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UNIVERSITY of NEW HAMPSHIRE

FISCAL YEAR 10-11 GREENHOUSE GAS EMISSIONS INVENTORY TECHNICAL REPORT



*UNH ENERGY TASK FORCE
SUSTAINABILITY INSTITUTE AT UNH
UNH FACILITIES*

FEBRUARY 2013

the
sustainability
institute

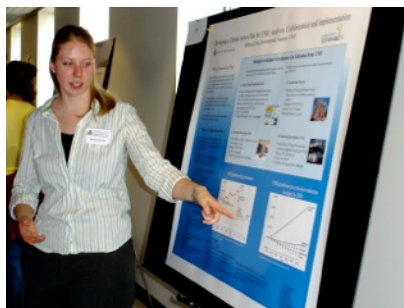
at the UNIVERSITY of NEW HAMPSHIRE

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Introduction



Curriculum and Research



Operations



Engagement

This technical report explains the specific practices, standards and assumptions employed in producing the bi-annual inventory of anthropogenic greenhouse gas (GHG) emissions generated by the University of New Hampshire's (UNH) Durham campus. This update extends UNH's GHG inventory records through Fiscal Year (FY) 2011, which ran July 1, 2010 to June 30, 2011. The report focuses on the data collection process for FY10 and FY11, which the Sustainability Institute at UNH (UNHSI) conducted between June 2012 and November 2012. The FY10-11 GHG inventory only covers UNH Durham excluding holdings the campus has in areas of the state outside of Durham and Lee, NH. This inventory does not include UNH Manchester or UNH Law.

Produced through the collaborative efforts of the UNH Energy Task Force (ETF) and UNHSI, this FY10-11 update to the UNH GHG inventory series serves as a tool for measuring the university's impact on regional and global climate. Specifically, the GHG inventory series helps track institutional progress in meeting the university's Climate Action Plan (called "WildCAP") goals and American College & University Presidents' Climate Commitment (ACUPCC) obligations, and informs the decision-making of the university as it strives to respond to the unprecedented disruption of our climate system. A shorter summary of this inventory update can be found online at sustainableunh.unh.edu/sites/sustainableunh.unh.edu/files/images/fy1011ghginventory.pdf.

Background

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 sustainableunh.unh.edu.)

As part of this climate and energy leadership, UNH has undertaken a number of initiatives, including:

- Collaborating with non-profit Clean Air - Cool Planet to develop the Campus Carbon Calculator for colleges and universities to track their GHG emissions. Since the Calculator's launch in 2000, thousands of campuses across North America use it to track their GHG 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.¹
- Tracking UNH Durham GHG emissions 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. The overarching goal of the ETF is to guide the university toward a systematic and integrated climate and energy policy that emphasizes health and integrity, climate protection, efficiency, cost-effectiveness and stability, and fairness for all university constituents. (More information can be found at sustainableunh.unh.edu/etf).
- Developing an innovative Climate Action Plan (called "WildCAP," after UNH's wildcat mascot) that calls for GHG 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. 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.

¹ <http://cleanair-coolplanet.org/carbon-map/>

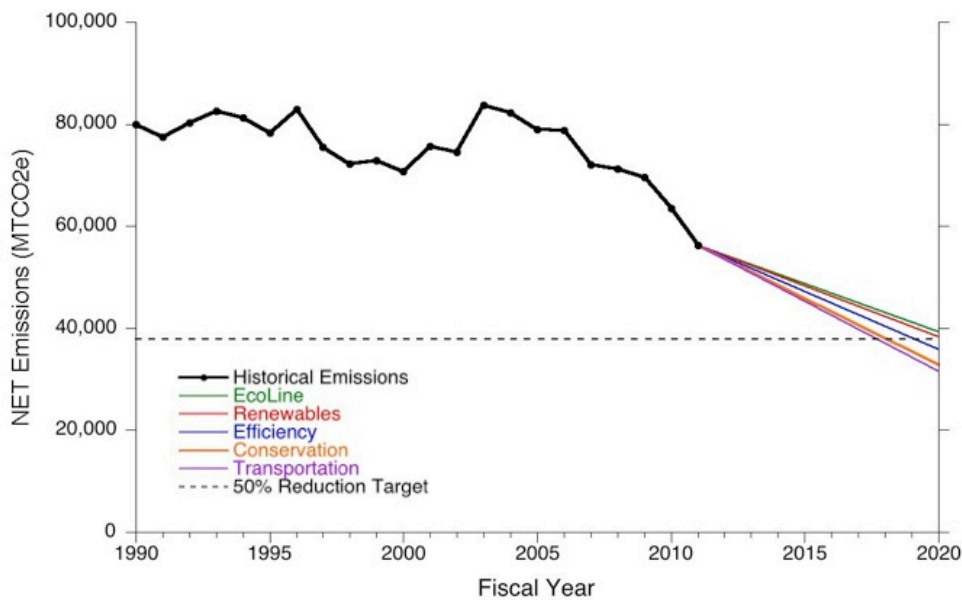
- Conducting engaged scholarship in climate and energy that helps the state and region respond and adapt to our changing climate, such as work done by Carbon Solutions New England (www.carbonsolutionsne.org).
- Engaging with the state and region on climate and energy policy, such as Carbon Solution New England's leadership role in the NH Energy and Climate Collaborative.

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

WildCAP: UNH's Climate Action Plan

UNH's GHG inventory series serves as the baseline to measure how UNH is meeting not only its ACUPCC obligations, but also the goals set under the university's Climate Action Plan, called "WildCAP." WildCAP was developed by the ETF from 2007 to 2009, purposely involving stakeholders from across campus to provide input on how UNH could lower its GHG emissions. Under WildCAP, UNH is committed to reducing its GHG emissions 50% reductions by 2020 and 80% reductions by 2050 en route to "climate neutrality"--elimination of net emissions--by the end of the century. In order to achieve these targets, WildCAP includes a series of recommended actions for the university to undertake which, when implemented, will reduce emissions to targeted levels, as shown in Figure 1.

Figure 1: 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.



Actions called for in WildCAP are divided into two broad categories: **policies** and **projects**.

- **Policies** are university-wide administrative directives that facilitate implementation of specific projects or influence behaviors in members of the university community that will lead to emissions reductions. Examples include LEED Silver-Equivalent Building Standards and an ENERGY STAR Purchasing Requirement.
- **Projects** are specific interventions in university operations--generally improvements to campus infrastructure--that will directly cut emissions. Examples include network power management for computers connected to the university's computer and internet network and installation of renewable energy projects on specific campus building.
- **Projects** and **policies** are further categorized by their area of impact, e.g., renewable energy, energy efficiency, procurement, etc.
- A full listing and descriptions of all recommended actions are contained in the Recommended Actions section of WildCAP.²

Achieving climate neutrality is an on-going process best thought of as a continual improvement through constant emission reductions. We challenge ourselves by taking this more difficult path than the alternative of purchased credits, which allow business as usual to persist. WildCAP is being updated by the ETF throughout 2013 for submission to the ACUPCC in January 2014.

² www.sustainableunh.unh.edu/wildcap

FY10-11 GHG Inventory Update Technical Details

Data Collection and Reporting Processes

UNHSI staff and student interns they hire and supervise collect data from across campus to populate the Campus Carbon Calculator,³ which then estimate UNH Durham campus emissions. The Campus Carbon Calculator is updated continually to reflect currently international best practices for tracking GHG emissions. Staff from UNH Facilities, along with the Joanne A. Lamprey Fellow in Climate and Sustainability, a faculty fellow of UNHSI, quality control the data collected and the public and technical reports written by UNHSI staff and interns. In addition, the full ETF reviews information and reports before they are shared with the ACUPCC and the broader public.

To date, data are collected for each GHG inventory from departments across UNH, including:

- Energy Office
- Campus Planning
- Facilities
- College of Life Science and Agriculture
- Environmental Health and Safety
- Institutional Research and Assessment
- Office of Woodlands and Natural Areas
- Athletics

Data are collected via email, phone calls, and face-to-face meetings. UNHSI staff and interns help staff in these departments convert data they collect into the formats needed for the Campus Carbon Calculator. If only a few data points are available, estimates are used to extrapolate data backwards and forwards in time as needed.

³ <http://cleanair-coolplanet.org/campus-carbon-calculator/>

KEY INDICATORS

TOTAL EMISSIONS FY11

Scope	t CO ₂ e
Scope 1*	33,073.8*
Scope 2	3,650.8
Scope 3	21,951.7
Total Emissions	58,676.3
Offsets	-2,372.6
Net Emissions	56,303.7

PERCENTAGE CHANGE

Base Year	%
1990	-29.6%
2001	-25.7%
2005	-19.0%

INTENSITY DEMOGRAPHICS

Indicator	t CO ₂ e
Per Student	FY11: 3.2
	FY05: 6.2
Per 2,000 ft ²	FY11: 7.2
	FY05: 14.2

t = metric ton = 2,000 kg
CO₂e = carbon dioxide equivalents

* Scope 1 data includes emissions associated with UNH sales of

Overall

FY 1990 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. FY 2001 functions as the baseline year for WildCAP. FY 2005 is the baseline year utilized by the STARS program (Sustainability Tracking, Assessment and Rating System), of which UNH is a charter member and participant. Total campus emissions and offsets for FY 2011 are shown in the sidebar to the left, as well as other key indicators.

UNH GHG emissions have fluctuated throughout much of the past two decades. From 1990–2006, annual emissions ranged from a low of 70,688 tCO₂e recorded in FY 2000, to a peak of 83,692 tCO₂e in FY 2003. However, UNH has steadily reduced its carbon footprint over the past five years.

Scope 1 Emissions

On-Campus Sources

Scope 1 sources account for nearly half of UNH's gross emissions for FY11, totaling 19,648 tCO₂e. Scope 1 sources include emissions associated with heating and cooling on campus, electricity produced by the on-campus cogeneration plant, university-owned vehicles, and agricultural activities. For reporting purposes connected to this GHG inventory, emissions associated with the sale of Renewable Energy Certificates or REC's (13,200 tCO₂e) off the EcoLine landfill gas project are also factored into the total value of Scope 1 emissions for the UNH Durham campus. The UNH Energy Office tracks all fuel sources used on campus.

Cogeneration & EcoLine

The UNH cogeneration plant (cogen) began operations in FY06. Cogen produces heat and power using multiple fuel sources: natural gas, distillate (#2) fuel oil, and landfill gas. Cogen provides heating, cooling, and electricity to 85% of Durham campus buildings. In spring 2009, UNH completed its EcoLine project linking the cogen plant to a nearby source of landfill gas. The superior efficiency of the cogen plant creates significant reductions in total campus emissions as it utilizes cleaner fuels

with lower carbon intensity while simultaneously reducing the need for electricity purchased from outside sources. Thus, in addition to remarkable reductions in GHG emissions, the cogen plant reduces annual budget demands for energy. Additionally, the EcoLine creates a direct income stream for the university via the sale of Renewable Energy Certificates.

In FY11, UNH's cogeneration plant burned 120,009 gallons of distillate oil (#2), 177,285 MMBtu of natural gas, and 600,941 MMBtu of methane transferred from the Turnkey Landfill in Rochester, NH via EcoLine. These fuel sources produced an electric output of 58 million kWh at 24.54% efficiency, and a steam output 252,254 MMBtu at 48.86% efficiency.

Purchased electricity is discussed further in "Scope 2 Emissions." The sale of RECs from the EcoLine is addressed under "Offsets."

Other Stationary Sources

The majority of energy needs on the Durham campus are met via cogen, but some fossil fuels are still consumed in buildings not connected to the plant. In FY11, such sources on the UNH Durham campus burned an additional 96,389 gallons of distillate oil #2, 82,874 MMBtu of natural gas, and 74,647 gallons of LPG (propane). These additional energy sources accounted for 13% of UNH's gross emissions.

Mobile Sources

The UNH vehicle fleet produces 4% of total campus emissions, consuming a variety of conventional and alternative fuels, such as biodiesel B20 (20% biofuel) and compressed natural gas (CNG). In addition to campus operations and farm activities, UNH vehicle emissions include WildCat Transit services both on and off campus, the most popular (e.g. highest ridership numbers) public transportation system in the state.

In 2007, UNH first implemented B20 biodiesel, replacing half of the total diesel consumed on campus. B20 now accounts for 82% of diesel consumption and 40% of the UNH fleet's total fuel use. For FY11, UNH vehicles consumed 97,962 gallons of gasoline, 18,949 gallons of diesel, 2,488 MMBtu of natural gas (CNG), and 85,561 gallons of B20 biodiesel. While B20 burns cleaner than other fossil fuels, some questions remain concerning the indirect carbon intensity of biofuel production.

Refrigerants & Chemicals

Refrigerant leaks continue to be an insignificant source of emissions, far less than 1% of overall campus emissions. UNH Facilities staff monitor and record the rare occurrence of such incidents.

Fertilizer Application

While fertilizer use accounts for only a small portion of total GHG emissions, UNH farms and athletic field operations have increased application of synthetic fertilizers in the past few years. Although exact records are difficult to track, significant use of synthetic fertilizers composed of nitrogen, phosphorus and potassium occur at the animal science farms, as well as on UNH athletic fields operations, which use an additional compound containing iron. Estimates place total annual synthetic fertilizer use for FY10-11 between 7,000 and 9,000 pounds. UNH's Thompson School greenhouses and the horticulture farms on campus use negligible amounts of fertilizer.

Animal Husbandry

A small but significant source of GHG emissions are produced by animal husbandry operations on UNH farms. UNH farm staff provide an annual inventory of animals housed on campus farms, and the Campus Carbon Calculator translates those numbers into GHG emissions equivalence. The only noteworthy change since FY09 in animal husbandry operations at UNH is the elimination of swine and poultry populations. No research has yet confirmed whether UNH's organic dairy cow operations create less GHG emissions than conventional dairies. Animal husbandry and fertilizer application combine for 3% of total campus emissions counted under "agricultural operations" in the Campus Carbon Calculator.

Scope 2 Emissions

Purchased Energy

The only Scope 2 energy source directly purchased by UNH is electricity produced by the New England electric power grid, distributed through Public Service of New Hampshire. All steam and hot water used at UNH is produced on campus by cogen.

Purchased Electricity

UNH purchases of electricity have decreased dramatically since cogen became operational in 2006. In FY11, UNH purchased 10,894,051 kWh of electricity, which includes the powering of cogen's methane transfer processing plant at Turnkey Landfill in Rochester, NH. The UNH Energy Office maintains records of annual electricity purchases, and these records indicate a reduction of 82% in purchased electricity since FY06. These reductions are of great significance as purchased electricity has remained a major component of total campus emissions throughout the history of the UNH GHG emissions inventory.

Scope 3 Emissions

Scope 3 emissions include a number of sources that are difficult to track directly and measure accurately. Faculty, staff, and student commuting account for the lion's share of Scope 3 emissions. Commuting, air travel, and solid waste disposal comprise the full slate of Scope 3 emissions currently tracked on the UNH Durham campus.

Commuting

UNH Campus Planning oversees all data collection concerning the transportation and commuting input for the Campus Carbon Calculator. Over the past ten years, three official surveys have measured campus commuting behaviors in 2002, 2007, and 2011. Significant changes manifested in student transportation habits between 2002 and 2007, but commuter data remained somewhat static in the most recent 2011 survey.

To produce the GHG emissions equivalence for campus commuting, the Campus Carbon Calculator takes basic inputs concerning the number of faculty, staff, and student commuters, along with average trips per week and average distance per trip. For FY11, UNH faculty and staff accounted for 22.6 million miles traveled and 10,296 MT eCO₂, while student commuters traveled a total of 13.8 million miles, producing 5,170 MT eCO₂.

With dramatic reductions in Scope 1 and 2 emissions over the past few years, commuting accounts for a growing portion of overall campus emissions. Currently measured at 30% of gross campus emissions, great potential exists for further emissions reductions via decreases in vehicle miles travelled through faculty, staff, and student single occupancy vehicle commuting. In FY12, UNH transit services will remove an estimated 5 million vehicle miles from the road, reducing carbon emissions by over 21,000 tons. The potential exists, therefore, to prevent even more vehicle miles traveled and concurrent emissions by increasing the number faculty, staff and students to take transit, bike, walk, or carpool to and from campus.

Long-distance Travel

FY10 was the first year for which the UNH GHG inventory series tracked emissions from airline travel. All air travel purchases made on UNH credit cards held by university employees (called “p-cards”) were reported by the UNH Accounting Office and converted into “air miles traveled” in accordance with emissions factor guidelines provided by the Campus Carbon Calculator and the US Department of Transportation. The Campus Carbon Calculator then translates those estimates into emissions equivalence. In FY10, UNH spent \$1.85 million on air travel, and in FY11 that expense increased to \$1.99 million. The Campus Carbon Calculator computes an emissions equivalence of 7,900 MT eCO₂ for UNH air travel in FY11. Based on these figures, air travel accounts for a significant portion of UNH’s overall carbon footprint (17% of FY11 gross emissions); however, the emissions factors employed to produce these calculations are still very rough estimates. More work needs to be done to enhance the validity of this data set, UNH aims to conduct the most comprehensive GHG emissions inventory possible, however, and therefore we are including these airline purchasing data.

Solid Waste Disposal

Considerable efforts have been made to revise this data set, streamline data collection, and improve reporting. A new waste-hauling contract with Waste Management, Inc., implemented in FY09, allowed for reporting on actual tonnages of waste disposed, but difficulties persist in obtaining consistent data. As a result, additional values are still constructed from a series of snapshots over the course of the year provided by UNH Facilities Operations and Maintenance. Furthermore, the Campus Carbon Calculator input fields for solid waste disposal do not apply accurately to UNH’s unique situation regarding methane capture from Turnkey Landfill, the landfill where UNH’s trash is disposed. The Campus Carbon Calculator computes a small emissions offset for solid waste disposal at landfills engaged in methane recovery and electric generation; however, since UNH also consumes that very same landfill methane gas, the offset computation is compromised. Based on the most accurate data entry possible, the Campus Carbon Calculator computes UNH’s emissions from solid waste disposal at less than 1% of total campus emissions.

Offsets

On-Campus Sequestration

Two sources of emissions offsets generated through on-campus activities apply to the UNH GHG emissions inventory: forest preservation and composting.

Forest Preservation

Carbon uptake by campus woodlands includes College Woods, Burley-Demeritt Farm, Woodman Farm, and Kingman Farm, totaling approximately 785 acres (317.6 hectares) for which the GHG inventory tracks carbon sequestration.

An extensive student project in 2009 reassessed the carbon sequestration data on UNH lands. This research determined that calculations in previous versions of the GHG inventory were grossly underestimated. On-campus carbon sequestration is now estimated at 7.33 t/hectare/year, which results in annual emissions offsets of 2,328 t CO₂e. This figure should be considered as a stock of carbon that would have to be added into gross emissions if the university were to sell or deforest those lands.

Composting

UNH continues its on-campus composting program, which began in 2003. Approximately 120 tons of waste are composted annually, reducing net emissions by about 50 t CO₂e per year. All pre-consumer and some post-consumer food scraps are composted from all UNH Dining-managed dining halls and eating establishments, like the UNH Dairy Bar. In addition, some fall leaf litter is also composted by UNH Facilities.

Carbon/Energy Market Activity

UNH participates in various markets for carbon and renewable energy created through regional cap-and-trade programs such as the Regional Greenhouse Gas Initiative (RGGI) and the Renewable Portfolio Standards (RPS) enacted by several states in New England. Renewable Energy Certificates (or RECs) create a direct income stream for UNH, but every certificate sold inflates the campus's ultimate net emissions profile.

Renewable Energy Certificates (RECs)

UNH sells the RECs associated with landfill methane capture and electricity generation via the EcoLine project. In the first year of operation (FY09), UNH sold 3,452 MWh worth of RECs, but in FY10 that number expanded to 46,285 MWh. REC sales decreased to 39,388 MWh in FY11.

The sale of RECs precludes the university from claiming any of the emissions reductions associated with those the EcoLine project. Through FY11, REC sales account for 30,000 t CO₂e that have been factored back into the university's net emissions profile via Scope 1 emissions. UNH sells RECs to help offset the capital investment in EcoLine and to bolster the revolving Energy Efficiency Fund, both of which are integral components in successful implementation of UNH's Climate Action Plan, WildCAP.

Purchased Offsets

UNH does not purchase any RECs. The current plans outlined in WildCAP call for a 50% reduction in net emissions by 2020 without the use of any purchased offsets. This goal is currently anticipated through the effort of retiring the RECs associated with the EcoLine project.

Revolving Energy Efficiency Fund

Launched in 2009 with a \$650,000 grant from the American Recovery and Reinvestment Act (ARRA), UNH's revolving Energy Efficiency Fund (EEF) 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, the university will realize more than \$4 million in energy savings and prevent more than 8,500 metric tonnes of GHG emissions -- the equivalent of over 1,600 passenger vehicles or 19,000 barrels of oil -- through projects the EEF funds. The EEF has already invested in many projects, such as a solar pre-heat ventilation project at Kingsbury Hall, efficient lighting retrofits, and installation of insulation for steam distribution piping across campus.

In 2011, UNH joined 32 other colleges and universities to launch a national challenge called the Billion Dollar Green Challenge, urging campuses to invest in revolving funds that finance energy efficiency upgrades on campus.

Next Steps

New methods for tracking GHGs emissions, in addition to new research and data, make the UNH GHG emissions inventory an evolving process. While some emissions can only be estimated, identifying all

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potential sources helps to create a more complete picture of the UNH carbon footprint. Emissions factors are updated by the international climate community as new technologies change the way we produce and consume energy.

Based on current carbon reductions goals set forth in the 2009 WildCAP, UNH is well on its way to achieving its goal of 50% GHG emissions reductions by 2020. As UNH succeeds in reducing Scope 1 and Scope 2 emissions, Scope 3 sources will demand more significant consideration in the university's emissions reductions efforts. Plans for 2013 include updating WildCAP as part of the university's 2014 progress report to the ACUPCC.

Campus-wide climate and energy efforts solidify the university's commitments to climate protection, model best practices, and expand the university's leadership in sustainability in higher education.

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Learning in Action

Sustainability is a core value of UNH. It shapes our culture, informs our behavior, and is a guiding principle in everything we do. As a nationally recognized leader, in sustainability, UNH calls on its Sustainability Institute to act as convener, cultivator and champion of sustainability on campus, in the state and region, and around the world.