2014

Greenhouse Gas Emissions Inventory FY 14 Update Report

UNH Sustainability Institute

SUSTAINABILITY
report

University of New Hampshire
The Sustainability Institute

UNH Durham Net Greenhouse Gas Emissions Down 32% Toward Goal of 50% by 2020

HIGHLIGHTS

Total FY 2014 Emissions (Metric Tons eCO2)
Net Reported Emissions: 59,303
Scope 1 & 2: 26,743
Adjusted Scope 1 & 2 (Includes REC Sales)*: 39,041
Scope 3: 20,573
Composting: -311
Biogenic Emissions: **150
Forest Sequestration: *** -2,200

Percent Change
From 1990 (First year measured) -24%
From 2001 (Reduction baseline: Adjusted****) -32%
From 2011 (Last year measured) +.03%
GOAL (by 2010): 50% compared to 2001
STILL NEED TO REDUCE: Roughly 4,000 MTeC02, or nearly twice the amount sequestered in our campus forests. (This assumes we stop selling EcoLine RECs.)

Intensity Demographics
Indicator t CO2e
per student 4.0 (3.3 w/o REC sales)
per capita 3.4 (2.8)
per 1,000 sq. ft. 9.3 (7.7)

*See the SI website for explanation
** Using biofuels like B20 results in CO2 emissions, but these are reported in a separate "biogenic" category because they are considered to be carbon neutral in the long term.
***These sequestered emissions are not considered as part of the "net" calculation because they are not "additional;" see the ACUPPCC GHG Inventory Protocol for more.
**** Adjusted to account for addition of air travel to GHGI to 2001 baseline. Air travel emissions are "backcasted" to 2001, the baseline year used for setting reduction goals in WildCAP. This was done by attributing the average annual amount estimated over the past five years (since this data collection began) to all years previous. UNH did not start collecting or reporting data regarding Air Travel until 2009.

EXECUTIVE SUMMARY

This Greenhouse Gas Inventory (GHGI) update captures UNH's carbon footprint for its Durham campus through Fiscal Year 2014 (7/13-6/14). Since publishing its first GHGI in 2001, the University has updated this analysis regularly (2003, 2005,2007, 2010, 2013). UNH used the GHGI to create (in 2009) and update (in 2014) its Climate Action Plan, WildCAP, which established a reduction goal of 50% from 2001 levels by 2020.

Overall Emissions & Trends

The most recent analysis shows that, while UNH's overall emissions trajectory is still something to be proud of, progress has stalled a bit in recent years. Since the publication of the previous GHGI update in early 2013, there was a very slight (less than half of 1%) increase in UNH's total GHG profile from the last recorded year (FY11) to the most recent (FY14). This is due primarily to a drop in the amount of landfill gas available from the EcoLine pipeline to fuel the campus energy plant—necessitating the use of more fossil fuels as a substitute. The good news is that these Scope 1 increases have been offset somewhat by progress in reducing commuting emissions in Scope 3.[1]

Sustainability Briefings are a collection of occasional essays, thought pieces, case studies and research briefings through which University of New Hampshire (UNH) faculty, staff and students can connect with larger audiences on the complex issues of sustainability. The collection is sponsored by the Sustainability Institute at UNH, a convener, cultivator and champion of sustainability on campus, in the state and region, and around the world. Learn more at www.sustainableunh.unh.edu.

Emissions Trajectory 2001-20014

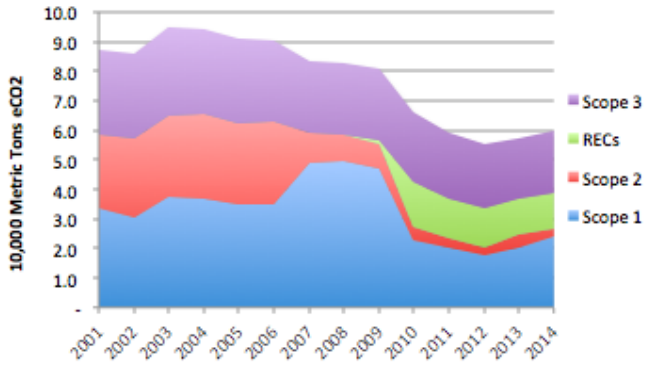


FIGURE 1: Historical emissions, by scope

Relative Contributions of Activities to UNH Carbon Footprint

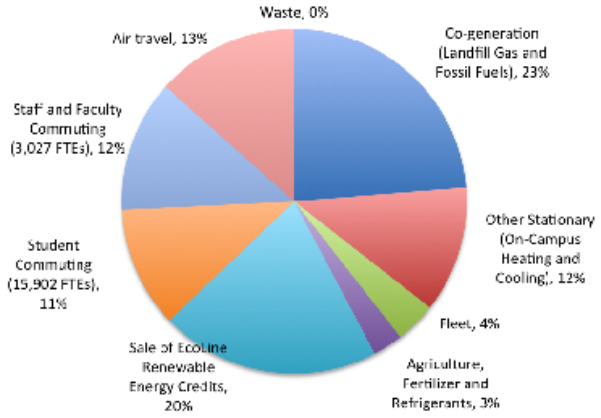


FIGURE 2: The components of UNH's carbon footprint

The University's goal of reducing total emissions 50% below 2001 levels by 2020 is still very much in reach. What the recent upward trend points to, however, is a need for a campus-wide commitment to reducing energy waste; without dedicated efforts on this front from all of our staff, faculty and students, it will be a struggle to meet the University's goal, and to remain a leader in campus climate and energy action.

Further reductions to the campus GHG footprint are expected in the next couple of years, when the university ceases its sale of Renewable Energy Credits from the EcoLine project and is then able to claim the full benefit of its greenhouse gas reductions.[2]

Comparative Metrics

Since many other universities also measure and report GHGs, another way to understand our carbon footprint is in a comparative context; that is, not only how are we doing relative to our own goals, but how are we doing compared to other similar campuses.

In that respect, UNH can be proud: our emissions per square foot and per capita are significantly lower than the average of other doctorate-granting institutions in the U.S. that are participating in the American College and University Presidents' Climate Commitment. (See figure 3)

Moving Forward

An update to WildCAP, the UNH Climate Action Plan, was released in 2014. The Sustainability Institute will continue to work closely with members of the Energy Task Force, and its many campus partners, to implement the solutions outlined in WildCAP.

Want to learn more, or get involved? Contact jennifer.andrews@unh.edu

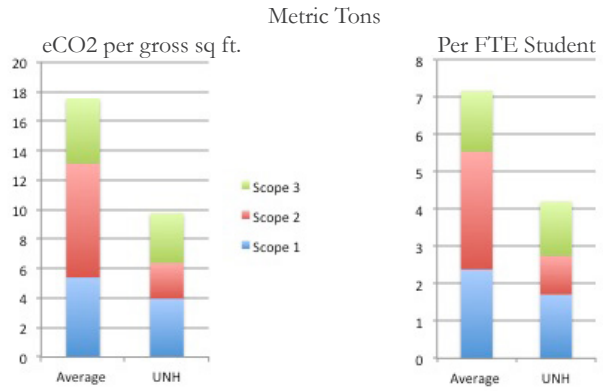


FIGURE 3: How UNH compares to other research universities

FY10-11 GHG INVENTORY UPDATE TECHNICAL DETAILS

Methodology

Boundaries

Organizational boundaries for this GHG update, as with previous iterations of the UNH GHGI, are limited to the Durham campus. Operational boundaries include calculations for all Scope 1 and Scope 2 emissions, and for selected Scope 3 sources—specifically commuting, air travel, and solid waste. These boundaries are the same as in the previous GHGI update published in 2013, and are in accordance with UNH's participation in the American College and University President's Climate Commitment (ACUPCC), which mandates that the campus report emissions from these source categories at least every two years.

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 estimates UNH Durham campus emissions. The Campus Carbon Calculator™ is updated continually to reflect current international best practices for tracking GHG emissions. Staff from the UNH Facilities office, along with the Josephine A. Lamprey Fellow in Climate and Sustainability (a faculty fellow of UNHSI) quality control the data collected, as well as the public and technical reports written by UNHSI staff and interns.

In addition, the full Energy Task Force (ETF)[4] has the opportunity to review information and reports before they are shared with the ACUPCC and the broader public.

As with previous versions of the report, data were collected via email, phone calls, and face-to-face meetings 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

When only a few data points are available, estimates are used to extrapolate data backwards and forwards in time as needed.

Adjustments From Previous Versions

Greenhouse gas accounting is still a relatively new field, and the data that underly the Campus Carbon Calculator (CCC), government and NGO are pulled from data from publicly available reports that take time to compile and release. This means that even the most robustly-done GHGI can only provide an estimate, because methodologies continue to be improved upon and refined, and there is a time lag in the availability of relevant annual data. A few methodological changes and updates have been made since the previous update—resulting in some (minor) retroactive changes to years previously reported GHG emissions. This is in keeping with accepted best practices in carbon accounting.

What follows is a catalog of the methodological adjustments and CCC updates that have occurred between the previous UNH GHGI and this one:

Methodological Changes

- Emissions added back in to our total footprint from the sales of Renewable Energy Credits (RECs) have been allocated to Scope 2, rather than Scope 1. This is in keeping with new guidance from the GHG Protocol.
- Emissions from air travel have been "backcast" for the years 201-2008 in order to identify the appropriate 50% reduction target. This was done by taking an average from the years for which there was available data, and attributing that average figure to previous years.
- UNH Forest lands are no longer counted as additional offsets, and are not subtracted from the total to derive the "net emissions." This is simply correcting an error made in previous versions of the GHGI.

The Impact of Methodological and Emissions Factor Changes on our Previously Reported FY11 Emissions			
	Previous MTCDE	Updated MTCDE	Explanation for Change
Scope 1	33,073.8	19,995.9	13,200 MTCDEDE of RECs were previously in this category. Fleet emissions have been revised slightly higher thanks to updated Emissions Factors from the Bureau of Transportation Statistics using actual reported figures for FY11 which were not yet available when the FY11 inventory was first completed.
Scope 2	3,650.8	16,819.5	The RECs subtracted from Scope 1 were added here, per updated guidance from the GHG Protocol. At the same time, the New England grid mix got slightly more polluting between 200x (the most recent data available when the FY11 inventory was done previously) and 2011. The reported, rather than projected, data for the 2011 grid was made available in the E-Grid update published in Feb. 2014, and is now being used to calculate 2011.
Scope 3	21,951.7	22,585.3	Waste EFs were adjusted downward based on new information from US DOT. However, emissions from electricity transmission and distribution losses are included.
Total			Forest sequestration is no longer subtracted (but compost is).
Biogenic	Not reported	150	Was not included in original FY11 report, but FY11 totals are included in the update.

- Transmission and Distribution ("T and D") losses (the emissions associated with needing to generate more eletricty than the end user actually needs because some of it is lost over power lines and at substations due to equipment inefficiency) are now included in Scope 3. These are relatively negligible.
- A "biogenic" emissions category has been added to reflect the impact of B20 in our campus fleet.

Emissions Factor Updates to the Campus Carbon Calculator[tm] relevant to the UNH GHGI

- Factors for grid-purchased electricity were updated, with data from the EPA's E-Grid database, for the latest available year (2010): http://www.epa.gov/cleanenergy/energy-resources/egrid/
- Factors for transportation fuels were updated, with data from U.S. Department of Transportation, Bureau of Transportation Statistics, National Transportation Statistics July 2013. BTS02-08 (4-20).
- Factors for solid waste were updated, with data from Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM), Combustion section, Exhibit 7. February, 2012.

EMISSIONS ACTIVITY AND CALCULATION DATA

Scope 1 Emissions: On-Campus Sources

Scope 1 sources account for 41% UNH's gross emissions for FY14, totaling 24,232 tCO2e. Scope 1 sources include emissions associated with heating and cooling on campus, electricity produced by the on-campus co-generation plant, university-owned vehicles, and agricultural activities. The UNH Energy Office tracks all fuel sources used on campus.

Co-Generation & EcoLine

The UNH co-generation (or combined heat and power) plant began operating in FY06. In the spring of 2009, the EcoLine project was completed, linking the co-gen plant to a nearby source of landfill gas—the Rochester Turnkey landfill operated by Waste Management (which is also where the majority of UNH's trash is landfilled.) The co-gen plant is multi-fueled; it can operate on landfill gas, distillate (#4) or residual (#6) fuel oil, or natural gas, and provides heating, cooling, and electricity to up to 85% of campus buildings.

The superior efficiency of the co-gen plant, its ability to use "carbon neutral" landfill gas or less carbon intensive fuels than residual (#6) fuel oil, and the subsequent reduction in electricity needed to be

purchased from the grid have all led to significant reductions in overall UNH emissions, while at the same time helping to control energy costs.

That said, a longer- and colder-than average winter, coupled with a smaller supply of available landfill gas from Ecoline than projected and dynamic energy economics all led to an increase in the use of fossil fuels in the co-gen plant compared to the previous update for FY11. In FY14, UNH's cogeneration plant burned 103,566 gallons of distillate oil (#2), 5,567 gallons of residual oil (#6), 233,169 MMBtu of natural gas, and 501,919 MMBtu of methane transferred from the Turnkey Landfill in Rochester, NH via EcoLine. These fuel sources produced an electric output of 68.8 million kWh at 51% efficiency, and a steam output 442,011 MMBtu at 77% efficiency. These efficiencies have increased from past years, as the Energy Office continues to optimize operations at the co-generation plant. At present, GHG emissions from the co-generation plant account for 23% of UNH's total carbon footprint.

Electricity use and the sale of Renewable Energy Credits (RECs) from EcoLine are discussed in the "Scope 2" section.

Other Stationary Sources

The majority of campus energy needs are now being met through the use of co-generation, but some other fuels—specifically, distillate (#2) fuel oil, natural gas, and propane—are still consumed in buildings not connected to the central heating and cooling system. Emissions from these sources account for 11% of total emissions.

Mobile Sources

The UNH vehicle fleet produces 3.75% 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

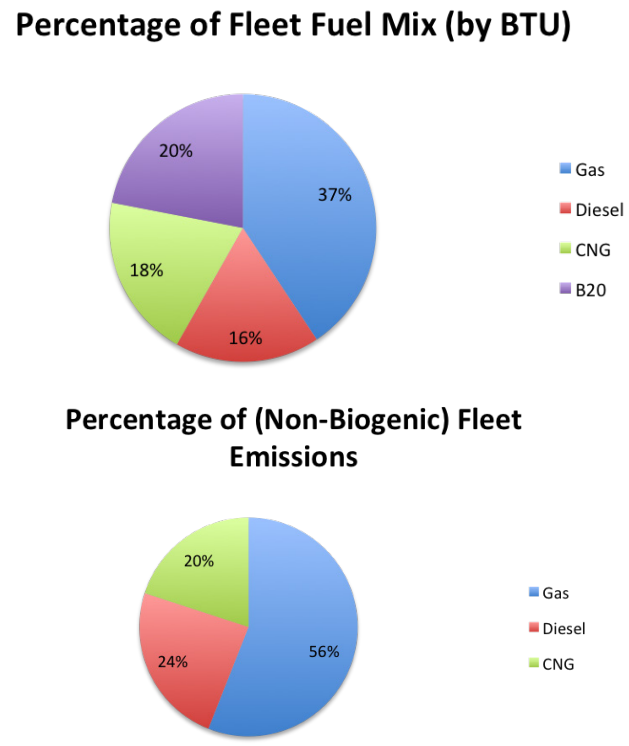


FIGURE 4: UNH Fleet statistics

on and off campus, the most popular (e.g. highest ridership numbers) public transportation system in the state. This is different from many other colleges and universities, whose fleets do not include public transportation vehicles operated beyond campus borders.

In 2007, UNH first implemented B20 biodiesel, replacing half of the total diesel consumed on campus. B20 now accounts for 65% of diesel consumption and 27% of the UNH fleet's total fuel use. For FY11, UNH vehicles consumed 100,763 gallons of gasoline, 38,683 gallons of diesel, 6,059 MMBtu of natural gas (CNG), and 71,944 gallons of B20 biodiesel. While B20 burns cleaner than other fossil fuels, some questions remain concerning the indirect carbon intensity of biofuel production.

In 1999, UNH began building a CNG fueling station to supply its own fuel needs and those of the local community. CNG is a cleaner-burning fuel than gasoline, diesel, or even biodiesel. While use of

biodiesel has declined from its high point at the time of the last GHGI update, the use of CNG for UNH fleet vehicles—especially its WildCat bus fleet—has increased by 143%; it now accounts for roughly 20% of fleet fuel usage.[5]

Non-Energy Sources

Non- Energy Sources like refrigerant leaks, fertilizer application and animal husbandry account for a small overall portion of UNH's carbon footprint; however, since they are Scope 1 emissions under the University's direct control, they must be reported as part of the GHGI according to accepted best practices.

Refrigerants & Chemicals

Refrigerant leaks have traditionally been an insignificant source of emissions; there was no data available to indicate refrigerant leaks in FY 2014.

Agriculture

Fertilizer Use: Fertilizer accounts for a very small portion of total GHG emissions, though UNH farms and athletic field operations have increased application of synthetic fertilizers in recent years. Estimates place total annual synthetic fertilizer use for FY14 just over 1,000 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. No very noteworthy changes in animal husbandry operations at UNH have occurred since the last update. No research has yet confirmed whether UNH's organic dairy cow operations create less GHG emissions than conventional dairies.

Animal husbandry and fertilizer application together account for less than 3% of total campus emissions counted under "agricultural operations" in the Campus Carbon Calculator.

Scope 2 Emissions: Purchased Energy

The only energy directly purchased by UNH is electricity produced by the ISO-New England electric power grid and distributed through Eversource Energy. All steam and hot water used at UNH is produced on campus and not purchased from an external entity.

Purchased Electricity

UNH's purchases of electricity have dropped drastically since the cogeneration plant became operational in FY06. IN FY 2014, UNH purchased only about 7.5 million kWh—compared to a high of more than 61 million in 2004. Emissions from the New England grid are also less carbon-intensive than those from other regions of the country that have more coal and less hydropower, nuclear or natural gas in their generation mixes. Direct purchase of electricity accounts for just over 4% of the University's GHG footprint.

Renewable Energy Credits

UNH sells Renewable Energy Credits (RECs) generated through landfill methane capture and electricity generation by the EcoLine project. The emissions associated with this electricity were calculated in the same way as emissions from purchased electricity, and then sold to a commercial or institutional buyer as emissions reduction units for which that buyer could take credit.

This precludes the university from claiming any of the environmental attributes associated with those megawatts. In effect, this is analogous to UNH purchasing additional energy – with the standard carbon mix – from the New England grid to replace the renewable energy it had sold. The emissions associated with this transfer are added to the University's carbon footprint. In FY14, this amounted to 11,677 t eCO2e that

must be added to the university's gross emissions—or roughly 20%.

UNH plans to continue to sell RECs to help offset the investment in EcoLine (which is still being paid off) and to contribute to the University's revolving energy efficiency fund –used in the implementation of the UNH Climate Action Plan, WildCAP.[6]

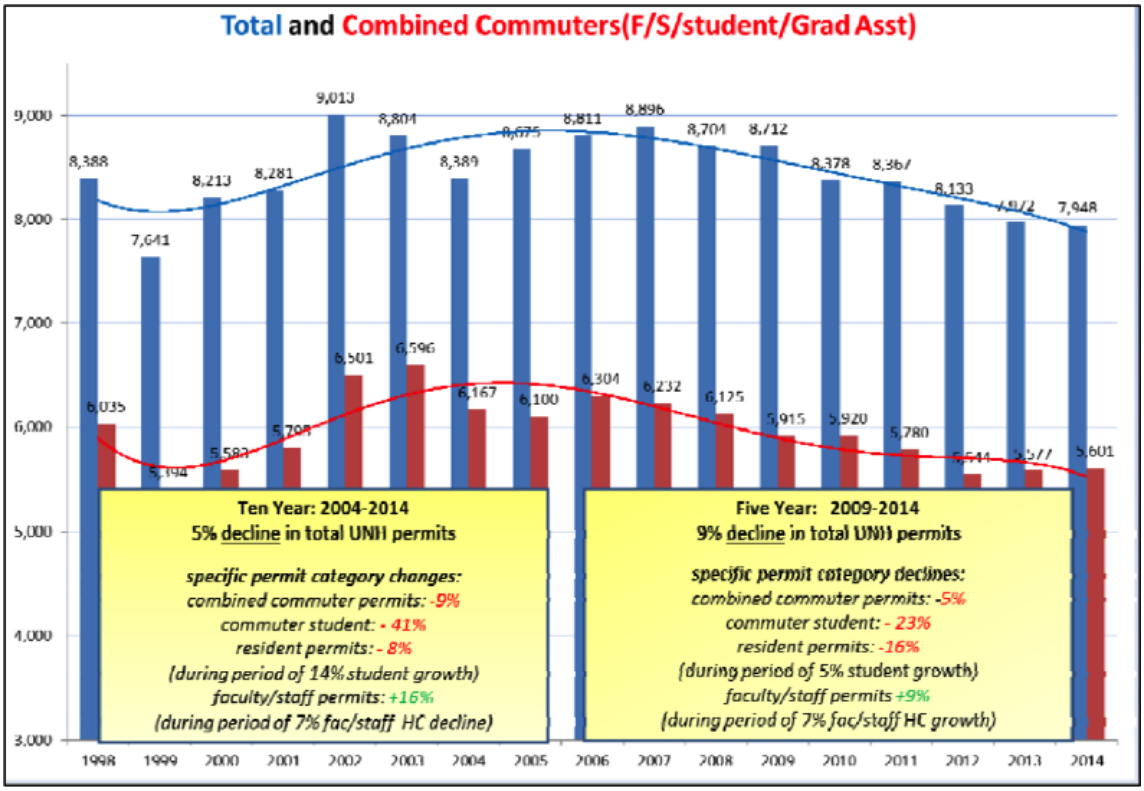
Scope 3 Emissions: Outsourced Activities

Though beyond direct control of the University, and optional from the perspective of international corporate carbon accounting and reporting standards, certain outsourced emissions-related activities have traditionally been reported as part of the campus GHG footprint. That's because UNH recognizes that it has the potential to impact these emissions sources—positively or negatively. Historically, the University has always included emissions from landfilling its solid waste, and from staff, faculty and student commutes in its GHGI. With the previous update published in 2013, UNH also started tracking emissions from Directly Financed Travel (i.e. air travel), per requirements of the ACUPCC.

Commuting

Estimates from available data suggest that combined commuting emissions are down nearly 21% from the last reported year (FY '11) and more than 35% from UNH's baseline year (FY '01). This continued downward trend in combined commuting emissions reflects UNH's concerted efforts at transportation demand management since 2003. UNH operates a large regional transit service – providing over 1.3 million trips a year to eight communities and offers free transit to faculty/staff and students. This is one of the largest transit services in the state.

Beyond UNH's robust transit programs, another key factor in the downward trend in student commuting emissions, specifically, is the increasing number of students moving into Durham from regional housing. UNH has historically housed over 50% of its undergraduates in university housing. Recently there has been a dramatic increase in privately built in-town Durham student housing in close proximity to campus. Over hundreds of new private student beds have been built in Durham since 2012—with significantly more continuing to come online since the



completion of this FY 2014 analysis. This 'in-migration' of student housing to Durham has resulted in a decline in commuter parking permit sales (down nearly 50% in past decade) and recently measured regional transit use – but an increase in walking, biking and on-campus transit use.

This shift in housing patterns may have a trickle-down effect for staff and faculty, as it has the potential to increase the amount of affordable family housing options in communities closer to campus (in the areas that students have been slowly vacating to move closer.) We anticipate this will continue to drive commuting emissions down across the board. It remains to be seen what the in-town traffic and emissions will be as the number of students living off-campus but in Durham continues to increase; however, approximately half of the recently built in-town units do not have associated student parking and these students are not eligible for UNH commuter parking permits.

It is notable that at present UNH's staff and faculty emissions constitute nearly the same volume of emissions as do those from student commuting—even though there are more than twice the number of commuting (i.e., off-campus) students as there are faculty and staff. This is due to some measure—as noted above—in the greater concentration of on-campus or near-campus student housing options (as contrasted with the relatively high cost of non-student housing in greater Durham, which requires many staff and faculty to live further out from campus.) It also reflects the availability of very cheap parking permits for staff and faculty, the price of which has remained static for the past decade. This remains a point of contention, as it is a disincentive to reduce single-occupancy-vehicle trips to campus, but is a dearly-held employee benefit that is entrenched in the campus culture and faculty union contracts

Details for FY '14 emissions estimation: Students

Number of student commuters: The total number of FY '14 "full-time equivalent" students (15,902) were obtained from campus planning.

Trips Per Week and Weeks Per Year: The number of weeks per year reflects a two-semester commute (30 weeks). The average number of trips per week is assumed to be 10—a figure which has been increased over recent years (from roughly 6 trips per week in 2001 and earlier) to account for changing students habits.

Mode Split: Roughly 50% of the UNH student (undergrad and graduate) body lives on-campus. The remaining students live off-campus in Durham and surrounding communities like Dover and Newmarket.

Estimated from prior year comprehensive standardized transportation surveys completed by the UNH Survey Center, parking permit applications and logical assumptions for the Durham-based population, the figures below represent the mode split for students in past GHGI reports and this update.

Students primary commute mode to UNH in typical week

	2001	2007	2011	2014
Drive Alone	93%	50%	24%	24%
Carpool 2+	2%	8%	6%	6%
Bike/walk	2%	15%	17%	45%
NH Transit	1%	20%	25%	25%
Other	2%	5%	0%	-

The next full comprehensive UNH Transportation Survey will be done in spring of 2016.

Distance: Information from student parking permit applications and transit route data were used to extrapolate commuting distances. Estimates were 10.25 average miles per single-car trip, 10 average miles per carpool trip, and 3.25 miles per bus trip (this number is based on a confirmed annual average of 9 miles per trip outside of Durham, 1.8 miles per trip in Durham.)

Details for FY '14 emissions estimations: Faculty and Staff

Number of commuters: Total number of faculty and staff "full-time equivalents" for the FY 2014 (844 and 2183, respectively) were obtained from Campus Planning.

Trips Per Week and Weeks Per Year: For faculty, the average number of (one-way) trips per week was assumed to be 9 and the number of weeks per year they would be commuting was assumed to be 40. For staff, the average number of (one-way) trips per week was assumed to be 9 and the number of weeks per year they would be commuting was assumed to be 50. These inputs have remained consistent since the baseline year.

Mode Split: These numbers were based extrapolated based on results from the transit survey and the number of parking permits issued.

Faculty/Staff primary commute mode to UNH in typical week				
	2001	2007	2011	2014
Drive Alone	93%	50%	48%	77%
Carpool 2+	2%	8%	11%	2%
Bike/walk	2%	15%	17%	2%
NH Transit	1%	20%	25%	19%
Other	2%	5%	0%	-

Distance: A list the communities from which faculty and staff commute (based on home addresses) and the number of combined staff and faculty commuting from each community was provided by the campus planning office. A weighted average commuting distance was calculated for the combined faculty and staff population, using the commuting populations of the top 32 commuting communities in New Hampshire and Maine. For commuters outside the top 32 communities, distances used were Concord (NH), Portland (ME), Boston (MA), and Hartford (other NE). Employees from outside NE were assumed to actually reside in Durham and were not included. Once the weighted distance of 14 miles for the combined employee categories was calculated, faculty and staff distances were differentiated using the equation 14 = (1/3)*faculty_distance + (2/3)*staff_distance; which resulted in an average commuting distance of 12 miles (for driving alone and carpooling) for faculty and 15 miles (for driving alone and carpooling) for staff. The distance for bus commutes for both groups was estimated at approximately 9 miles, based on transit survey and ridership data.

Solid Waste Disposal

While collecting solid waste data is important from a sustainability perspective, and emissions from solid waste disposal are a required reporting category for the ACUPCC, emissions from landfilling UNH's garbage are negligible. This is especially true because the waste gets sent to a landfill that captures the methane and converts it to landfill gas that is sent back to UNH as fuel, creating a closed loop. That said, even were the trash to be sent to a landfill that did not capture and flare the methane, the relative contribution to the UNH GHGI from waste disposal would be small compared to the other sources.

Carbon Offsets, Sinks, Avoided and Biogenic Emissions

Renewable Energy Credits

As noted in the Scope 2 section, UNH sells the RECs generated from the EcoLine project—resulting in a net addition to our overall carbon footprint. Currently these RECs account for 20% of reported UNH emissions.

Purchased Offsets

UNH does not purchase any renewable energy credits. The current plans for emissions reductions outlined in WildCAP calls for a 50% reduction by 2020 without the use of purchased offsets.

Forest Preservation

Carbon uptake by woodlands in College Woods, Burley-Demeritt Farm, Woodman Farm, and Kingman Farm is once again tracked in this inventory. These lands total about 785 acres and represent the woodlands immediately abutting core campus. An extensive student project in FY09 did a rigorous assessment of the carbon sequestration on UNH's lands—now estimated at 7.33 t/hectare/year. This results in 2,267.7 t CO2e of sequestration each year.

Note, however, that this figure is NOT directly subtracted from the university's gross emissions. It is tracked and reported because it is useful to note that this is stock of carbon that would have to be added into gross emissions if the university were to deforest those lands. It does not count as an offset to the reported UNH footprint.

Composting

UNH continues its on-campus composting program, which began in 2003. Roughly 200 tons of waste were composted in FY14. These reductions are considered "additional" and have the effect of reducing the UNH carbon footprint by ~310 t CO2e per year.

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 $1,500,000 in energy savings "returns," including over $500,000 in FY15 alone, it has allowed the University to leverage an an additional $400,000 in grants and incentives. 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-- 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. That initiative now has 51 members and accounts for $110 million in investments.

Biogenic Emissions

Using biofuels like B20 results in carbon dioxide emissions, but because the carbon dioxide would have been emitted over time, as the biomass that created that biofuel decayed, these emissions are not generally reported as part of the Scope 1, 2 or 3 categories. They have been considered "carbon neutral" because the carbon dioxide would have been released back into the atmosphere as part of the natural carbon cycle at some point, anyway. However, the GHG Protocol now recommends reporting these emissions in a separate "biogenic" category. UNH, as noted, uses some B20 in its campus fleet; we used nearly 72,000 gallons in FY14. This resulted in 136 MTCDE in biogenic GHG emissions.

Next Steps: Future Data Considerations

New methods for tracking greenhouse gas emissions, new research, and new data make this inventory an evolving process. Some potential ideas for future improvement are detailed below.

Expanding Operational Boundaries:
More Comprehensive Scope 3 Accounting

As noted, UNH currently reports several "Scope 3" emissions sources: namely, emissions from student, staff and faculty commuting, long-distance travel, and landfilling our solid waste. We report these categories of emissions, even though the University has less control over managing them than it does our Direct (Scope 1) our Purchased Energy (Scope 2) emissions, because we know they have a significant impact; because protocols exist for measuring them in a standardized fashion; and because as a signatory to the American College and University Climate

Commitment, these are the categories we are required to report. We *could* also measure and report other such indirect contributors to our carbon footprint—for example, the GHGs emitted in the process of producing and transporting the food that we serve on campus, or the GHGs associated with actually producing the fuels that we use—but because those are not currently standard categories for campus GHG reporting, and because established protocols for doing so had not been created until recently, we have not yet chosen to do so.

While this selective reporting of Scope 3 emissions is the current standard practice nationwide (and globally), there is a growing push for more comprehensive Scope 3 reporting. A pilot project at the University of Cambridge that estimated the entire Scope 3 campus footprint, for example, found that the Scope 3 emissions actually comprised more than 50% of the total campus footprint. A few corporate attempts to do a similarly comprehensive analysis have had similar or even more extreme findings. This suggests that current US campus greenhouse gas reports, which on average show Scope 3 emissions comprising roughly 10-30% of the total campus footprint, may be significantly under-representing their true impact or influence in terms of climate change.

In 2014, the Sustainability Institute began researching how a newly-released Scope 3 Accounting Protocol from the Greenhouse Gas Protocol project (considered the definite global authority on entity-level GHG reporting, whether for campuses, businesses or governments) might be applied to the Campus Carbon Calculator™, which UNH uses to determine its own carbon footprint and also curates as a tool for other colleges and universities to use. This means that, when the next GHGI update is conducted, we might have a roadmap in place for including all relevant Scope 3 emissions.

Expanding Organizational Boundaries: Including the Law School and UNHM Campuses

From a University of New Hampshire system perspective, the Law School in Concord and the Manchester campus are operationally affiliated with the Durham campuses. However, the UNH GHGI has traditionally only included emissions from the Durham campus, and not from the Concord or Manchester campuses. The UNH Sustainability Institute is investigating the feasibility of conducting a GHGI analysis that includes the Concord and Manchester campuses, which could be examined separately but could also be integrated into the overall UNH GHGI in the future in order to provide a more comprehensive view of the University's total climate impact.

Nitrogen Footprinting

Just as UNH helped pioneer campus carbon footprint reporting as one of the first universities to publish a campus greenhouse gas inventory, back in 2001, the University is likewise seeking to lead in efforts to be transparent about another aspect of its environmental impact: the nitrogen footprint. Like greenhouse gas pollution, nitrogen pollution has a significant deleterious impact on global ecosystems. It also leads directly to local negative impacts on human and ecosystem health, including smog, acid rain, biodiversity loss, dead zones, and climate change.

The first institution-level nitrogen footprint calculation was completed at the University of Virginia in 2013. The methodology and tool resulting from that UVA initiative has since been updated and expanded for use by a broader range of universities. A small group of leading US campuses—including the University of New Hampshire—is now testing the tool before it is launched publicly. The calculation of a baseline nitrogen footprint for the University of New Hampshire will be complete in fall 2015.

The nitrogen footprint has significant overlap with the carbon footprint, particularly in the energy sector. (In fact, the GHGI already captures one aspect

of nitrogen pollution: emissions of N2O.) In addition, most carbon footprint reduction strategies will also reduce the nitrogen footprint, which is a win-win for sustainability. Because UNH provides the widely-used Campus Carbon Calculator™ tool to campuses already, we are now investigating possibilities for combining the campus nitrogen footprint tool with the existing Campus Carbon Calculator, to streamline data collection and reporting and to provide our UNH community as well as the many hundreds of Campus Carbon Calculator users across the globe with a more complete picture of the campus environmental impact.

ENDNOTES

1 See Page 12 of the ACUPCC Implementation Guide for an explanation of Scopes in GHG accounting: http://www.presidentsclimatecommitment.org/files/documents/ACUPCCImplementationGuide_V2.1.pdf .

2 See http://www.sustainableunh.unh.edu/ecoline for further explanation.

3 The Campus Carbon Calculator (CCC), created and maintained by UNH, is the most widely used tool in higher education for measuring and managing campus carbon footprints. http://www.sustainableunh.unh.edu/calculator

4 Founded in 2005, the Energy Task Force (ETF) is the formal working group behind UNH's broad Climate Education Initiative (CEI). - See more at: http://www.sustainableunh.unh.edu/etf

5 This comparative number was arrived at based on the energy content (MMBTU) of each fuel.

6 The UNH Durham campus's climate action plan -- called WildCAP -- consolidates the energy conservation, energy efficiency, and climate mitigation and adaptation planning and work being done across campus into one coherent framework. http://www.sustainableunh.unh.edu/wildcap

Sustainability is a core value of UNH, shaping culture, informing behavior, and guiding work. As a nationally recognized leader, the Sustainability Institute acts as convener, cultivator and champion of sustainability on campus, in the state and region, and around the world. Learn more at www.sustainableunh.unh.edu.

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APPENDIX A: HISTORICAL TOTALS

SUMMARY OF HISTORICAL EMISSIONS

Fiscal Year	Total Scope 1	Scope 2 "Raw"	Scope 2 w/REC Sales	Total Scope 3	Scope 1 and 2	Scope 1 and 2 Adjusted for REC Sales	Gross Combined Emissions
	MT eCO_2	MT eCO_2	MT eCO_2	MT eCO_2	MT eCO_2	MT eCO_2	MT eCO_2
1990	29,683	20,343	20,343	28,498	50,026	50,026	78,524
1991	27,810	20,182	20,182	27,935	47,992	47,992	75,927
1992	31,671	20,425	20,425	28,240	52,096	52,096	80,336
1993	30,373	20,700	20,700	29,164	51,073	51,073	80,237
1994	31,650	20,542	20,542	29,145	52,192	52,192	81,337
1995	28,911	21,136	21,136	28,819	50,047	50,047	78,866
1996	37,676	23,982	23,982	28,840	61,658	61,658	90,498
1997	34,742	23,878	23,878	28,448	58,620	58,620	87,068
1998	32,665	22,952	22,952	28,097	55,618	55,618	83,715
1999	32,619	23,401	23,401	28,378	56,020	56,020	84,398
2000	30,352	23,684	23,684	28,116	54,036	54,036	82,152
2001	33,348	25,153	25,153	28,676	58,500	58,500	87,176
2002	30,374	26,691	26,691	28,905	57,064	57,064	85,970
2003	37,733	27,149	27,149	30,285	64,881	64,881	95,166
2004	36,685	28,643	28,643	28,865	65,329	65,329	94,194
2005	35,159	27,273	27,273	28,566	62,431	62,431	90,998
2006	34,816	28,131	28,131	27,638	62,947	62,947	90,585
2007	48,842	10,107	10,107	24,704	58,949	58,949	83,653
2008	49,719	8,594	8,594	24,555	58,312	58,312	82,867
2009	46,983	8,538	9,695	24,377	55,521	56,678	81,055
2010	22,678	4,333	19,710	23,787	27,010	42,388	66,176
2011	19,996	3,619	16,706	22,597	23,615	36,702	59,299
2012	17,552	2,722	15,874	21,134	20,275	33,426	54,560
2013	19,964	4,834	16,987	19,729	24,798	36,951	56,680
2014	24,232	2,510	14,808	20,264	26,743	39,041	59,305

APPENDIX B: SCOPE 1 AND 2

SCOPE 1 AND 2 EMISSIONS

Fiscal Year	Scope 1						Scope 2	
	Co-gen Electricity	Co-gen Steam	Other On-Campus Stationary	Direct Transportation	Refrigerants & Chemicals	Agriculture	Purchased Electricity	REC Sales
	$MTeCO_2$	$MTeCO_2$	$MTeCO_2$	$MTeCO_2$	$MTeCO_2$	$MTeCO_2$	$MTeCO_2$	MT eCO2
1990	0	0	25743	2575	0	1365	20343	
1991	0	0	23845	2575	0	1389	20182	
1992	0	0	27777	2575	0	1318	20425	
1993	0	0	26437	2575	0	1361	20700	
1994	0	0	27767	2568	0	1314	20542	
1995	0	0	25025	2518	0	1369	21136	
1996	0	0	33810	2494	0	1372	23982	
1997	0	0	31020	2356	0	1366	23878	
1998	0	0	28845	2493	0	1327	22952	
1999	0	0	28952	2393	0	1275	23401	
2000	0	0	26571	2364	0	1417	23684	
2001	0	0	29519	2335	3	1491	25153	
2002	0	0	26565	2308	5	1496	26691	
2003	0	0	33987	2277	0	1468	27149	
2004	0	0	32972	2192	0	1521	28643	
2005	0	0	31503	2066	49	1540	27273	
2006	1835	1375	27684	2371	0	1552	28131	
2007	15716	15444	13710	2031	407	1535	10107	
2008	18218	18223	8660	2017	1143	1458	8594	
2009	17679	17683	7771	2016	267	1567	8538	1157
2010	7961	4819	6391	1953	0	1554	4333	15378
2011	6534	4133	5793	1919	78	1538	3619	13086
2012	4030	4597	5503	1829	0	1594	2722	13152
2013	4449	5522	6409	2022	0	1562	4834	12153
2014	5706	7822	6771	2229	0	1705	2510	12298

APPENDIX C: SCOPE 3

Fiscal Year	SCOPE 3 EMISSIONS						
	Faculty / Staff Commuting	Student Commuting	Directly Financed Air Travel	Other Directly Financed Travel	Study Abroad Air Travel	Solid Waste	Scope 2 T&D Losses
	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2
1990	11,808	7,233	7,444	Not tracked	Not tracked	0	2,012
1991	11,488	7,007	7,444	Not tracked	Not tracked	0	1,996
1992	11,545	7,231	7,444	Not tracked	Not tracked	0	2,020
1993	12,170	7,503	7,444	Not tracked	Not tracked	0	2,047
1994	12,181	7,488	7,444	Not tracked	Not tracked	0	2,032
1995	11,923	7,362	7,444	Not tracked	Not tracked	0	2,090
1996	11,762	7,262	7,444	Not tracked	Not tracked	0	2,372
1997	11,497	7,211	7,444	Not tracked	Not tracked	-66	2,362
1998	11,370	7,077	7,444	Not tracked	Not tracked	-64	2,270
1999	11,741	6,950	7,444	Not tracked	Not tracked	-72	2,314
2000	11,499	6,892	7,444	Not tracked	Not tracked	-62	2,342
2001	11,951	6,859	7,444	Not tracked	Not tracked	-66	2,488
2002	11,858	7,030	7,444	Not tracked	Not tracked	-66	2,640
2003	12,965	7,256	7,444	Not tracked	Not tracked	-66	2,685
2004	11,438	7,216	7,444	Not tracked	Not tracked	-66	2,833
2005	11,311	7,180	7,444	Not tracked	Not tracked	-66	2,697
2006	10,496	6,981	7,444	Not tracked	Not tracked	-66	2,782
2007	9,547	6,772	7,444	Not tracked	Not tracked	-59	1,000
2008	9,585	6,760	7,444	Not tracked	Not tracked	-85	850
2009	9,334	6,803	7,444	Not tracked	Not tracked	-48	844
2010	9,085	6,922	7,556	Not tracked	Not tracked	-44	268
2011	8,702	6,908	6,820	Not tracked	Not tracked	-57	224
2012	7,406	6,004	7,578	Not tracked	Not tracked	-22	168
2013	6,441	5,686	7,327	Not tracked	Not tracked	-24	299
2014	6,048	6,168	7,941	Not tracked	Not tracked	-48	155