campus, UNH Chief Financial Officer, Faculty Senate, Staff Councils, and others across campus to develop a UNH Employee Air Travel Policy. The policy should state that before any faculty or staff member travels for work, they should:

- See if they can participate remotely instead of in person.
- If they must participate in person, see if the conference or event is less than 100 miles from campus and, if so, be required to take public transportation or carpool instead of flying.
- If they must attend and must fly, the traveling employee's office or department should consider donating money to UNH's Energy Efficiency Fund as a travel "offset" for the GHGE emitted by their flight.

Related to this policy, UNH Durham should invest in and publicize to faculty, staff and students more teleconferencing rooms and equipment across campus, making remote attendance at conferences and meetings easier to do.

Expand Power Down Outreach

Faculty, staff and students power down effectively over Thanksgiving and winter breaks, the two times at which major communication efforts have focused. The ETF should work with University Communications and Marketing, Residential Life, Housing, and other departments on campus to develop additional communication and educational campaigns encouraging powering down on weekends would yield increased savings.

Intermediate Term Goals:

Expand and Improve Waste and Recycling Signage

Communications and signage need to be made consistent across campus. UNH Trash-2-Treasure, which conducted an on-campus trash and recycling audit in 2013-2014, along with anecdotal evidence show that different buildings have different signs and signs are sometimes incorrect. The ETF should bring together UNH Facilities, PLAN/Trash-2-Treasure, Purchasing, Housing and others to develop improved signage and outreach as part of a UNH waste minimization and recycling plan. (See the "WALRUS" section.)

Explore Infrequent parking permits

UNH Facilities should explore the use of infrequent employee parking permits for faculty and staff who only want to park on campus occasionally. Such permits could save employees money while promoting the use of transit, carpools, ZipCap, bicycle or walking on those days employees who buy these permits do not drive to and from campus.

Expand Faculty and Staff Engagement through Partnerships with Other UNH Offices

The ETF should work with UNHSI, the Energy Office, the TPC, and others to expand the online sustainability information shared with UNH faculty and staff via emails and *Campus Journal*. This expansion could including:

- Sharing weekly reminders for energy savings, waste minimization, etc., on UNHSI and other departmental social media. For instance, using the Energy Office's real time online energy information, UNHSI began tweeting and posting a screen shot of its building's weekly energy use and bill, encouraging others to evaluate their own buildings.
- Regular sharing of sustainability information with the Faculty Senate and PAT, OS and EE staff councils, who can disperse the information to their respective constituents.
- A partnership with UNH Human Resources can be explored to help educate managers and supervisors about sustainability programs and actions available for them to do themselves and to share with their staff.
- The ETF and UNHSI can explore partnerships with other UNH departments and offices that share information with employees, such as UNH Health Services or the Office of Inclusive Excellence, to integrate messaging to shared audiences, increasing the impact of any one department's messaging.
- A partnership with the Research Faculty Council and the Associate Vice Provost for Research to work with research faculty, staff and students on a plan for balancing continuous laboratory energy demands with conservation needs.

Expand Student Engagement Online and Through Student-Focused Offices

As attendance and levels of engagement dwindled for UNH Unplugged, the Student Sustainability Alliance, and the Ecological Advocates, UNHSI began to phase out programs or transition them into online instead of face-to-face efforts. UNH Unplugged will continue, but as a student-lead effort, like Trash 2 Treasure.

Overall, for any student engagement effort to be successful, student leaders and offices that work directly with students -- such as Residence Life, Housing, the Office of Student Involvement and Leadership, and the Office of Multicultural Student Affairs -- should be engaged from the beginning as collaborative partners. Examples of specific projects these partnerships could work on include:

- Creating bulletin board "kits" for residential advisors to download that include information on energy savings, recycling, transit etc.
- Working with residence hall advisors to promote campaigns and awareness on campus, allowing for major issues or events to be brought to the attention of hall council members.

- Utilizing the weekly student organization email from Office of Student Involvement and Leadership to share information and tips.
- Continuing to have Student Sustainability Ambassadors and UNHSI interns communicate peer-to-peer with their fellow students via participation at student organization meetings, tabling at student events, writing on the UNHSI blog and other social media, etc.
- Continuing to have a sustainability column in *The New Hampshire* written by students on a variety of sustainability related issues.

In addition, the ETF, UNHSI and others should share student sustainability event, internship and other timely information with faculty and lecturers as early as possible so that student attendance and participation can be written in to syllabi as faculty and lecturers see fit. In addition, they can share information via Blackboard, email, or face-to-face with their students.

Long Term Goals:

Conduct a Cost/Benefit Analysis of and Outreach around Bottled Water

An evaluation of how much money is spent annually on water coolers and bottled water by UNH departments and offices should be conducted in partnership with USNH Purchasing and Contract Services. An analysis can then be done of costs and benefits of putting those funds into hydration stations near those offices, cutting the need for bottled water.

Integrate Sustainability Information into Other Campus Communications

UNHSI, the ETF, and other sustainability task forces should work through the UNHSI communications plan to partner with those offices that oversee direction communication with students and employees to have those offices include sustainability information in their communications. Offices with whom to partner include:

- Advancement (Foundation, Communications and Marketing, Alumni, etc.)
- Dean's Offices and College communications
- Facilities
- Housing
- Human Resources
- Student & Academic Services (Admissions, Orientation, Residential Life)
- Office of the President
- Office of the Provost

These information "gate-keepers" are the only ones who can integrate sustainability messaging into direct communications with prospective students and parents, current students, prospective and current faculty and staff, alumni, etc. Such integration can be done in collaboration with UNHSI and the ETF to ensure the messaging is clear, accurate, and consistent.

Implementation and Evaluation

Outreach and communication at UNH are dispersed among the colleges, schools, departments and offices across campus. As a result, sustainability-focused behavior/cultural campaigns and efforts will only be successful if done via close working relationships with those departments and offices that control the flow and content of information to faculty, staff and students. These include:

- Advancement (University Communications and Marketing, Foundation and Alumni Association)
- Residential Life
- Housing
- Faculty Senate
- College and school communications staff
- Human Resources
- Staff Councils (PAT, OS and EE)
- Student Senate, Graduate Student Organization
- Business Services Centers

The success of these efforts will be determined by:

- Numbers of readers/subscribers to and click-throughs/opens of newsletters and other e-campaigns
- Numbers of social media followers, “like’s,” and retweets
- Number of hits on websites
- Number of attendees at events
- Number of media hits/coverage of events and other campaigns
- Level of engagement witnessed after campaigns are completed, at events, etc.
- Behavior change witnessed after campaigns are completed (though causal relationships may not be able to be determined)

Focus groups, interviews and online surveys of faculty, staff and students should be used on a regular basis to gather both quantitative and qualitative data on the effectiveness of different efforts for different audiences.

Policies, like a UNH Air Travel Policy, must be developed and implemented collaboratively with groups like Business Service Centers, Deans, Faculty Senate, Research Faculty Council, Facilities, Purchasing, the Transportation Policy Committee, etc. Such a policy can be evaluated by how frequently it is followed, which could be estimated via online surveys and p-card travel purchase information collected for UNH’s biannual GHGE inventory.

WALRUS - Waste and Recycling, Offsets/Sinks, and Land Use

Due to the limitations of managing land use projects in a way that reduces campus GHGE (outside of the campus master plan), the ETF proposes that this section be reserved solely for discussing actionable targets for waste, recycling, offsets, and sinks.

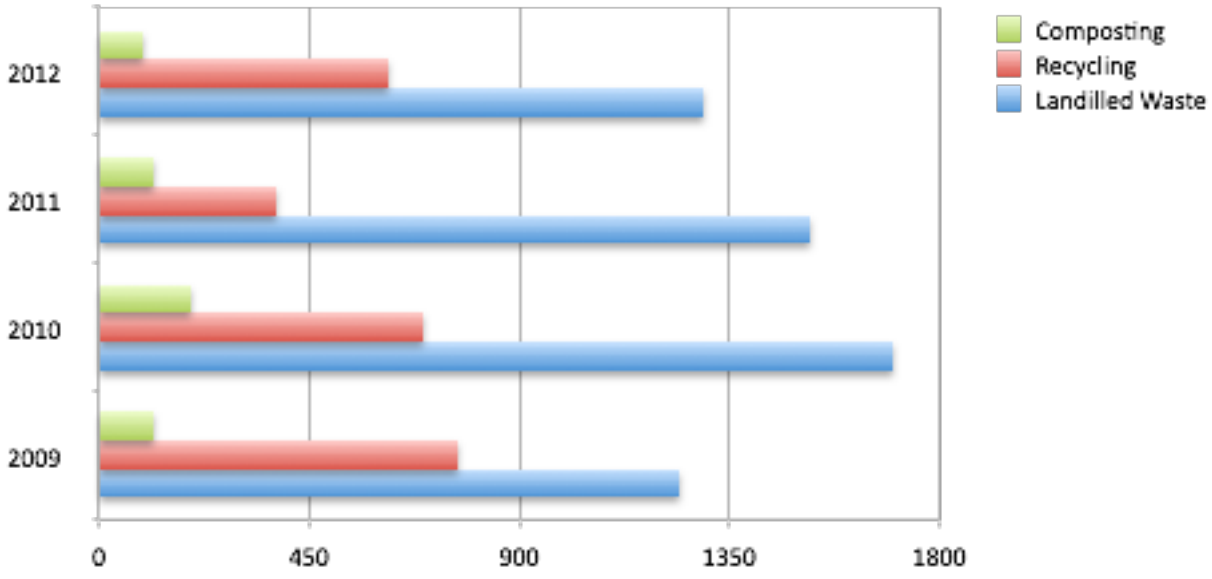
Achievements To Date

Waste Management, Recycling and Composting

While waste and recycling tonnages are calculated monthly for the university, there are no formal waste reduction targets and no cohesive, centralized strategy for managing non-regulated (i.e., hazardous, biological, and other wastes managed by UNH Environmental Health and Safety) waste on campus. Additionally, there continues to be competing interest at play for how waste should be managed stemming from the EcoLine landfill gasification project: composting programs and landfill diversion efforts essentially limit the methane output of the landfill, thereby reducing gasification levels.

Below are non-regulated waste comparison levels for 2009 – 2012 at UNH Durham. While there has been a decline in landfill tonnage since 2010, recycling and composting rates appear inconsistent over the entire four-year period. Waste and recycling data before 2009 are spotty and inconsistent.

Figure 3: UNH Composting, Recycling and Landfilled Waste Tonnage



The UNH compost program has been particularly successful. In April 2013, the Environmental Protection Agency honored UNH with its Food Recovery Challenge Achievement Award, recognizing the university for cutting food waste significantly below the previous years' levels as part of the school's campus-wide composting program. Since launching a composting program – a collaboration between UNH Dining, the UNH College of Life Sciences and Agriculture (COLSA), and the UNH Sustainability Institute -- in 1998, UNH has diverted more than half a million pounds of food waste from the waste stream and converted it to nutrient-rich compost, some of which goes to campus research farms. All UNH dining halls have installed food pulpers to pulverize food waste into small bits and extract liquid, a process that helps to facilitate the composting process. In addition to education campaigns encouraging students to minimize food waste, UNH Dining has implemented "trayless" dining in two of its dining halls, Stillings Dining Hall and Philbrook Dining Hall.

Trash-2-Treasure

Trash-2-Treasure is a UNH student-led waste reduction program that began as a way to give second life to the furniture, clothing and household items left behind by students at the end of each school year. Now in its third year of operation, all of the salvageable materials collected by student volunteers are placed in storage over the summer and then sold back to students at a steeply discounted rate at the start of fall semester at the Trash 2 Treasure yard sale.
In its first three years, the UNH Trash-2-Treasure program has:

- Diverted over 100 tons of waste from UNH's waste stream
- Achieved over $30,000 in sales
- Donated 5 tons of food and clothing to local shelters
- Saved UNH $10,000 in waste disposal costs
- Saved students and families an estimated $125,000 by selling goods at steep discounts compared with local big box stores

The founder of the UNH Trash-2-Treasure program, former student Alex Freid '13, is attempting to bring his concept to universities around the country under the heading of his 501(c)3 nonprofit called the Post-Landfill Action Network (PLAN).

End of Life Management

UNH IT Safe Electronic Equipment Disposal (SEED) program provides for the disposal of surplus equipment containing data storage, including computers and mobile devices, as well as equipment containing circuit boards – monitors, printers, peripherals, scientific equipment and audio-visual equipment. Trash 2 Treasure worked with Housing and SEED to deal with student e-waste starting in 2012, and this partnership is being expanded for 2013 and beyond to include UNH surplus property.

Construction/Renovation Projects and Surplus Property

USNH Purchasing manages surplus property. University-owned furniture and equipment are collected and posted online before being donated or disposed of, keeping usable materials out of the landfill. USNH Purchasing tracks surplus property through this system.

Construction and major renovation waste is managed by UNH Facilities and building contractors under the UNH Planning, Design and Construction Guidelines, SECTION 01 7419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL. The guidelines were updated in 2013. According to the guidelines,

> Demolition waste and construction generated waste: the contractor shall be responsible for knowing and complying with regulatory requirements. Demolition and construction generated waste shall be recycled. Refrigerants shall be recovered in accordance with EPA regulations and guidelines. Documentation of refrigerant recovery shall occur on UNH provided forms for each refrigerant. A waste management plan shall be established, and waste reduction progress reports shall be issued concurrent with each application for payment. Burning on site of waste is prohibited. All waste not recycled shall be transported off Owner's site and legally disposed of. Provide documentation of disposal for each load removed. Waste materials are not to accumulate on site and all waste waiting transport shall do be managed in a manner that will prevent spillage on adjacent surfaces and areas.

In particular, building contractors are required to:

- Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work.
- Practice efficient waste management in the use of materials in the course of the Work.
- Use all reasonable means to divert construction and demolition waste from landfills and incinerators.
- Facilitate recycling and salvage of materials.

More information can be found at http://www.unh.edu/facilities/design_standards/pdfs/chapter%205%20contruction%20standards%2012.pdf and http://www.unh.edu/facilities/design_standards/design_standards.html.

Offsets and Sinks - UNH Carbon Sequestration

A 2009 research project conducted by a UNH research faculty member and several graduate students found that UNH Durham forested lands had an annual GHGE sequestration rate of 7.33 metric tonnes per hectare (MT/ha) for the estimated 785 acres (317.6 ha) of forested land close to campus. The latest GHGE inventory (for fiscal years 2010-2011) showed that UNH Durham forested lands sequestered 2,372.6 metric tons of carbon dioxide equivalent (CO_2e). Further research is needed concerning the carbon management and sequestion from additional forest areas outside of Durham, NH, owned by the university as compared to other potential modes of land usage.

UNH does not purchase offsets or Renewable Energy Certificates (REC). In fact, the university sells the REC's associated with the electricity produced from EcoLine, using the revenues to help pay for the cost of the EcoLine project.

Priority Goals, Actions and Timelines

Short-Term Goals:

Finalize Waste and Recycling Audit and Develop a Management Plan

The university should consider implementing a “zero-waste” integrated waste, recycling and composting plan with baselines, targets, and process improvements that would not compromise the effectiveness of the EcoLine project, perhaps by focusing largely on reducing inorganic material waste (aluminum, plastic, glass, etc.). The university should also consider engaging our partners at Waste Management to develop a more coordinated waste management strategy with metrics and real-time reporting that can be accessed by stakeholders. (See Waste Management’s College and University Solutions.)

The management plan should be informed by a campus-wide waste and recycling audit performed by the Post-Landfill Action Network (PLAN) in 2013-2014. PLAN will be finishing the following tasks by June 1, 2014:

- Move-Out Waste Audit conducted of 5 dumpsters near residence halls during move-out and move-in periods and identify areas for improvement.
- Waste Audit of 7 Academic Buildings during the school year to identify areas for improvement inside classrooms.
- Discussions around industrial recycling and small construction projects.
- Discussions around best practices and designs for recycling signage/marketing and a more streamlined bin system.
- Analysis of UNH's waste disposal system and tonnage reports and identification of areas for improvement and cost savings.
- Research into the feasibility, implementation, and maintenance of various waste reduction efforts.
- Research into other area campuses to explore opportunities for aggregating waste collected among multiple campuses for greater efficiency and cost-savings, especially around waste generated in residence halls and on-campus apartments, student move-in and move-out waste, and electronic waste.

A UNH “zero-waste” plan could include recommendations like:

- Creation of a UNH Zero-Waste Task Force and possibly the hiring of a zero-waste coordinator.
- Development of a series of goals and policies to move campus in the direction of zero waste by a certain deadline.
- Collaboration across multiple departments, units and offices to find opportunities for waste collaboration and aggregation of materials.
- Streamlined waste and recycling bins and marketing across campus inside and outside buildings.
- Improved communication and marketing around waste minimization, recycling and composting for faculty, staff, students, and campus visitors.
- Improved small project construction and demolition waste management and recycling.

- Pilot monitoring of dumpster placement and emptying schedules.
- Improvements to the UNH composting program.
- Building relationships with vendors to research end-of-life product take-back and recycling opportunities.
- Development of zero-waste event guidelines.

Intermediate Goals:

Institutionalize Trash 2 Treasure

While the Trash-2-Treasure program continues to be a great benefit for the university, it remains a student-led volunteer effort. UNH should consider formalizing a long-term commitment that would enable the program to live on in perpetuity. This commitment should be tied in some form to the campus-wide waste reduction goals laid out in the previous section and continue to involve and promote student leadership and engaged scholarship of the campus as a living laboratory.

Maintain and Expand the UNH Composting Program

While the composting program may be considered a drag on the effectiveness of the EcoLine project, it is one of the few areas of on-campus waste management where an output (food waste) can be looped back into the university as an input (high-nutrient soil supplement). Therefore, the UNH composting program should be maintained and expanded as part of the overall waste management portfolio of the university. In addition, UNH Dining should continue to expand its goals of lowering pre-consumer and student plate food waste.

Long-term Goals:

Research Offsets and Sinks

While the university owns and maintains several hectares of forested land around the state, these lands should not be declared as carbon offsets to on-campus emissions. To ensure that the carbon sequestered by forest preservation is a real and “additional” offset, the Intergovernmental Panel on Climate Change (IPCC) recommends that existing forestland not be accounted for as an offset. Counting existing forestland is considered “business as usual” and does not represent an additional removal of GHGE from the atmosphere. That being said, the UNH Campus Master Plan and committees that weigh in on campus land use, such as the Ecosystem Task Force, should prioritize land conservation and forest and farm preservation where appropriate. In addition, they should continue to work with the ETF and UNHSI to continually evaluate and update the carbon management and sequestration potentials of UNH-owned forested land and farms, including land not immediately next to the UNH Durham campus.

This WildCAP update assumes that the university will continue to sell the RECs associated with EcoLine at least through 2020.

Implementation and Evaluation

Any waste, recycling, composting or offset/sink policies or practices should be implemented by campus-wide committees or groups to ensure shared governance and in recognition of the fact

that waste, recycling and composting responsibilities are decentralized and distributed across campus. For example a UNH Zero-Waste plan or task force should be developed, implemented and evaluated by:

- Athletics
- College of Life Sciences and Agriculture
- Dining
- Energy Task Force (ETF)
- Environmental Health and Safety
- Facilities, including Campus Planning; Design and Construction; Grounds and Roads; and others
- Housing
- Information Technology
- Purchasing
- Residential Life
- Sustainability Institute
- Trash-2-Treasure
- University Communications and Marketing
- Others

Such a cross-campus group could be coordinated by the ETF. Efforts will be evaluated by GHGE reductions (as tracked in UNH's biannual GHGE inventory) and waste, recycling and composting data collected and reported by a variety of these units, including as part of efforts like STARS and EPA's RecycleMania, WasteWise and Food Recovery Challenge programs.

REC sale decisions involve the USNH Board of Trustees, the UNH President and Cabinet, and others.

Adaptation

Adaptation is a new area of climate work for UNH, and this update to WildCAP recommends the formation of an ETF subcommittee that would bring faculty, staff, students, and external partners (like the Town of Durham and the State of New Hampshire) together as appropriate to assess the climate change impacts the university is already facing and will have to face in the coming years and recommendations for responsive policy and practice changes. Any subcommittee or other group formed to focus on UNH climate adaptation should follow standards of shared governance and be transciplinary in nature. Any future updates to WildCAP, then, should include a details adaptation section with short-term, intermediate, and long-term goals.

Overall Implementation and Evaluation

Implementation of recommended actions will require coordination across all units of the campus. At the beginning of each academic year, the ETF will review the list of recommended actions and select priority items for implementation in that year. Priority actions will be determined using the following criteria:

- Overall emissions reductions
- Cost saving potential
- Ease of implementation
- Relation to other campus activities (e.g., a building renovation would prioritize any actions associated with that building)
- Additional criteria that may speed the implementation of the project.

Selected actions for the year will be brought to the President's Cabinet for approval to proceed. A subcommittee consisting of ETF members as well as key faculty, staff, and students essential to implementing the action, will be established for each selected action. Subcommittees will report monthly at the ETF meetings until the action is completed. Actions that will require a long implementation process will be broken into definite, achievable goals that can be completed over the course of one academic semester.

UNH has established procedures for the development of institutional policy that are already in place. These guidelines can serve as the basis for implementation teams working to develop one of the recommended actions in the previous sections into an instituted policy. Additionally, the university has processes in place for the review of constructions projects, submission of projects for funding under the repair and renovation budget process, and other mechanisms that can be utilized by an implementation team to help bring a recommended policy to completion.

Financing

Actions will be financed through two primary mechanisms. The university's Energy Efficiency Fund (EEF) will be used as a primary source for ongoing funding of energy savings projects with a significant cost savings that can be recouped by the fund. Additional funding will need to be prioritized within existing internal funding mechanisms and external sources as available as part of implementation.

UNH Energy Efficiency Fund (EEF)

Starting in fiscal year 2010, UNH began funding energy efficiency projects through its new Energy Efficiency Fund (EEF). The intent of the fund is to capture all energy cost savings associated with energy efficiency retrofits through an internal collection mechanism similar to a systems benefit charge (SBC) that are common within electric and gas utilities in the country. The captured savings, as collected through the SBC, is returned to the EEF fund balance to further invest in retrofit projects that will yield energy savings. UNH has two types of end users on campus: the first is the larger set of buildings used for academic and research purposes and the second group serve the student population for dining and housing. Since student service organizations collect their funding from fees, they are charged a consumption based

fee for all utilities. The academic facilities (the larger percentage of buildings, as well as the more inefficient) are funded through research grants and tuition, making it difficult to recover costs across departments and schools. These groups, therefore, are charged for utilities on a square foot basis. This is a deficiency in the school's accounting system that is being addressed, but is unlikely to change in the near term. With student service organizations paying for utilities based on consumption, there is a direct incentive for energy conservation. That incentive does not exist in the square footage methodology, as all costs are spread across all end users. Therefore, the EEF will fund efficiency projects in these buildings to lower operating costs and save energy. The tracked savings will be forecast for the following fiscal year and applied to an average BTU (British thermal unit (general energy unit that can be traced to all energy consumed on campus)) rate to determine the total funding required for the EEF in that upcoming fiscal year. That budget amount will be allocated evenly across all academic buildings through the existing square footage allocation methodology. The true savings will be reconciled over the next year and added/subtracted from the EEF balance. The captured savings for each project will be tracked over the lifetime of each project's expenditure. Although only the student service organizations are charged based on actual consumption, all buildings on campus are metered for end use energy consumption. This metering (over 600 meters campus-wide) allows us to track the impacts of each project to modify what the projected savings were during budget development. Using the International Performance for Measurement and Verification Protocol (IPMVP) standards, UNH will only recover quantified savings from its investments. The establishment of this fund allows for investment in energy efficiency, which has been lacking in this past decade, to further our campus goals of greenhouse gas reductions but also becomes a dedicated funding mechanism that need not seek funding approval each budget cycle. The savings generated have provided its needed revenue stream. It also becomes an established fund that others (grants, gifts, etc.) can contribute to knowing that a successful return on investment will be achieved.

Renewable Energy Certificates (RECs)

The landfill gas utilized by the EcoLine project is classified as a renewable resource, enabling electricity generated from it to be sold as Renewable Energy Certificates (RECs) for purchase by entities needing to meet regulatory or voluntary commitments for emissions reduction or renewable energy development. The purpose of RECs is to further the development of renewable energy and reduce overall energy consumption in the region.

This WildCAP update assumes that the RECs generated by EcoLine will be sold through 2020. Revenue from these sales will go towards paying the cost of the EcoLine project. Additional revenues will be added to the energy efficiency fund to finance additional projects on campus.

Evaluation

The progress made on this plan will be evaluated in the following ways:

Greenhouse Gas Emissions Inventory

The university's greenhouse gas emissions will continue to be tracked annually by UNHSI and presented to the university in a biannual report developed by the ETF. This report will serve as the basis for UNH's reporting requirements to the ACUPCC.

Individual action evaluation plans

Each area of this plan has embedded within it a plan for evaluation. As actions are implemented, they will be tracked and evaluated by the implementation teams. Progress will be reported on a regular basis to the ETF.

Annual report to the President's Cabinet

The ETF will report at the end of each academic year to the President's Cabinet regarding the progress made that year on its WildCAP goals.

Comprehensive, 10-year evaluation report

In 2019 the ETF will conduct a comprehensive evaluation of its progress to date beginning with the establishment of WildCAP in 2009. This evaluation report will highlight successes and challenges encountered over the past decade, and will identify the key next steps moving forward. The report will be presented to the President's Cabinet and to the university community.

Appendix A: WildCAP Update Recommended Actions

Category	Action
Campus Buildings	• Install Lighting and Lighting Controls • Continue Retro-Commissioning Program • Review Demand Controlled Ventilation • Review Feedback Mechanism to Modify Heating Controls (Central Plant HW) • Install Occupancy Controls • Exolore Distribution Piping Insulation (Mechanical Spaces) • Research Remote Building Energy Management Systems • Explore Mini Back Pressure Steam generation • Pursue Fuel Conversions to Natural Gas from Oil and Propane
Information Technology and Plug Loads	• Promote Energy Smart Purchasing and Working Guidelines for Faculty and Staff • Research Projects / Case Studies to Assess Plug Loads • Identify and Act Upon Easy Wins / Higher Draw Plug Loads • Implement IT/Plug Load Awareness Campaign • Investigate Network Based Energy Monitoring • Create and Implement and EPEAT Purchasing Policy Across Campus • Create Enterprise IT Energy Guidelines for Labs, Servers and Data Centers
Transportation	• Submit for FTA Bus-Livable Community Grant Funding • Fine-tune and promote NextBus (real-time transit systems) • Expand use of targeted email, social media, and UNH application suite for promotion of Wildcat Transit and other alternative transportation services at UNH • Redesign western Campus Connector routes to use West Edge Connector Road • Submit Pettee Brook/Quad Roundabout CMAQ grant application • Pursue Wildcat Transit Fleet Replacement • Develop South Drive Transitway • Expand Bicycle Facilities and Route Accommodation in Repavement and Reconstruction Projects • Expand CNG Station Storage and Backup Power • Introduce Pay and Display Technologies to UNH Parking Facilities • Enhance Fiscal Sustainability of the UNH Transportation System Through User Revenue Enhancements and Value-Based Pricing Strategies • Continue evaluation of opportunities to modernize the UNH parking permit system • Implement an incentivized Infrequent User parking permit program • Evaluate electric vehicle (EV) charging infrastructure and UNH EV niche fleet • Expand Cat Cycles and or other projects to improve bike culture at UNH • Strengthen anti-idling provisions • Increase allocated funding for UTS annual marketing program of transit and other non-SOV alternatives • Build Out the Intermodal Transit Center • Review the Possibility of a Wildcat Transit: East-West Connection (UNHM and Concord • Pursue ongoing streetscape improvements to improve the mobility of the campus with a focus on transit, walkable and biking modes.
Energy Production and Renewables	• Explore Solar Thermal • Explore a Wood Chip/Bioreactor Heating System at Fairchild Dairy • Explore Photovoltaic/Wind at Offsite Locations

Category	Action
	• Research Energy Storage/Load Shifting • Explore Mini Back Pressure Steam Generation • Explore Fuel Conversions to Natural Gas from Oil and Propane • Explore Hydropower
Behavior/Culture	• Expand and Improve Bike, Carpool and Transit Schedules and Outreach • Establish an Employee Air Travel Policy • Expand Power Down Outreach • Expand and Improve Waste and Recycling Signage • Explore Infrequent Parking Permits • Expand Faculty and Staff Engagement through Partnerships with Other UNH Offices • Expand Student Engagement Online and Through Student-Focused Offices • Conduct a Cost/Benefit Analysis of and Outreach around Bottled Water • Integrate Sustainability Information into Other Campus Communications
WALRUS (Waste and Recycling, Offsets/Sinks, and Land Use)	• Finalize Waste and Recycling Audit and Develop a Management Plan • Institutionalize Trash 2 Treasure • Maintain and Expand the UNH Composting Program • Research Offsets and Sinks
Adaptation	• Form a cross-campus adaptation subcommittee of the ETF • Research and write a report detailing the climate change impacts UNH may face and suggested policies and actions for how to address them

Appendix B: Background Information

UNH has been advancing sustainability in some way, shape or form over the last 40-plus years. While energy conservation and efficiency work has been ongoing at UNH since the 1970's, this work took on expanded meaning when UNH's Climate Education Initiative was developed in 1997–1998 under the direction of UNH's then-newly endowed sustainability program, the Office of Sustainability Programs (now the Sustainability Institute at UNH). Under UNHSI's Climate Education Initiative, the university is committed to being a Climate Protection Campus that pursues a sustainable energy future through emissions reduction policies, practices, research, and education. Such climate and energy work is a key component of UNHSI, a convener, cultivator and champion of sustainability on campus, in the state and region, and around the world. (More information can be found at www.sustainableunh.unh.edu.)

As part of this climate and energy leadership, UNH has undertaken a number of initiatives, which are explained in more depth throughout this report. Highlights include but are not limited to the following:

- Collaborating with non-profit Clean Air - Cool Planet to develop the Campus Carbon Calculator for colleges and universities to track their GHGE. Since the Calculator's launch in 2000, thousands of campuses across North America have used it to track their emissions, and it has become one of the recommended tools of the American College and University Presidents' Climate Commitment (ACUPCC). In 2013, the Calculator (an Excel spreadsheet) was transformed into CarbonMAP, an online carbon management and analysis platform. In 2014, the Sustainability Institute at UNH assumed ownership and management of the Campus Carbon Calculator and the Climate Fellows Program from Clean Air – Cool Planet as it dissolved.
- Tracking UNH Durham GHGE from 1990 to the present through a continually updated GHG inventory series.
- Convening a campus-wide Energy Task Force (ETF) in 2005, which advises the UNH administration on climate and energy issues like energy generation, demand management, efficiency and conservation, greenhouse gas mitigation policy and action, participation in energy and carbon markets, and curriculum, research, outreach and engagement opportunities related to climate and energy.
- Developing an innovative Climate Action Plan (WildCAP) that calls for GHGE reductions of 50% by 2020 and 80% by 2050 (measured against a 2001 baseline).
- Becoming a charter signatory to the American College and University Presidents' Climate Commitment (ACUPCC), with UNH President Mark Huddleston serving on its Steering Committee starting in 2012.
- Finishing the EcoLine project, a landfill gas-to-energy project that uses methane gas from a nearby landfill to meet most of the campus's energy needs. Renewable Energy Certificates (REC's) are sold off the electricity product by EcoLine, with revenues used to pay off the costs of the EcoLine project and to invest in a revolving Energy Efficiency Fund (EEF). UNH is the first campus in the country to use landfill gas as its primary fuel source.

- Developing an Energy Efficiency Fund (EEF) that invests in campus energy efficiency projects. Begun in 2009 with a $650,000 grant from the American Recovery and Reinvestment Act (ARRA), through the EEF UNH has already seen more than $1,000,000 in energy savings "returns," including over $250,000 in FY12 alone. The ETF estimates that after a decade, through the EEF the university will realize about $4 million in energy savings and prevent more than 8,500 metric tonnes of greenhouse gases from being emitted -- the equivalent of over 1,600 passenger vehicles or 19,000 barrels of oil.
- Engaging students in unique and innovative courses, academic programs, co-curricular activities (including an annual residence hall energy challenge called UNH Unplugged), student organizations, and internships in the broad areas of climate and energy.
- Conducting engaged scholarship in climate and energy that helps the state and region respond and adapt to our changing climate, such as work done by Climate Solutions New England (www.climatesolutionsne.org) and its leadership role in the NH Energy and Climate Collaborative.

For more information on UNH's climate and energy leadership, visit www.sustainableunh.unh.edu/climate.

UNH Energy Task Force

Chaired by the Associate Vice President for Facilities and coordinated by UNHSI and the UNH Energy Office, the Energy Task Force (ETF) is the formal working group behind UNH's broad Climate Education Initiative. Members come from UNHSI, the Energy Office, Campus Planning, Information Technology, Purchasing and Contract Services, University Communications and Marketing, Cooperative Extension, faculty from across campus, an undergraduate Student Sustainability Ambassador (a paid internship position at the UNHSI), and other undergraduate and/or graduate students.

Initially founded in 2005 to develop new ways to reduce energy consumption in response to fast-rising energy prices, the mission of the ETF soon broadened to serve in an advisory capacity to the UNH president and administration on the full range of issues that relate to climate change and energy, including energy generation, demand management, efficiency and conservation, GHGE mitigation and adaptation policy and action, participation in energy and carbon markets, and curriculum, research and engagement opportunities. The overarching goal is to guide the university toward a systematic and integrated set of energy and climate policies and practices that emphasize health and integrity, climate protection, efficiency, cost-effectiveness and stability, fairness for all university constituents, and consistency with priorities set by UNH plans like the strategic plan, academic plan, and campus master plan.

The ETF's role in advising the campus administration on climate and energy issues took on even greater prominence when UNH became the first land grant university in New England to sign the American College & University Presidents' Climate Commitment (ACUPCC) in February 2007. A member of the leadership circle of ACUPCC signers, UNH pledges to take immediate actions to reduce GHGE and to develop a plan to move the university toward carbon neutrality.

In particular, the ETF is charged with:

- Developing timelines, targets, and action items under the UNH Climate Action Plan (called “WildCAP”) to help move UNH towards carbon neutrality.
- Developing immediate and future actions to reduce energy costs, lower GHGE, and improve energy conservation through technological improvements, increases in efficiency, reductions in waste, and selection of fuels.
- Inventorying and promoting curricular, research and engagement programs intended to increase awareness, knowledge, scholarship and behaviors around energy use, efficiency, GHGE and climate change.

For more information, visit www.sustainableunh.unh.edu/etf.

UNH Greenhouse Gas Emissions (GHGE) Inventory Series and Overall Trends

The ETF uses a unique tool to track GHGE for the UNH Durham campus. In the winter of 2000, UNHSI partnered with the New Hampshire-based non-profit Clean Air - Cool Planet (CACP) to produce a GHGE inventory tool that adapted national and international inventory methodologies to the unique scale and character of a university community. Combining financial and intellectual resources, the partners hired a UNH graduate student who developed the tool and gathered data with support from UNH faculty and staff. Using the inventory tool, UNH's GHGE were documented back to 1990, and the first version of the GHGE inventory was published in the spring of 2001.

Following publication of the initial inventory, the partners continued to work together in order to package the inventory methodology into a generic tool that could be used by other campuses. By the fall of 2001, the Clean Air-Cool Planet Campus Carbon Calculator became available, and over the next 18 months was employed by nearly 10 other Northeast campuses. UNHSI and CACP then hosted a series of technical meetings to continue to refine and simplify the calculator. As the calculator was adopted by more and more campuses over subsequent years, the revisions continued. Today, the calculator – now also online as CarbonMAP – is being used by thousands of campuses across North America and is a recommended tool of the ACUPCC. UNHSI took over management of the Calculator in 2014. (Learn more at sustainableunh.unh.edu/calculator.)

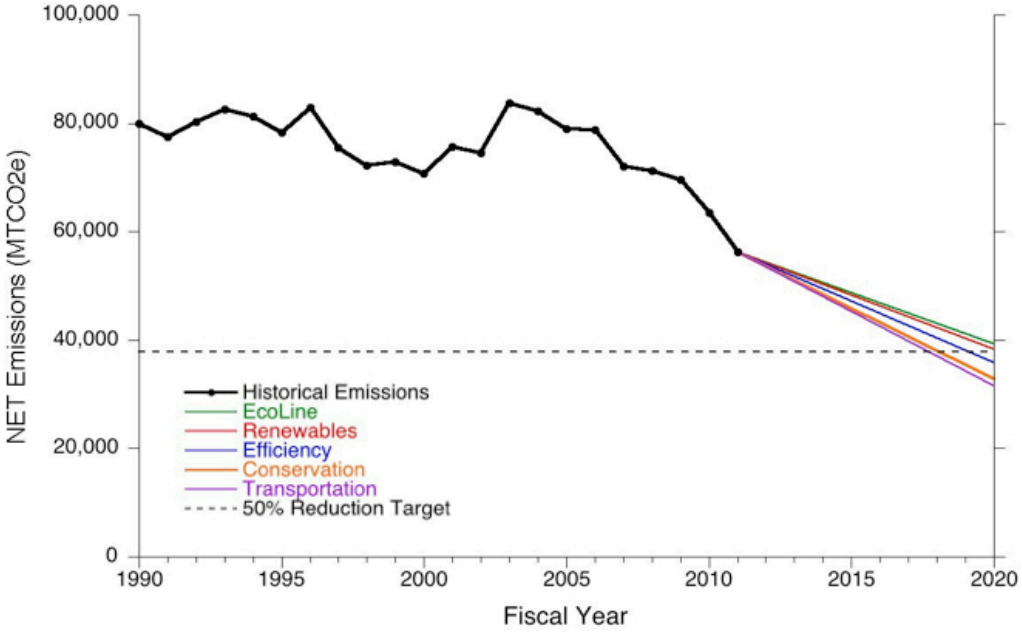
UNH’s GHGE inventory series serves as the baseline to measure how the university is meeting not only its ACUPCC obligations, but also the goals set under WildCAP. It informs the decision-making of the university as it strives to respond to the unprecedented disruption of our climate system. UNHSI staff and student interns they hire and supervise collect data from across campus to populate CarbonMAP, which then estimates UNH Durham campus emissions. Data are collected, and public and technical reports published, at least every two years. The ETF, including staff from UNH Facilities and the Joanne A. Lamprey Fellow in Climate and Sustainability at UNHSI, quality control the data collected and the reports published. The GHGE inventory series covers UNH Durham excluding holdings the campus

has in areas of the state outside of Durham and Lee, NH. The series does not yet include UNH Manchester or UNH Law. (Learn more at sustainableunh.unh.edu/ghginventory.)

The last inventory update was a supplement to previously published inventory reports (2001, 2003, 2005, 2007, 2009) and extended UNH records through Fiscal Year (FY) 2011, which ran July 1, 2010 to June 30, 2011. FY1990 is the first year for which UNH emissions were tracked (using historical data) due to the Kyoto Protocol's use of 1990 as the baseline year for international agreements on emissions reductions. FY2001 functions as the baseline year for the reduction targets in WildCAP. FY2005 is the baseline year utilized by the STARS program (Sustainability Tracking, Assessment and Rating System), of which UNH is a charter member and participant.

UNH GHGE have fluctuated throughout much of the past two decades (Figure 4). From 1990–2006, annual emissions ranged from a low of 70,688 tCO2e in FY2000 to a peak in FY2003 of 83,692 tCO2e. However, UNH has steadily reduced its carbon footprint over the past five years. primarily due to the UNH cogeneration heat and power plant, the UNH EcoLine landfill gas project, and a revolving energy efficiency fund (EEF). UNH sells the Renewable Energy Certificates (REC's) associated with EcoLine's electricity generation and is therefore careful not to include any GHGE reductions associated with that power generation. Funds from the REC sales are used toward repayment of the EcoLine project cost and investment in the EEF, which in turn is lowering total campus GHGE.

Figure 4: UNH Actual and Projected Anthropogenic Greenhouse Gas Emissions 1990 – 2020*



** Air travel data were collected for FY09-11 and used to estimate air travel back to 1990. A conversion factor of $0.15/mile was used as indicated by the Campus Carbon Calculator; taxes and fees were not taken out, slightly overestimating travel miles. More information can be found in the UNH FY10-11 Greenhouse Gas Emissions Inventory Technical Report.*

Appendix C: WildCAP Update Committee Members

WildCAP Section	Energy Task Force Member
Campus Buildings	• Matt O'Keefe (Chair), Energy Office • Jim Dombrosk, Energy Office • Tat Fu, Civil Engineering • Vincent Lyon '13, Energy Office Intern
Information Technology (IT) and Plug Loads	• Lisa Pollard (Co-chair), USNH Purchasing and Contract Services • Michael Welch (Co-chair), Information Technology • Jackie Furlone Cullen, Sustainability Institute
Transportation	• Stephen Pesci (Campus Planning), Chair • Tat Fu, Civil Engineering • Lou Simms, Sustainability Institute intern
Campus Energy Production and Renewables	• Matt O'Keefe (Chair), Energy Office) • Cameron Wake, Institute for the Study of Earth, Oceans and Space and UNHSI • Fil Glanz (Emeritus), Electrical Engineering • Vincent Lyon, Energy Office student intern
Behavior/Culture	• Jackie Cullen (Chair), Sustainability Institute • Beth Potier, University Communications and Marketing • Sara McKinstry, Sustainability Institute • Pete Wilkinson, ETF Student Ambassador
WALRUS (Waste and Recycling, Offsets/ Sinks, and Land Use)	• Michael Bellamente (Chair), Climate Counts, housed at the Sustainability Institute • Jackie Cullen, Sustainability Institute • Lou Simms, Sustainability Institute intern
Adaptation	• Cameron Wake (Chair), Institute for the Study of Earth, Oceans and Space and the Sustainability Institute • Paul Kirshen, Civil Engineering • Lou Simms, Sustainability Institute intern
Overall Coordination of WildCAP Update	• Sara McKinstry, Sustainability Institute