

SIMAP

SUSTAINABILITY INDICATOR MANAGEMENT & ANALYSIS PLATFORM

user's guide

The complete guide to conducting an inventory of greenhouse gas emissions and nitrogen losses and building a portfolio of reduction projects on your campus

UNH Sustainability Institute

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Document Control

Date	Author	Changes	Version #
September 2017	Allison Leach, Yulia Rothenberg	Updated to reflect Nitrogen addition and new SIMAP methodology Edited and added SIMAP new structure	Draft 5.3.1
November 2017	Yulia Rothenberg	Updated with "changes from CCC language" for Air Travel emissions calculations and RECs. Added Weighted Users methodology to align with other tools explanation. [AASHE STARS] Updated to reflect SIMAP data entry and changes from previous version.	Draft 6
January 2018	Allison Leach	Wastewater section in Appendix Light editing, especially to images, offsets appendix section, and air travel radiative forcing text	Draft 6.1
In process	Jennifer Andrews	RECs	Draft 6.2
January 26, 2018	Yulia Rothenberg	Agriculture: removed from the reports and results screens in SIMAP, updated throughout the document and on page 56. Added details for new fields added in SIMAP since last update in Appendix 2, Data Checklist. Local food calculation description – Appendix 1: Data Collection Outline	Draft 6.1

1. Executive summary

1.1 What is SIMAP?

This UNHSI Sustainability Indicator Management and Analysis Platform (SIMAP™) is a new web-based platform for tracking, calculating, and managing your campus' carbon and nitrogen footprints.

This new and improved platform is based on the Campus Carbon Calculator (a tool used by over 1500 hundred schools, colleges, universities, and other organizations across North America and the globe) and the Nitrogen Footprint Tool (a novel metric for tracking a broader range of sustainability criteria).

1.2 What can SIMAP do?

SIMAP will help facilitate these major tasks for a sustainability inventory:

Current →
1. **Conduct an Inventory of Greenhouse Gas Emissions and Reactive Nitrogen:** Collect, analyze, and present data on the emissions of greenhouse gases and losses of reactive nitrogen attributable to the activities and operations of an institution. This first step provides an essential foundation for a comprehensive assessment of a campus' contribution to climate change and other environmental impacts, and it is the basis for institutional action.

Future →
2. **Project into the Future:** Project the campus' "business as usual" and alternate-scenario footprint trajectories to provide a context for choosing greenhouse gas emission reduction and nitrogen reduction projects and targets.

Future →
3. **Evaluate a Portfolio of Carbon and Nitrogen Reduction Projects:** Develop a portfolio of proposed carbon and nitrogen reduction projects to create an effective climate action plan that will address the specific emissions identified in your inventory.

The current version of SIMAP directly supports #1 above. Future versions will help you project your results into the future, assess the impact of different strategies on your footprints, and report your results directly to sustainability organizations.

1.3 What is a carbon footprint?

The carbon footprint is a measure of the greenhouse gases emitted from a campus' activities. It includes all six greenhouse gases specified by the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), and perfluorocarbons (PFC), and sulfur hexafluoride (SF_6). The platform was based on the workbooks provided by the Intergovernmental Panel on Climate Change (IPCC) for national-level inventories, and it incorporates data from the Fourth Assessment Report of the IPCC. SIMAP has adapted this IPCC data for use at institutions like a college or university but follows the same protocols.

1.4 What is a nitrogen footprint?

The nitrogen footprint is the amount of reactive nitrogen released to the environment from a campus' resource consumption. Reactive nitrogen includes all forms of nitrogen except the unreactive dinitrogen (N_2) that makes up 80% of the atmosphere. Examples of reactive nitrogen include water pollutants nitrate (NO_3^-) and ammonium (NH_4^+); air quality pollutants ammonia (NH_3) and nitrogen oxides (NOx); and the greenhouse gas nitrous oxide (N_2O). When released to the environment, reactive nitrogen contributes to a cascade of negative impacts to human and ecosystem health (e.g., smog, acid rain, forest dieback, eutrophication, climate change). Major sources of reactive nitrogen include food production and fossil fuel combustion.

1.5 What does this user's guide provide?

This user's guide – in addition to SIMAP – is meant to support real change on your campus. This manual provides guidelines for using SIMAP and documentation for the methods and calculations. Once emissions sources are tracked and quantified, feasible and effective carbon and nitrogen reduction measures can be identified. A holistic incorporation of environmental sustainability is a long and evolving process; SIMAP will give you the tools you need to get started.

2. SIMAP: The Basics

SIMAP™: Sustainability Indicator Management and Analysis Platform is a new platform for calculating, tracking, and managing your campus' carbon and nitrogen footprints.

The mission of SIMAP is to continue to help institutions, colleges, and universities track their footprints so they can meet their sustainability goals as effectively and efficiently as possible.

A web-based platform, SIMAP also supports the collection of aggregated data sets to track the progress of higher education in general towards sustainability targets.

SIMAP has a new robust reactive nitrogen component, which allows users to see how their campus contributes to a broader range of environmental impacts. In the future, there are plans to include more sustainability indicators, such as water and phosphorus.

2.1 Why a new tool?

We are launching SIMAP to replace the Excel Campus Carbon Calculator and the online CarbonMAP for several reasons:

1. Capture the multiple systems impacts of campus operations by including the nitrogen footprint, with the potential to expand to additional indicators in the future;
2. Increase standardization and streamline tracking efforts by using a single tracking tool;
3. Align with organizational carbon commitments and new GHG protocols for renewable energy;
4. Integrate with the reporting platform for Presidents' Climate Leadership Commitment signatories;
5. Ensure UNHSI's continued ability to support and maintain a dedicated, user-driven accounting tool for the higher education sector; and
6. Conduct and publish research about data trends across higher education and other sectors.

2.2 What is a carbon footprint?

The carbon footprint is a measure of the greenhouse gases emitted from a campus' activities. It includes all six greenhouse gases specified by the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), and perfluorocarbons (PFC), and sulfur hexafluoride (SF_6). When the 'carbon footprint' is referred to in this document and in SIMAP, it includes all six of these greenhouse gases.

SIMAP enables you to calculate [now] and project [in next version] emissions for the years 1990-2060 and produce charts and graphs illustrating changes and trends in your institution's emissions over time. The platform was based on the workbooks provided by the Intergovernmental Panel on Climate Change (IPCC) for national-level inventories, and it incorporates data from the Fourth Assessment Report of the IPCC. SIMAP has adapted this IPCC data for use at institutions like a college or university, but follows the same protocols.

SIMAP uses standard methodologies codified by the GHG Protocol Initiative and employed by corporations, the state of California, The Climate Registry, and other entities to account for greenhouse gas (GHG) emissions.[1] These methodologies are currently the most accurate and widely accepted amongst policy makers. Inventories produced by SIMAP are compatible with current standards used to craft forthcoming cap-and-trade policy.[2] SIMAP is also a preferred tool for the Second Nature Carbon/ Climate Commitment.

Since its development in 2001, the campus carbon footprint tool has been used by thousands of campuses around the world. The original Excel-based campus carbon footprint tool was developed at the University of New Hampshire in 2001 (Figure 1). The tool then moved to the non-profit Clean Air Cool Planet, which launched a food module (CHEFS, which is no longer in use) and the first web-based version of the tool (CarbonMAP). In 2014, the campus carbon footprint tools moved back to the University of New Hampshire Sustainability Institute.

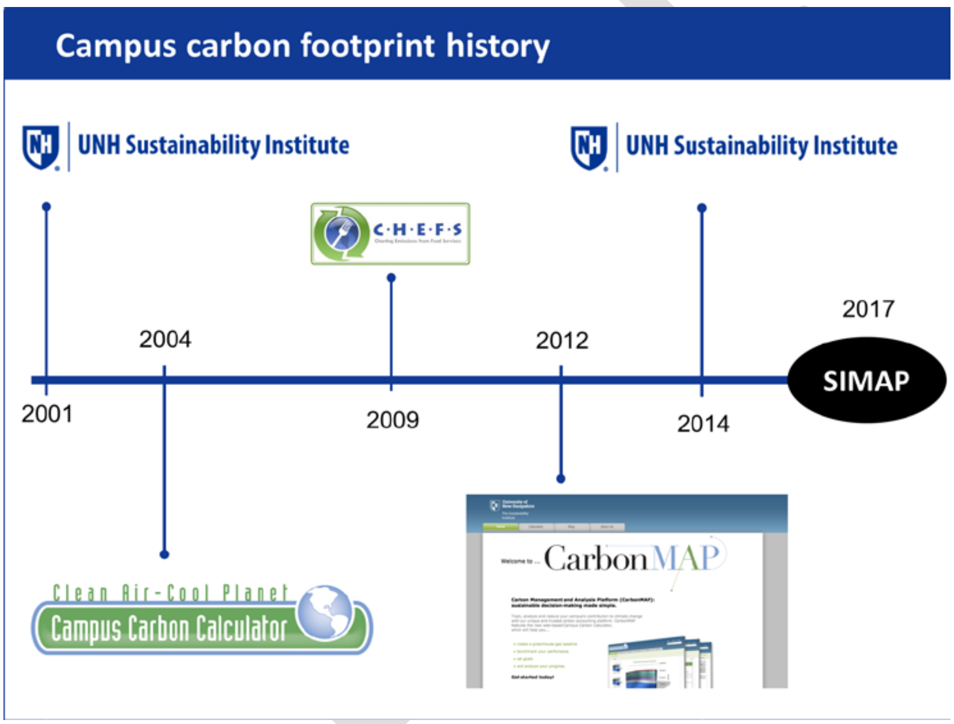


Figure 1 A history of the campus carbon footprint tool

2.3 What is a nitrogen footprint?

[1] Most Notably, WRI (World Resources Institute) and the CCAR (California Climate Action Registry).
[2] Disclaimer: though methodologies remain fairly constant, the evolution of markets for RECs and carbon offsets may have a profound effect on electricity emissions attributed to institutions – especially when custom fuel mixes contain high ratios of emissions free power like nuclear and hydropower.

A nitrogen footprint is the amount of reactive nitrogen released to the environment from a campus' resource consumption (Leach et al. 2012, Galloway et al. 2014). Reactive nitrogen includes all forms of nitrogen except the unreactive dinitrogen (N_2) that makes up 80% of the atmosphere. Examples of reactive nitrogen include water pollutants nitrate (NO_3^-) and ammonium (NH_4^+); air quality pollutants ammonia (NH_3) and nitrogen oxides (NOx); and the greenhouse gas nitrous oxide (N_2O) (Galloway et al. 2003). When released to the environment, reactive nitrogen contributes to a cascade of negative impacts to human and ecosystem health (e.g., smog, acid rain, forest dieback, eutrophication, climate change) (Erisman et al. 2013). Major sources of reactive nitrogen include food production (from sources like fertilizer runoff, manure management, and food waste) and fossil fuel combustion (a by-product of combustion).

The nitrogen footprint was originally developed at the University of Virginia (UVA) in 2009 to calculate UVA's nitrogen footprint (Leach et al. 2013) (Figure 2). With the support of a cooperative agreement from the Environmental Protection Agency, the Nitrogen Footprint Tool was expanded for use by other campuses. The Nitrogen Footprint Tool was launched for pilot testing in 2014, and two dozen campuses from the Nitrogen Footprint Tool Network have participated (Castner et al. 2017). For more information on campus nitrogen footprints, please see:

- The nitrogen footprint website, www.n-print.org, where you can also calculate your personal nitrogen footprint!
- The April 2017 Special Issue on Nitrogen Footprints in Sustainability: The Journal of Record, the flagship journal of AASHE (Figure 3).

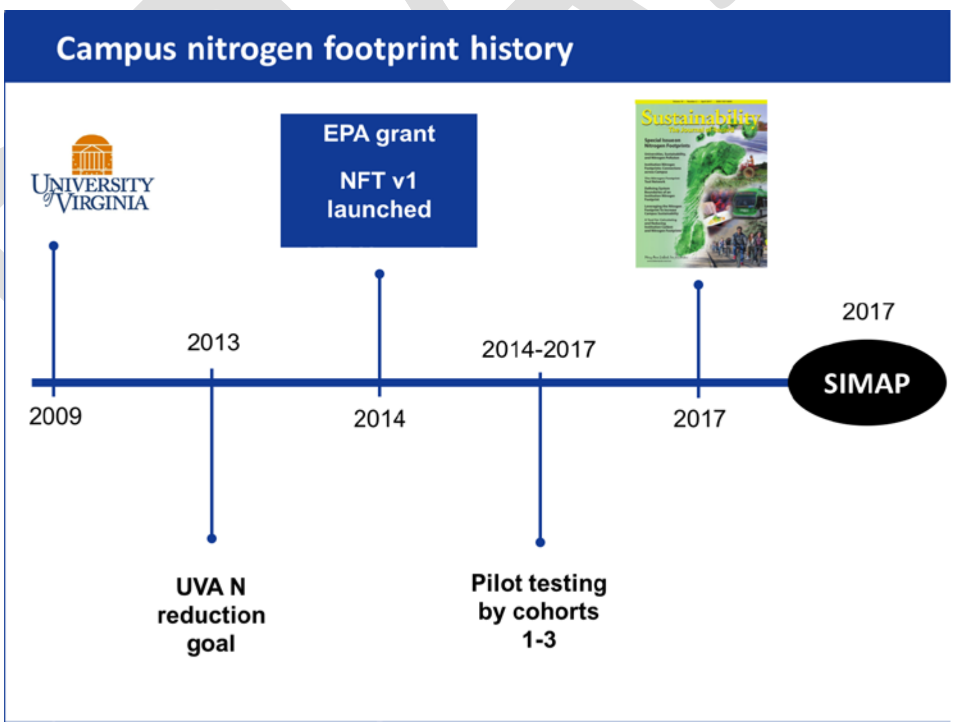


Figure 2 A history of the campus nitrogen footprint tool

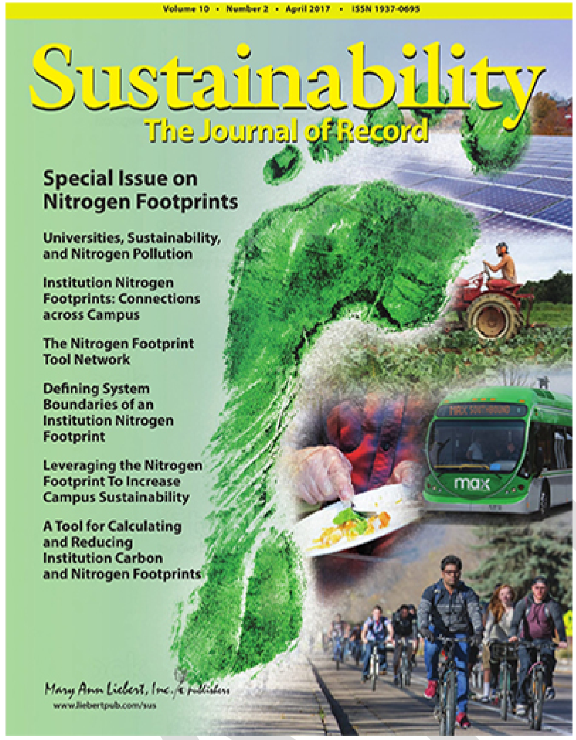


Figure 3 Cover of the Special Issue on Nitrogen Footprints in the April 2017 issue of the peer-reviewed journal Sustainability: The Journal of Record

SIMAP is the first tool to integrate the campus carbon and nitrogen footprints (Leach et al. 2017). SIMAP allows institutions to calculate, assess, and plan reductions for their campus nitrogen footprint. An important addition to SIMAP is food purchasing, which typically makes up the majority of a campus nitrogen footprint.

2.4 Why are we integrating the carbon and nitrogen footprints into a single tool?

After entering your campus inventory data set, you will now be able to calculate, track, and manage your campus carbon and nitrogen footprints together. There are several benefits to integrating these two footprints into a single tool. First, SIMAP provides a broader range of environmental impacts (Figure 4). Climate change is just one impact that results from campus activities. The nitrogen footprint broadens the scope to extend from local to global impacts such as biodiversity loss, eutrophication, water quality, smog, and acid rain.

Tracking the carbon and nitrogen footprints together is a win-win for most reduction strategies. Almost any time you reduce your campus carbon footprint, you will also reduce your nitrogen footprint. This is powerful for messaging and can highlight the broader impacts of mitigation strategies. If a carbon reduction goal is already in place or in progress at your institution, it may be synergistic to combine the carbon and nitrogen footprints. A combined carbon and nitrogen footprint reduction goal would have a broader reaching sustainability impact than either individual goal.

Finally, from a practical perspective, combining footprints into a single tool reduces data entry and analysis. You can enter your campus use data set once into SIMAP and calculate both footprints.

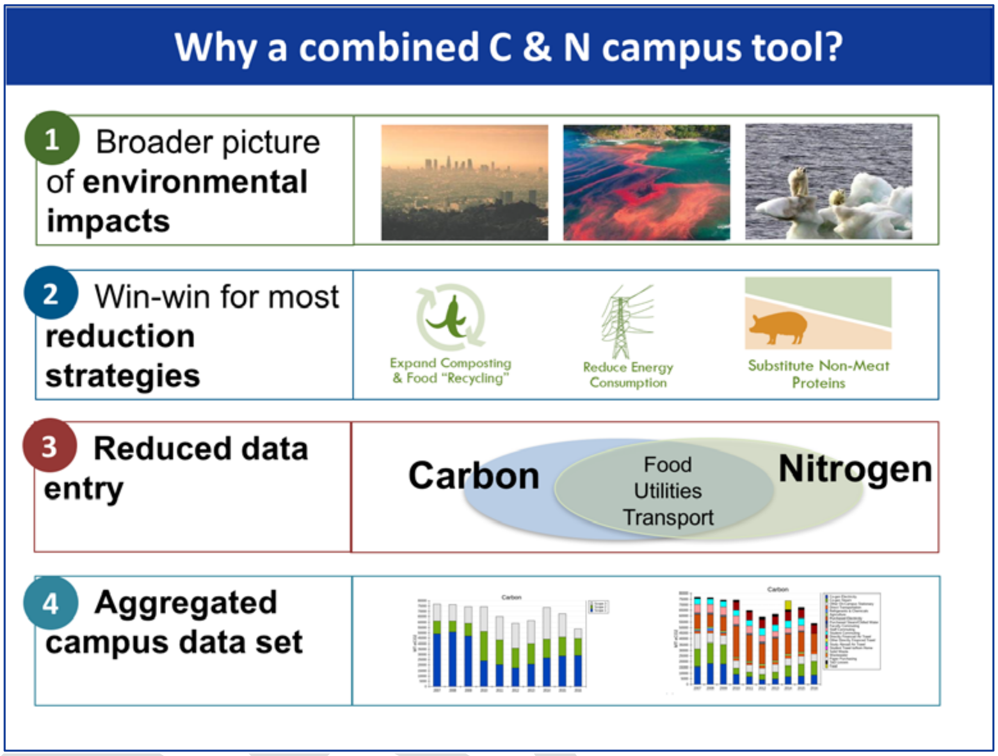


Figure 4 Reasons for combining the campus carbon and nitrogen footprints into a single tool

2.5 What can SIMAP help you do?

The redesigned and expanded SIMAP will offer campuses a simple, comprehensive, and affordable online platform for measuring, reporting, and managing their carbon and nitrogen footprints. After entering your institution information and campus resource use data, the tool calculates your carbon and nitrogen footprint.

The integration of the nitrogen footprint extends the scope of the tool beyond carbon, allowing it to account for environmental impacts such as biodiversity loss, water quality, and air quality. In addition, this integration incorporates the nitrogen and carbon footprint of food purchases.

We are also looking towards the future of sustainability reporting, designing the platform so that new sustainability indicators (phosphorus, water, and others) could be easily integrated in the future.

SIMAP will help facilitate these major tasks for a sustainability inventory:

1. **Conduct an Inventory of Greenhouse Gas Emissions and Reactive Nitrogen:** Collect, analyze, and present data on the emissions of greenhouse gases and losses of reactive nitrogen attributable to the activities and operations of an institution. This first step provides an essential foundation for a comprehensive assessment of a campus' contribution to climate change and other environmental impacts, and it is the basis for institutional action.
2. **Project into the Future:** Project the campus' "business as usual" and alternate-scenario footprint trajectories to provide a context for choosing greenhouse gas emission reduction and nitrogen reduction projects and targets.
3. **Evaluate a Portfolio of Carbon and Nitrogen Reduction Projects:** Develop a portfolio of proposed carbon and nitrogen reduction projects to create an effective climate action plan that will address the specific emissions identified in your inventory.

The current version of SIMAP directly supports #1 above. Future versions will help you project your results into the future, assess the impact of different strategies on your footprints, and report your results directly to sustainability organizations.

2.6 What are the different tiers of SIMAP?

SIMAP will offer three tiers of the tool with increasing features:

Basic

At no cost, the basic access to SIMAP will provide the calculation of the campus carbon and nitrogen footprint. This basic access will be available on a web platform where users can enter and store their data for up to two months. This option is ideal for classroom exercises and demonstrations, and it can also be used for stand-alone annual footprint calculations.

Tier 1

The Tier 1 functionality will be the first paid version, made available with the fall 2017 launch of SIMAP. The additional features of Tier 1 will include:

- Import of all input data, and export of all input data, emissions factors, and results for ease of use and analysis in Excel
- Customized emissions factors for all sources
- The ability to add and manage multiple users for one institutional account
- Additional user support from UNHSI
- Long term data storage for as long as an account is active

Tier 2

An update planned for fiscal year 2019 will implement the Tier 2 functionality, which will include additional premium features. The following are examples of the types of features that may be included:

- "Projections" and "solutions" analysis to assist in Climate Action Planning and nitrogen footprint reduction goals

- Complete Scope 3 reporting module (based on the World Resources Institute Scope 3 Protocol)
- Benchmarking capabilities based on sector averages and peer institutions
- Customizable report templates
- Auto-reporting to other platforms

Functionality	Basic	Tier 1	Tier 2
Calculation of a campus carbon and nitrogen footprint	X	X	X
Store data for limited time (two months)	X		
Store data for as long as license is active		X	X
Export all input data, results and emissions factors		X	X
Ability to add multiple users		X	X
Import previous data from the Excel Campus Carbon Calculator™ [v7 – v9.1] or CarbonMAP™ and now from Food Uploader		X	X
Calculation of all **Scope 1** and **Scope 2** carbon and nitrogen emissions	X	X	X
Scope 3 • C & N from Commuting (staff, faculty and students) • C & N from Business Travel • C & N from Study Abroad Air Travel • C & N from Student Travel to/from Permanent Residence • C & N from Waste Disposal • C & N from Wastewater Treatment • C & N from Purchased Food	X	X	X
Customize emission factors for all sources		X	X
Basic technical and methodological guidance from UNHSI	X	X	X
One-on-one technical and methodological support from UNHSI		X	X
Basic data validity control measures		X	X
Option to have inventory data and results reviewed by UNHSI staff		X	X
Complete Scope 3 emissions reporting			X
"Projections" and "solutions" modules			X
Customizable report templates			X

Table 1 SIMAP subscription levels and functionality for each level

2.7 What are the plans for continued development?

1. The 'Basic' and 'Tier 1' functionality will be part of the initial launch, which will allow you to calculate and track your campus carbon and nitrogen footprints
2. We will transition from the Campus Carbon Calculator and CarbonMAP over to SIMAP by January 2018 and end support of those tools
3. We have plans for future developments that will be launched as part of the 'Tier 2' functionality in December of 2018

3. Key concepts for footprint accounting

In this section, we provide important background information that will help you understand what to measure and what is included in the carbon and nitrogen footprint. We address what an inventory is (section 3.1), how to set your boundaries (section 3.2), key concepts for the carbon footprint (section 3.3), and key concepts for the nitrogen footprint (section 3.4).

3.1 What is an inventory?

Several different methods can be used to track the sustainability of a campus' activities, including the inventory/footprint approach and the budget approach. An inventory or footprint approach, which is used in SIMAP, connects campus activities with their associated carbon and nitrogen footprints. It focuses on activities that are part of a campus and are anthropogenic.

A budget, on the other hand, assesses inputs and outputs across the boundaries of a system. A budget can include natural sources not directly related to campus activities, such as atmospheric nitrogen deposition. Although a carbon or nitrogen budget provides important information about an institution's activities, it does not show as directly the amount of carbon or nitrogen released into the environment for which an institution is responsible — or highlight the opportunity to reduce it. If an institution has already calculated its carbon or nitrogen budget, then it will be easier to calculate its nitrogen footprint.

3.2 Setting boundaries

As you begin to work toward reducing your carbon and nitrogen footprint, how do you know what to measure? How do you define your system bounds? How do you differentiate between emissions the institution is responsible for versus those that are the responsibility of the individuals that make up that institution? These questions are not always easy to answer, but they must be addressed to collect data, measure your carbon and nitrogen footprint, set goals, and formulate a plan.

One of the most important topics found in this user's guide is how to set your campus boundaries. There are three types of boundaries to consider: organizational, operational and temporal. This section also addresses the concept of 'de minimus emissions' to help you understand what you should measure.

Organizational Boundaries

Organizational boundaries are generally the highest-level, most straightforward boundaries drawn. These boundaries tell you where you are measuring and reporting emissions – for one department or school, or the entire campus? For one state university campus, or the entire university system? What facilities or property will be included in your analysis?

The GHG Protocol suggests choosing one of two approaches to set organizational boundaries: the control approach or the equity share approach. The **control approach** suggests you measure emissions for any operations over which you have practical control, whether at facilities that are owned or leased. The

equity share approach suggests you measure emissions from facilities where you have some degree of ownership. The basic guidance is to choose and then consistently apply the approach that is going to be the most comprehensive. The same concepts apply to measuring a nitrogen footprint.

Scopes (operational boundaries)

Once you've identified *where* you will be managing carbon and nitrogen emissions, next you should decide *which* emissions sources to measure. Since there are greenhouse gas emissions and nitrogen losses associated at some point with nearly every action we take and every product we use, this counting could go on forever. Selecting operational boundaries is a key aspect of carbon and nitrogen management because it dictates how ambitious, and how comprehensive, your carbon and nitrogen management efforts will be.

One problem commonly identified when people first start considering carbon and nitrogen management commitments and strategies is the potential for the "double counting" of GHG and nitrogen sources or sinks. Given the nature of our market-driven society, it's hard to definitively place responsibility for many types of greenhouse gas emissions and nitrogen losses solely with one entity. Carbon and nitrogen management initiatives typically balance two competing desires: the institution's need to be a responsible citizen, thoughtfully and thoroughly accountable for its "true" impact, and its need to make commitments that it can keep and that make sense from a pragmatic, operational perspective.

The GHG Protocol presents a useful accounting concept, called scopes, that can help entities understand and structure decisions about operational boundaries, and can simultaneously help address the potential for "double counting." This approach defines three levels of responsibility for emissions, and it posits that an entity's responsibility for emissions is directly related to its control over, or ownership of, the sources of those emissions. For example, I am more responsible for the emissions from gasoline used in my car than the emissions from diesel in a bus I ride. It was my decision to buy a gas-guzzler rather than a fuel-efficient vehicle, and only I determine how far or frequently I drive. By contrast, I have no control over the fuel efficiency of another entity's buses, yet it was still my choice to outsource my transportation needs to them.

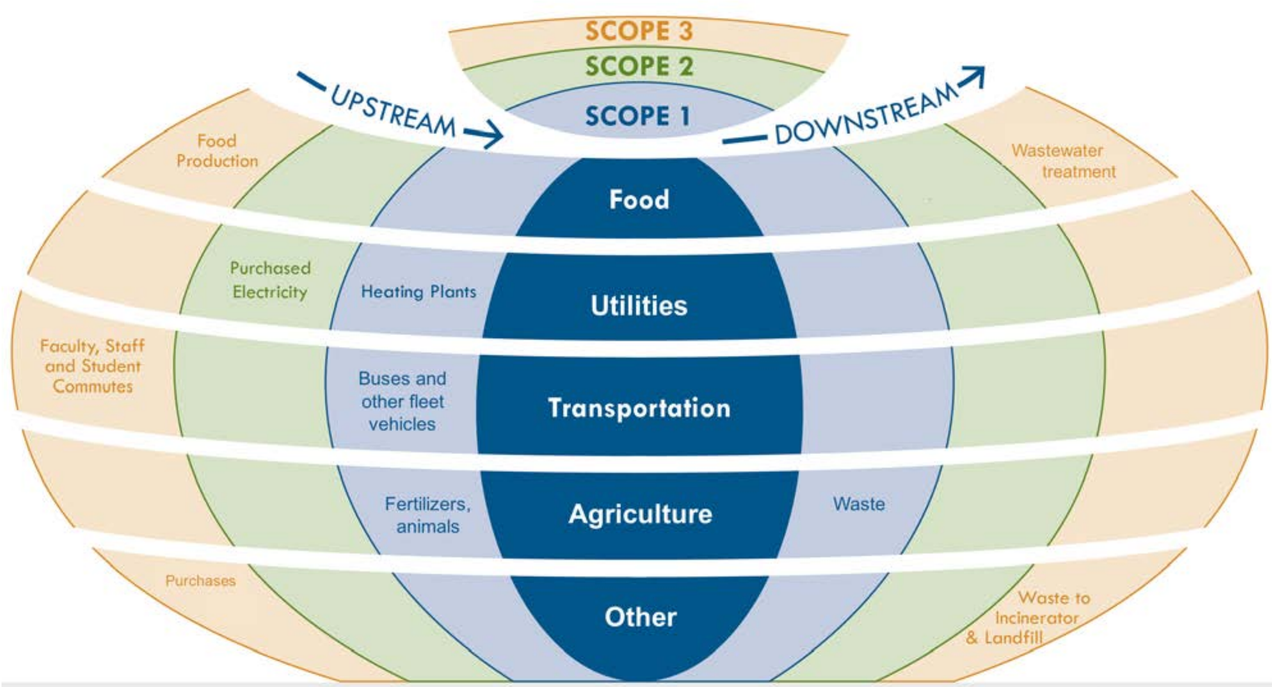


Figure 5 An example categorizing common emissions sources into scopes. This figure also addresses whether the losses occur upstream or downstream of the institution.

The scopes laid out by the GHG Protocol are as follows:

Scope 1 – Direct emissions from sources that are owned and/or controlled by your institution. This includes combustion of fossil fuels in college-owned facilities or vehicles, fugitive emissions from refrigeration, and emissions from on-campus agriculture or livestock husbandry. Your institution has complete control over these emissions, and they are no-one else's responsibility . Examples of these generally include the following:

- **On-Campus Stationary Sources**
  Emissions from all on-campus fuel combustion, excluding vehicle fuels
- **Direct Transportation Sources**
  Emissions from all fuel used in the institution's fleet (the vehicles it owns)
- **Agriculture**
  N_2O emissions from fertilizer use and CH_4 emissions from animals (cattle, horses, etc.)
- **Refrigeration and other Chemicals**
  Fugitive emissions from refrigerants and other sources

SCOPE 2

Purchased Electricity, Steam / Chilled Water

Renewable Energy Credits

Custom Fuel Mix (Electricity)

Custom Fuel Mix (Steam)

Custom Fuel Mix (Chilled Water)

Scope 2 – Indirect emissions from sources that are neither owned nor operated by your institution but whose products are directly linked to on-campus energy consumption. This includes purchased energy: electricity, steam, and chilled water. Although your institution is not directly responsible for these emissions, it is strongly implicated. These emissions come from converting energy sources that release greenhouse gas emissions when used (fossil fuels) to energy sources that do not (electricity, steam, or chilled water). Although your institution did not burn the coal to make the electricity you use, someone had to, and although the electricity producer emitted the gasses, they did not use any of the energy produced.[3]

- **Purchased Electricity**
  Emissions from the production of any electricity the institution purchases
- **Purchased Steam**
  Emissions from the production of steam purchased from off-campus
- **Purchased Chilled Water**
  Emissions from the production of chilled water purchased from off- campus
- **Renewable Energy Certificates**

SCOPE 3

Commuting

Business Travel & Study Abroad

Student Travel to/from Home

Food

Paper

Waste & Wastewater

Scope 3 – Other emissions attributed to your institution, deemed "optional" emissions by corporate inventories. This includes emissions from sources that are neither owned nor operated by your institution but are either directly financed (i.e. commercial air travel paid for by the institution) or are otherwise linked to the campus via influence or encouragement (i.e. air travel for study abroad programs, regular faculty, staff, and student commuting). Many Scope 3 emissions are considered "upstream" like the emissions associated with making and transporting plastic silverware. To prevent institutions from accounting for too many upstream emissions, most campuses define distinct financial or control boundaries to distinguish which Scope 3 emissions they are indeed responsible for.

- **Commuting**
  Emissions from regular commuting by faculty, staff, or students (does NOT include student travel to and from home over breaks) (note – student commuting is generally considered to be under more institutional control than staff/faculty commuting)
- **Directly Financed Outsourced Transportation**
  Emissions from travel that is paid for by the institution, but does not occur in fleet vehicles (business trips in commercial aircraft, staff travel in personal vehicles where mileage is reimbursed, etc.)

[3] The electricity producer IS responsible for energy losses due to inefficiency of production (i.e. if burning 1000 MMBtu of coal only generated 300 MMBtu of electricity). And the owner of the power lines is responsible for any electricity that is lost during transmission and distribution from power plants to end users (usually about 9%).

- **Study Abroad Air Travel**
  Emissions from students flying to their study abroad location
- **Transportation and Distribution Losses from Purchased Energy**
  Energy lost while transporting purchased electricity, steam, or chilled water to campus
- **Food**
  Emissions from producing, transporting, preparing, consuming, and composting food
- **Upstream Emissions from Directly Financed Purchases**
  Emissions associated with paper production, food production, fuel extraction, etc.
- **Solid Waste and Wastewater**
  Emissions from managing the institution's waste (incineration, landfilling, etc.)

Offsets and Sinks – Your footprint is what it is, regardless of what happens outside of your campus. However, if you use your financial control over outside entities in a way that creates a net reduction in worldwide carbon emissions and nitrogen losses that otherwise would not have occurred, you can justly declare that you have "offset" another entity's carbon or nitrogen. Usually, offset transactions are managed by firms that specialize in such complex transactions, but institutions can claim offsets if they oversee their own carbon and nitrogen reduction projects.

One of the primary goals of a scopes approach is to encourage the creation of more emissions inventories. Comprehensive inventories can be costly, but cursory inventories can be useless; the scope system allows all inventories done within the scoped model to be useful. If an institution just wants to measure its most direct (yet limited) footprint, it could conduct a 1-year snapshot inventory of Scopes 1 and 2. This inventory would be comparable to the Scope 1 and 2 sections of any other institution's inventory, and none of the emissions from Scope 1 or 2 would be included in the same scope in any other institution's inventory.

The scopes approach categorizes emissions by level of responsibility, but does not in itself dictate what boundaries an entity should adopt. This is left at the discretion of the institution. However, the GHG Protocol Initiative (www.ghgprotocol.org) has developed consensus-based protocols to help guide operational boundary decisions, as has the Second Nature Carbon/Climate Commitment. To ensure consistency and compatibility across inventories, we strongly recommend that you choose one of the following institutional boundaries:

<u>All Scope 1 and Scope 2:</u> This is the bare minimum for most inventories. The WRI Corporate Accounting and Reporting Standard requires the reporting of all Scope 1 and Scope 2 emissions, but considers all Scope 3 emissions optional. This reporting protocol is the basis of the reporting guidelines for The Climate Registry and the California Climate Action Registry, among others. The **Second Nature Carbon/Climate Commitment** protocol requires that signatories inventory all Scope 1 and 2 emissions and report Scope 3 emissions from commuting and directly financed air travel "to the extent that data is available." Institutions are also encouraged to report any other Scope 3 emissions, especially those that are large or "can be meaningfully influenced."

<u>All Directly Financed Emissions:</u> This includes all of Scopes 1 and 2, as well as any Scope 3 emissions that are directly financed by the institution such as emissions from directly financed

outsourced travel and solid waste management. The rationale here is that although an institution has no control over the fuel efficiency of individual airplanes or the waste management practices of a landfill, the institution finances air travel and waste management and is thus partially responsible. Also, including these emissions in an inventory provides an incentive to find ways to avoid or reduce them.

<u>All Directly Financed Emissions, Plus Selected Directly Encouraged Emissions</u>: This includes all of Scopes 1 and 2, plus any directly financed Scope 3 emissions, plus any emissions the institution feels it strongly encourages. For example, some universities require students to study abroad to complete their major. Although the university does not pay for the plane ticket, its policy is directly responsible for this air travel. Similarly, some universities consider themselves responsible for the emissions produced by faculty, staff, and students commuting on a regular basis. Although the university does not explicitly require or pay for this travel, it would not occur were it not for the existence of the university. Especially in areas with few public transit alternatives, it is hard to see how faculty, staff, and students living off campus could do anything but commute by personal vehicle.

<u>All Directly Financed or Significantly Encouraged Emissions, Plus Selected Upstream Emissions</u>: This includes all of Scopes 1 and 2, plus any directly financed or strongly encouraged Scope 3, plus selected Scope 3 upstream emissions. Some universities opt to include certain Scope 3 upstream emissions in their inventories, generally for the sake of allocating reductions to these sources. For example, a university might choose to include in its inventory the Scope 3 upstream emissions from producing and transporting purchased paper. If the university then instituted a policy that reduced paper use, its emissions would be proportionately reduced. It is also possible to track selected Scope 3 upstream emissions but not include them in the institution's footprint.

Temporal Boundaries

SIMAP can collect emissions data from 1990 onward, but that does not mean schools are required to track or report their emissions back that far. In fact, it is best to only go as far back in your data collection as you can find reliable numbers. It is not considered best practice to try to extrapolate past years' data based on more recent trends.

Another question related to setting temporal boundaries is that of whether you are collecting data based on calendar years or fiscal years. Most schools choose fiscal years, and SIMAP is designed with that convention in mind. More specifically, we name the fiscal year after the end date year, so FY06/07 = 2007 on the add data fields. Fiscal Year 2006 - 2007 (FY06/07) will typically begin on July 1, 2006, and end on June 30, 2007 (but referred to as "2007" in SIMAP).

"De Minimus" Emissions

The "Corporate Accounting and Reporting Standard," on which our methods are based, considers material emissions to be 95-100% of an institution's footprint. Sources that add up to less than 5%, are considered "de minimus" and need not be inventoried. To assess these relatively insignificant sources, (*e.g.,* students commuting to class on a residential campus from their dorms), the conventional method is to use assumptions that produce high-bound emissions estimates. Rather than invest resources in precise calculations each year, institutions assume high bound emissions estimates, and then have the option of choosing to reject them from their inventories as immaterial.

We strongly recommend that your inventory estimate carbon and nitrogen as accurately as possible – even de minimus emissions. Understandably, investing time and effort in precise data collection for minute emissions sources is not always the most effective allocation of resources. However, we recommend that all high- bound estimates of "de minimus" emissions not calculated regularly should be included in your inventories, even though corporate inventories reserve the right to dismiss them from the inventory. Basically, if you find a de minimus source on campus, take fertilizer use for example, and your preliminary data indicates that it represents no more than 0.5% of your total footprint, there is no need to collect data for that emissions source on a regular basis. Instead, simply add the same upper-bound emissions estimate to your footprint each year. That way, footprint estimates are as precise as possible – erring on the conservative side, if at all – without causing undue stress during data collection.

Some examples of de minimus emissions could be: wastewater, student commuting, methane and nitrous oxide from biogenic sources, propane, off-road diesel, emissions from buildings that are marginal to campus operations or have outdated energy monitoring systems.

3.3 Key Greenhouse Gas Accounting Concepts

3.3.1. The greenhouse gas standards for accounting in SIMAP

The Greenhouse Gas Protocol Initiative is a multi-stakeholder partnership of businesses, non-governmental organizations (NGOs), governments, and others convened by the World Resources Institute (WRI), a U.S.-based environmental NGO, and the World Business Council for Sustainable Development (WBCSD), a Geneva-based coalition of 170 international companies. Launched in 1998, the Initiative's mission is to develop internationally accepted greenhouse gas (GHG) accounting and reporting standards for business and to promote their broad adoption.

Over the past decade, the World Business Council for Sustainable Development and the World Resource Institute (WBCSD/WRI) jointly established a set of accounting standards[4] to begin to address these questions and guide entities in their emissions reporting. These standards provide concepts and systems to ensure transparency, accuracy and standardization for carbon management. They are primarily found in the GHG Protocol's "Corporate Accounting and Reporting Standard" and "Project Protocol," available at the GHG Protocol website (www.ghgprotocol.org). These protocols, created and maintained through multi-stakeholder input and dialogue, are the foundations upon which most national and international reporting standards rest.

[4] WBCSD/WRI, http://www.wbcsd.org/web/publications/ghg-protocol.pdf

3.3.2. Biogenic Carbon

Following the GHG Protocol guidelines, SIMAP separates out biogenic emissions of carbon. Biogenic CO_2 refers to carbon in wood, paper, grass trimmings, etc. that was originally removed from the atmosphere by photosynthesis and, under natural conditions, would eventually cycle back to the atmosphere as CO_2 due to degradation processes. The quantity of carbon that these natural processes cycle through the earth's atmosphere, waters, soils, and biota is much greater than the quantity added by anthropogenic GHG sources. Examples of anthropogenic (human-caused) emissions of biogenic CO_2 include landfill gas, incinerator emissions, and biodiesel, ethanol, or biomass combustion.

The main driver of global climate change is the net increase in the amount of CO_2 in the atmosphere due to anthropogenic – resulting from human activities and subject to human control – emissions of fossil carbon. These emissions result in a net increase in the amount of carbon in the carbon cycle, because the carbon that was previously locked away in fossil fuels is now available. By contrast, anthropogenic processes that emit biogenic CO_2 can be thought of as simply "closing the loop" in the carbon cycle—they return CO_2 to the atmosphere that was originally removed from the atmosphere by photosynthesis, but they do not increase the total amount of carbon in the carbon cycle.

<u>Anthropogenic emissions of biogenic carbon do not generally increase the total amount of carbon in the carbon cycle, though they may increase the speed at which the carbon is returned to the atmosphere.</u> For that reason, in the past it was suggested that, in keeping with IPCC guidance, biogenic emissions essentially be ignored or counted as "0." Current protocols for GHG accounting suggest a new best practice, however—that is to track biogenic emissions accurately, but report them separately from the rest of your carbon footprint. Thus, the results page includes a total for biogenic carbon, tracked and reported separately from all other campus emissions, outside of the scoped categories (i.e., CO_2 emitted as the result of combustion in an on-campus stationary source is not counted as "0," but neither as it counted with the rest of your Scope 1 emissions or your total emissions.)

<u>This approach, as in the past, ultimately assumes that anthropogenic emissions of biogenic CO_2 do not result in any long-term changes in the amount of carbon in the atmosphere.</u> Such changes could occur if demand for biogenic carbon sources leads to long-term changes in land-use or land-cover. For example, burning wood from a sustainably harvested forest should not result in a net increase in atmospheric carbon, but burning wood from forest that is clear-cut to build parking lots probably will result in a net increase in atmospheric carbon. In the latter case, the emissions could be reported as Scope 3 upstream emissions associated with fuel production.

Although few people bother to calculate or report Scope 3 upstream fuel production emissions for conventional fuels, when calculating biofuels, it is common to consider how significant these emissions are. For example, corn-based ethanol is widely disparaged within the environmental movement because lifecycle analyses suggest that its use results in few or no net atmospheric carbon reductions and could lead to far-reaching market effects on many goods and services due to increased corn prices. <u>If you are considering using any source of biogenic carbon, we recommend that you carefully evaluate whether your</u>

actions might lead to long-term changes in land-us, land-cover, or significant upstream emissions associated with fuel production.

While emissions of biogenic carbon may be discounted under some circumstances, emissions of other greenhouse gasses from biogenic sources should be included in your inventory. They are included in SIMAP as part of your total institutional emissions. For example, CH_4 emissions from landfilled waste or N_2O emissions from burning biomass should be included in your inventory because these emissions are the result of human activity (creating anaerobic conditions by landfilling waste or releasing N_2O through incomplete combustion) and so would not have occurred under natural circumstances.

Greenhouse Gases (GHGs)

From https://archive.epa.gov/epawaste/nonhaz/municipal/web/html/airem.html

Estimates of greenhouse gas emissions from US MSW combustion facilities range from 10 to 20 million metric tons, depending on the different methods used to estimate the biogenic fraction of MSW. Regardless, it is a small fraction of the nearly six billion tons emitted by the combustion of fossil fuels. Per unit of electricity produced, the MSW combustion facilities generate less GHGs than coal or oil, but slightly more GHGs per unit energy than natural gas. EPA's climate change website addresses air emissions of electricity generation from different sources. The value reported on this website for MSW (2,988 pounds of carbon dioxide per megawatt-hour) includes emissions for both the biogenic and fossil fractions of MSW. However, when considering carbon dioxide (CO2) emissions from MSW combustion, it is necessary to count only emissions from fossil fuel-based products, like plastics. The biogenic fraction of MSW is material generated from living organisms and is already in the planet 's carbon cycle. This biogenic fraction should not be included when determining the GHG outputs of combusting MSW for energy recovery. In the table below, we use EPA's eGrid (a database of information on electrical generators in the United States) that indicates about 53 percent of the energy generated by MSW combustion facilities is from biogenic sources and 47 percent is fossil-derived power. eGrid relies on the Department of Energy's Energy Information Administration methodology for allocating MSW to biogenic/non-biogenic energy (which, in turn, relies on EPA's Annual MSW Report) and information about MSW combustor type.

Note: Biogenic emissions are calculated in SIMAP and identified in the results dashboard.

Compost Calculation Guidance

The GHG Protocol notes that composting is a part of the waste disposal process and thus (non-biogenic) emissions from it can be accounted for as part of the Scope 3 footprint—though like all Scope 3 emissions sources, reporting of these emissions is considered optional. Emissions from composting really come down to emissions from transporting material from the point of waste generation to the facility or area where it as processed as compost. Currently, the SIMAP does NOT have emissions factors built in to account for that. That's because it would be difficult to come up with a standard distance or fuel efficiency for compost transport, cumbersome to ask schools to provide custom numbers, and the whole thing would be a very small proportion of overall emissions (in the same way that the transportation factors for other waste disposal are also proportionately a very small part of the footprint.)

Emissions from the actual breakdown of the compost (assuming it is being done properly) are biogenic emissions, so not part of the Scope 3 total. Those are currently not accounted for in SIMAP.

What IS accounted for in SIMAP is the carbon soil sequestration that occurs as a resulting of spreading the finished compost; these calculations are done in the "Offsets and Sinks" section of SIMAP. Including them as such is also consistent with the GHG Protocol (their Waste Sector Guidance document).

3.3.3. Unit of Measure

The carbon footprint is reported in metric tons of carbon dioxide equivalents (CO_2e)[5]. This measure includes all six greenhouse gases, which are converted to CO_2e based on their 100-year global warming potential (Table 2). Global warming potential (GWP) indicates the magnitude of climate warming that a given amount of a greenhouse gas would cause relative to that of CO_2. (IPCC 2014).

Greenhouse gases		Global warming potential
CO_2	Carbon dioxide	1
CH_4	Methane	25
N_2O	Nitrous oxide	298
SF_6	Sulfur hexafluoride	22800
HFC	Hydrofluorocarbons	Range
PFC	Perfluorocarbons	Range

Table 2 Greenhouse gases and their Global Warming Potential

3.4 Key Nitrogen Footprint Concepts

A nitrogen footprint quantifies the amount of reactive nitrogen released to the environment as a result of an entity's (e.g., individual, institution) resource consumption (Leach et al. 2012). Reactive nitrogen includes all forms of nitrogen except the unreactive dinitrogen (N_2) that makes up 78% of the atmosphere. Examples of reactive nitrogen include ammonia (NH_3), ammonium (NH_4^+), nitrogen oxides (NOx), nitrous oxide (N_2O), nitrate (NO_3^-), urea, amines, proteins, and nucleic acids.

The major sectors of resource consumption included are energy (e.g., transport, utilities) and food (e.g., consumption, production). The extensive and detrimental effects of reactive nitrogen indicate the importance of managing nitrogen efficiently to reduce its loss to and impact on the environment. A first step in managing nitrogen is determining the current impact from an entity through a nitrogen footprint assessment. After determining its N footprint, that entity can then take steps to manage and reduce it.

Unless otherwise noted, a reference to 'nitrogen' throughout this user's guide and in SIMAP is referring to 'reactive nitrogen.'

[5] America Carbon Registry http://americancarbonregistry.org/carbon-accounting/standards-methodologies/american-carbon-registry-standard/acr-standard-v5_public-comment-version-feb-2017-final.pdf

3.4.1. Why is nitrogen important?

Nitrogen (N) is one of the key elements necessary for life. Most of the nitrogen on earth is in the form of N_2, which is unreactive and makes up most of the atmosphere (~78%). However, this supply of nitrogen is unavailable to the vast majority of living organisms (Galloway et al. 2003). All species on earth need some form of nitrogen to survive, and most (99.9%) require a reactive form. Humans consume nitrogen in the form of protein. In order to be usable to living organisms, the strong triple bond between the N atoms in N_2 must be broken in high-temperature processes, by a small number of specialized N-fixing microbes, or by man-made processes (Figure 6).

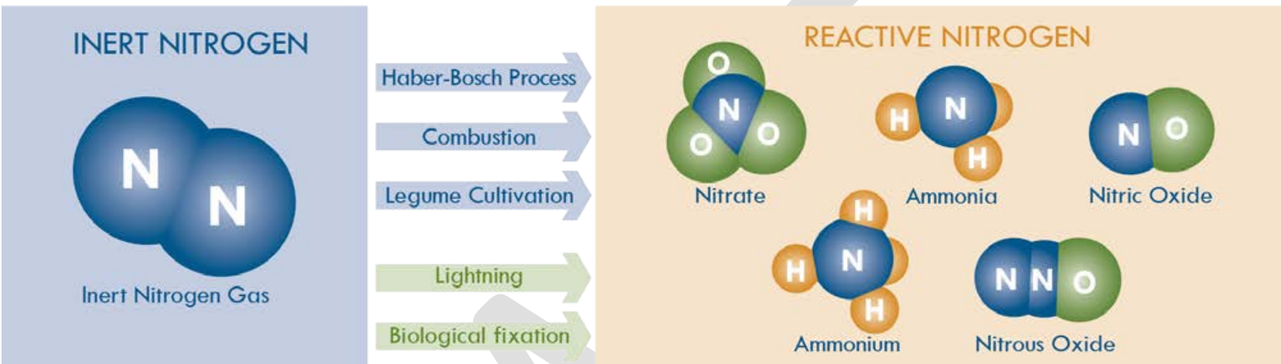


Figure 6 The conversion of inert nitrogen (N_2) to reactive nitrogen. Natural conversion processions are depicted by green arrows (lightning, biological nitrogen fixation by microbes) and anthropogenic processes are depicted by blue arrows (Haber Bosch process, fossil fuel combustion, legume cultivation). Source: The Nitrogen Footprint Tool User's Guide

Both natural and human-caused processes can create reactive nitrogen. In nature, specialized microbes accomplish most of the conversion of N_2 to reactive nitrogen. Lightning also produces a small amount of reactive nitrogen generated through its high temperatures. There are three primary anthropogenic, or man-made, mechanisms for reactive N creation:

(1) **Haber-Bosch process**, which is an industrial process developed in the early 1900s to make NH_3 from N_2. This process is now used to make synthetic fertilizer and feeds almost half of the global population (Erisman et al. 2008);

(2) **Cultivation of legumes,** which have a symbiotic relationship with the specialized microbes that create reactive nitrogen; and

(3) **Combustion of fuels**, which generates high temperatures strong enough to break the N_2 triple bound and allowing the N atoms to form other molecules and create reactive nitrogen.

Man-made processes make 3-4 times more reactive nitrogen than natural terrestrial processes each year (Fowler et. 2013). Because of this and the long time it takes reactive nitrogen to be converted back to unreactive N_2, the global nitrogen cycle is unbalanced.

Once in the environment, nitrogen can contribute to a variety of environmental and human health problems (Figure 7). Effects of excess nitrogen include production of ground-level ozone (a pollutant that contributes to smog), biodiversity loss, acid rain, stream and lake acidification, low oxygen levels and eutrophication in bodies of water, habitat degradation, degradation the ozone layer, and global climate change. Additionally, a single molecule of nitrogen may cause each of these effects in sequence before that molecule is converted back to the unreactive form. This concept is called 'the nitrogen cascade' (Galloway et al. 2003).

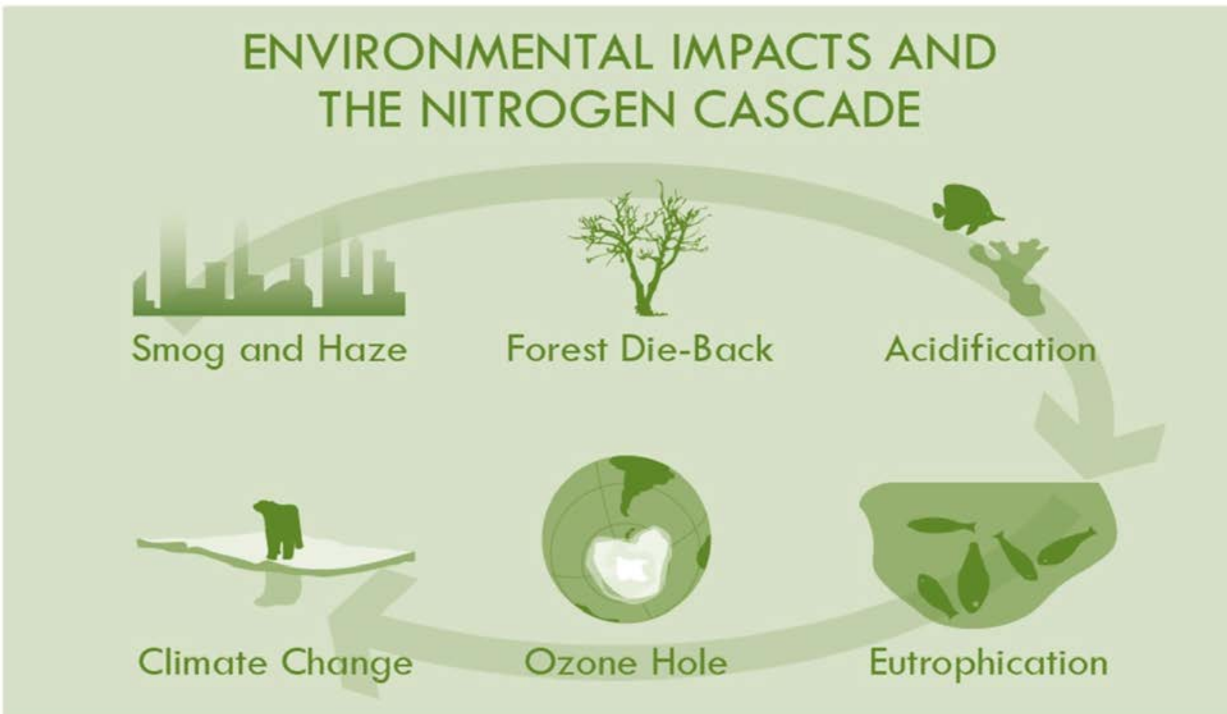


Figure 7 Environmental Impacts and the Nitrogen Cascade

The first two support food production: reactive N is an important component to fertilizers and is necessary for the food production process. However, essentially all of the reactive N used in food production is lost to the environment, ~80% prior to human consumption (e.g., fertilizer runoff, manure losses, food waste, etc.; this is also referred to as "virtual nitrogen") and 20% following human consumption (e.g., human waste). The third mechanism (combustion of fuels) produces energy and, in the process, all of the reactive N formed is lost to the environment. Globally, these anthropogenic sources of reactive N are at least twice as large as natural terrestrial sources (Galloway et al. 2008; Vitousek et al. 2013). This means that humans are creating more than three times as much reactive N as nature. This dominance is so great that human interference with the nitrogen cycle was recently identified as one of three global issues where the rate of change has crossed the so called 'Planetary Boundary' and cannot continue without significantly impacting the Earth-system (Rockström et al. 2009).

3.4.2. What activities contribute to a nitrogen footprint?

Many activities affect an institution's nitrogen footprint. The following are a few that will be covered in this manual, along with a brief description of how it contributes to the N footprint:

- **Food consumption/wastewater:** The average adult does not accumulate nitrogen, so any nitrogen consumed enters our sewage treatment system. If the wastewater is not treated, that nitrogen enters the waterways.
- **Food production**: The use of nitrogen fertilizers in crop production, the transportation of food, the amount and type of food consumed, and food waste management contribute to the loss of reactive nitrogen to the environment.
- **Utilities**: The burning of fuels emits reactive nitrogen into the atmosphere.
- **Transportation**: The burning of fuels emits reactive nitrogen into the atmosphere.
- **Fertilizer**: Nitrogen-containing fertilizer is used in landscaping, little of which is taken up by the plants. The reactive N not taken up by the vegetation is lost to the environment.
- **Research animals and livestock**: The production of feed, excretion of waste, and disposal of carcasses contribute to the loss of reactive nitrogen to the environment. Currently, the nitrogen footprint of research animals and livestock can only be added to SIMAP through a custom addition in the Animals sector.

CARBON NITROGEN

3.4.3 How do the sectors in the carbon and nitrogen footprints compare?

The sectors included in the carbon and nitrogen footprints overlap substantially (Figure 8, Table 3, Figure 9). A carbon and nitrogen footprint can currently be calculated for the following sectors in SIMAP: on-campus stationary, direct transport, fertilizer, electricity, steam, chilled water, commuting, travel, wastewater, food production.

There are several sectors with a carbon footprint but not a nitrogen footprint in SIMAP: refrigerants, paper, solid waste, and agriculture. Refrigerants are greenhouse gases, and they do not have a nitrogen footprint. The production and disposal of paper and solid waste both have a small nitrogen footprint, and they may be added in a future version. Agriculture is partially addressed in the nitrogen footprint (fertilizer), but research animals and livestock are not yet addressed for nitrogen in SIMAP. Research animals and livestock do have a large nitrogen footprint from the production of their feed, waste management, and carcass disposal. Research animals and livestock will be added to a future version of SIMAP.

There is one sector not yet in SIMAP that was important for the Nitrogen Footprint Tool: food consumption. The food consumption footprint is a different way of calculating the wastewater footprint, which is addressed in SIMAP. The wastewater footprint looks at the volume of wastewater processed on a campus and applies an appropriate emissions factor based on the level of treatment. The food consumption footprint looks at the total amount of food purchased and consumed on a campus (which would then presumably enter the wastewater stream) and the level of sewage treatment. These two approaches are not identical. The wastewater footprint can include wastewater sources not related to food (e.g., storm water runoff) and it does not distinguish between food purchased on campus versus food that students or employees bring from home. The food consumption approach makes a more direct link to food. It may be added to a future version of SIMAP. For more information on how to calculate these two approaches, see the SIMAP guidance document for the NFT Network.

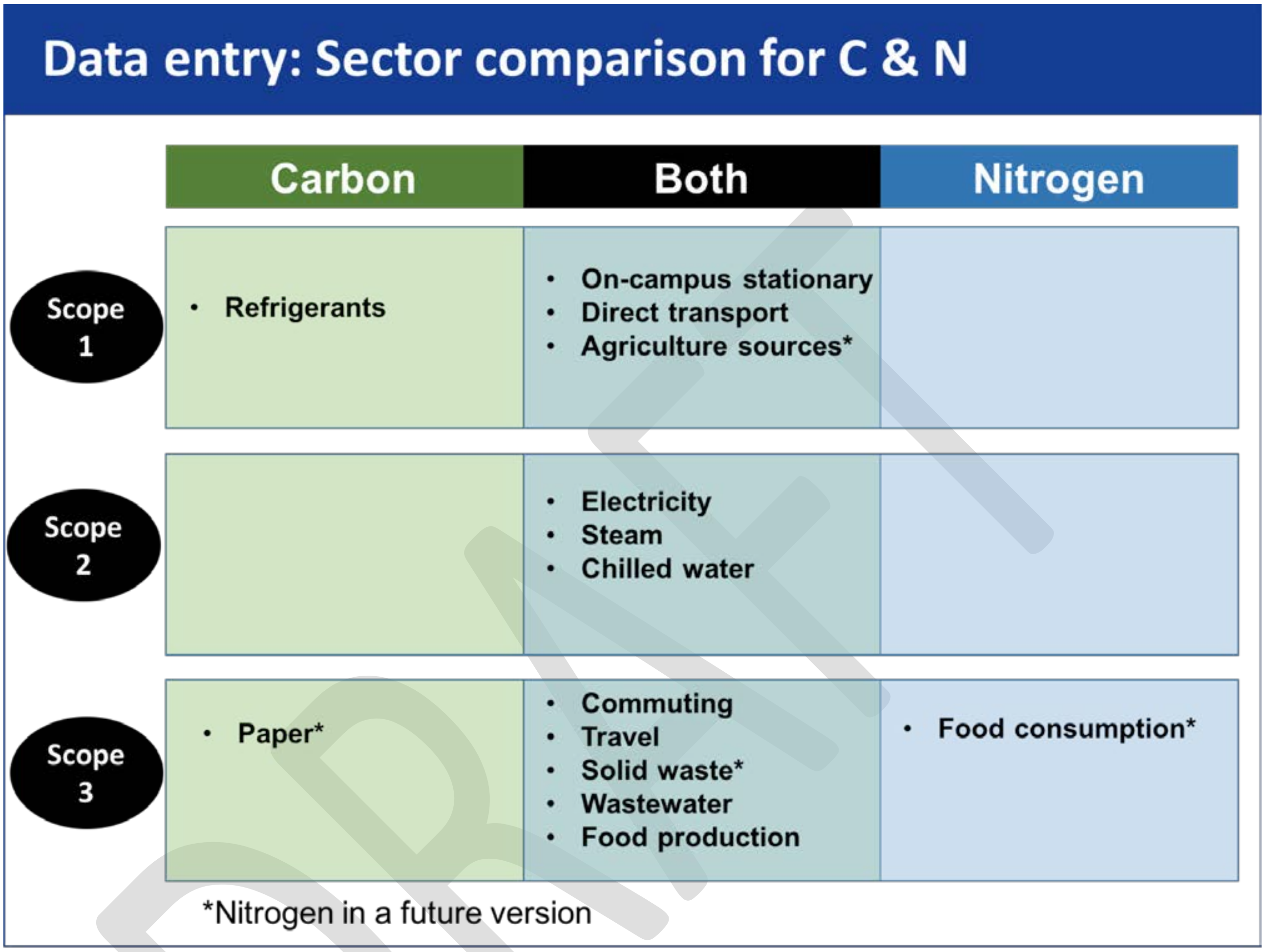


Figure 8 A summary comparison of sectors in the campus carbon and nitrogen footprints. *Indicates sectors for which nitrogen will be added in a future version. The agriculture section of the N footprint currently only include fertilizer; animals will be incorporated in a future version. Source: Adapted from Leach et al. 2017

Scope	Data category	Carbon footprint	Nitrogen footprint
Scope 1	On-campus stationary sources	Yes	Yes
	Direct transportation sources	Yes	Yes
	Refrigerants & chemicals	Yes	N/A
	Agriculture sources: fertilizer and animals	Yes	Yes*
Scope 2	Electricity, steam, chilled water	Yes	Yes
Scope 3	Commuting	Yes	Yes
	Directly financed outsourced travel; Study abroad; Student travel to/from home	Yes	Yes

	Solid waste	Yes	To be added
	Wastewater	Yes	Yes
	Paper	Yes	No
	Food purchases	Yes	Yes
Offsets	Sinks	Yes	Yes
	Offsets	Yes	Yes

Table 3 *Detailed comparison of sectors in the campus carbon and nitrogen footprints. *The agriculture section of the N footprint currently only includes fertilizer; animals are possible to add with custom emissions factors and will be fully incorporated in a future version. Source: Adapted from Leach et al. 2017*

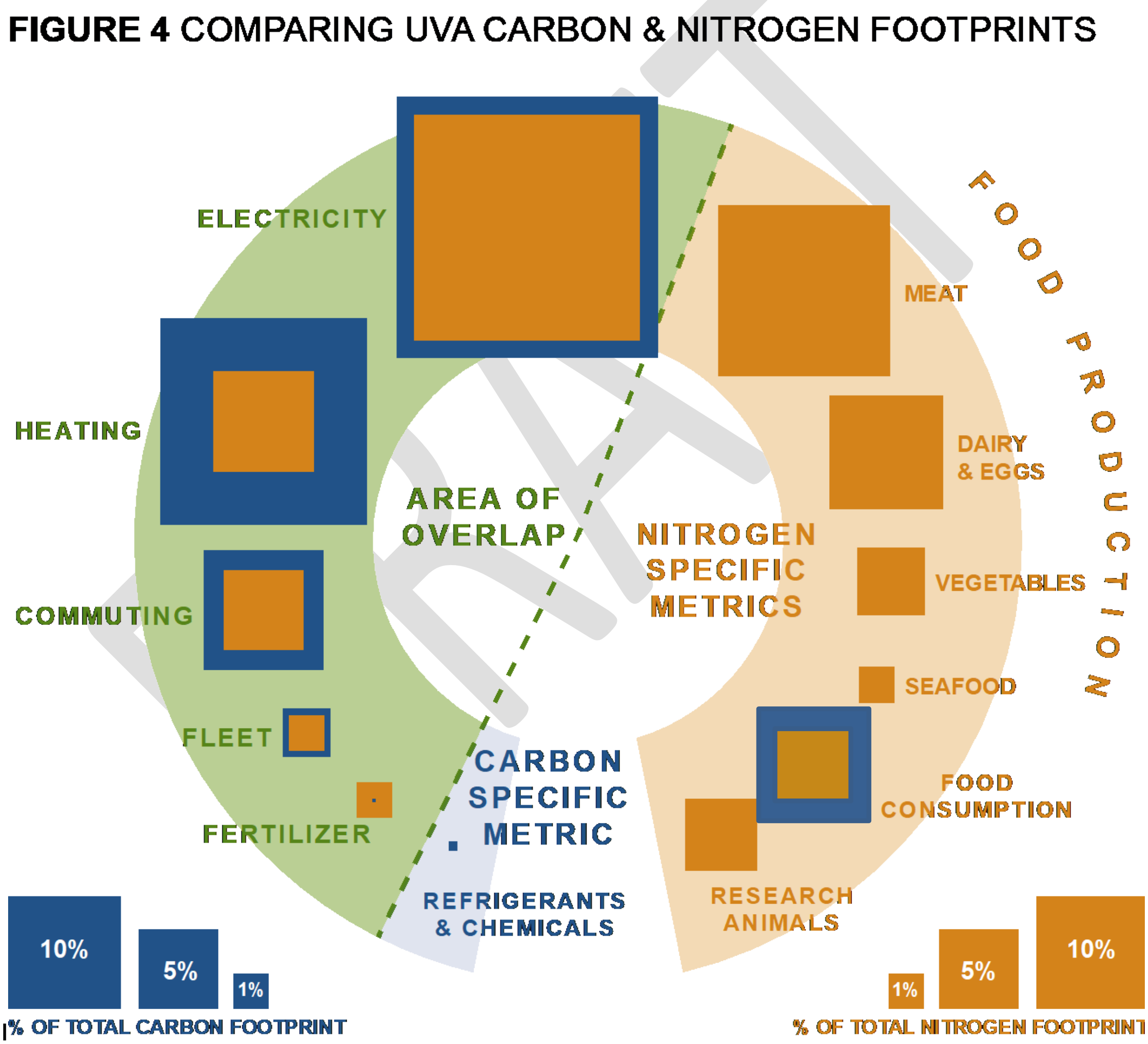


Figure 9 A comparison of the sources for the University of Virginia carbon and nitrogen footprint in 2010. It should be noted that the food carbon footprint was not included in this diagram but contributes about 10% of UVA's total carbon footprint. Source: Leach et al. 2013

Is there any overlap between the carbon and nitrogen footprints?

The types of greenhouse gases and nitrogen species that make up the two footprints are almost entirely distinct. However, there is one area of overlap: nitrous oxide (N_2O) is both a greenhouse gas and a type of reactive nitrogen.

N_2O is included in both the carbon and nitrogen footprints for several reasons. First, N_2O has distinct impacts within the two footprints. It is a greenhouse gas, but it is also part of the nitrogen cycle and a contributor to the nitrogen cascade, where it leads to environmental impacts like stratospheric ozone depletion. Second, the two footprints are reported separately and are not additive. Finally, N_2O makes up a very small percentage of the total nitrogen footprint.

The Nitrogen Footprint Tool Network

The Nitrogen Footprint Tool (NFT) Network is an organization of twenty campuses that have pilot tested the NFT. The participating campuses represent a diverse range of institutions, ranging from small liberal arts colleges to large public universities. The NFT Network includes universities, colleges, and research institutes. The institutions are located across the US and include three international campuses.

Founded by the University of Virginia, the first seven campuses in the NFT Network began meeting in 2014 to test the first version of the NFT. The network has gathered for an annual meeting each year to provide feedback on and direct the development of the NFT. If you are interested in participating in the Nitrogen Footprint Tool Network, please contact us at simap@unh.edu.

4. Collecting the Data

Once you've created your team and set boundaries, you're ready to embark upon the GHG inventory process. The first step is collecting your campus data. There are three types of data you can collect for your campus footprints, which are described in the sections below in more detail:

- ✓ Institution data
- ✓ Campus inventory data
- ✓ Customized emissions factors (optional)

As you may suspect, data collection will probably be the most challenging step of the inventory process. Good places to start looking for the data you need are the Purchasing, Physical Plant or Facilities Office, the Campus Planning Office, local utilities, Dining Manager, the Farm Manager (if applicable) and related offices (see Appendix 1 for outline and Appendix 2 for details).

4.1 Institution data

Data entry starts with descriptive information about your campus. In addition to basics like your campus' name and location, we also ask you to share your campus' population, building space, operating budget, and the number of meals served. These statistics can later be used for normalizations. The institution data section is also a place to record your campus sustainability goals, such as your carbon or nitrogen footprint reduction goal. Please see Appendix 1 for details on the data points for institution data.

4.2 Campus inventory data

The campus inventory data is the core of your data collection and footprint calculation. This is the data set that reports what resources your campus is consuming, which then lead to carbon emissions and nitrogen losses. The data collection in this section is sub-divided into four sections based on scopes:

- Scope 1
- Scope 2
- Scope 3
- Sinks and offsets

For scope 1, you will collect data about your on-campus stationary fuels (and co-gen efficiency, if applicable), transport fuels, fertilizer, animals, and refrigerants and chemicals. These data sets are typically available through on-campus records.

For scope 2, you will collect data on the electricity, steam, and chilled water that your campus purchases. The best source for this data set is utility bills. This is also where you enter information about any purchased or sold renewable energy credits.
For scope 3, you will collect a range of data based on what your campus decides to track. This data set is often the most difficult to collect because it may not be tracked centrally through receipts or on-campus

records as the other data sets are. The types of data you might collect for scope 3 include commuting information, business travel & study abroad, student travel to/from home, food purchases, paper, waste, and wastewater.

For sinks and offsets, you will enter information about ways your campus is already trying to limit its footprint through offsets, non-additional sequestration, and compost. Offsets are usually purchased from a third party that sells offset credits. Compost data can be collected from on-campus records at dining halls or research farms. You can also enter information about non-additional sequestration on your campus (e.g., planting forested lands that take up carbon).

When collecting data for SIMAP, it is important to have all the data from each year being inventoried (except for data that does not apply – for example if there are no animals at the school the animal section can be left blank). If some data is simply unavailable, leave it blank but be sure it is noted in any report on the inventory. Remember to save after entering each data point.

4.3 Customized emissions factors

Emissions factors and loss factors are built into SIMAP, but you can customize them if you have specific factors for your campus. The types of factors that can be customized are:

- ✓ All greenhouse gas emissions
- ✓ All nitrogen emissions and loss factors
- ✓ Heating values of fuels

The emissions factors and loss factors in SIMAP are all taken from U.S. government documents and the scientific literature. Specific reference information for each of the emissions factors in SIMAP will be noted in the Emissions Factors section of SIMAP. In the meantime, please contact UNHSI if you have questions about any emissions factors. If you customize any emissions factors, be sure to add an explanation for the change in the “notes” section.

Fuels have a higher heating value (HHV, also called a Gross Caloric Value, GCV) and a lower heating value (LHV, also called a Net Caloric Value, NCV). The HHV is the quantity of heat that would be liberated by the complete combustion of one unit of fuel, if the produced water vapor was completely condensed and the heat from it recovered. The LHV takes the HHV and subtracts the heat content of the water vapor. The LHV provides a better estimate of the real-world heat value of a fuel, as most of the heat contained in water vapor is not recovered. Emissions factors are calibrated for either the HHV or LHV, and must be used with the corresponding fuel heating value. Following the US EPA’s example, SIMAP’s emissions factors are calibrated for HHVs. If you replace any of the heating values or emissions factors in SIMAP, be sure to use HHVs or factors calibrated for HHVs. If you are entering a custom fuel, be sure that the heating value and emissions factors you enter are compatible.

4.4 Keeping notes on your inventory

It is critical that you maintain a detailed journal of every telephone call, inquiry, and successful data request throughout the data collection process. Keeping a detailed journal provides a resource to consult if questions arise about emissions and data down the road, especially when another person assumes responsibility for data collection, such as updating the inventory in subsequent years. Keeping the inventory up-to-date is a long-term project, so staff changes are inevitable.

SIMAP offers the ability to take notes at two levels:

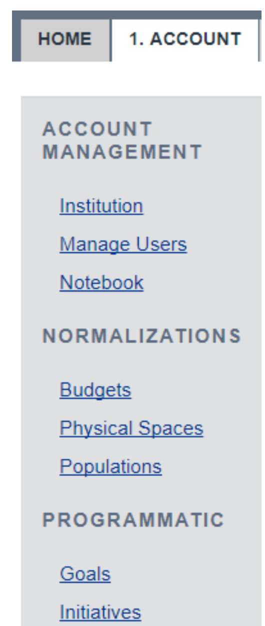
- System-level notes, which are saved for your overall account
- Data entry notes, which can be entered for each individual data input

In some cases, data may simply not be available for a given source. If all the information is not available, or the resources needed to gather it are not available, gather complete data for as far back as possible. It is better to have solid numbers back to 1995 than weak estimates back to 1990. In these cases, make note of the data gaps in the final report.

The need to improve record keeping of a campus' energy usage could be illuminated by a project like this, so noting significant gaps could help support making this a recommended action step. This is made simple by adding a notes field into each data entry category, allowing you to enter information about each data point right in the entry field for that data point.

5. Using SIMAP

Now that you have collected your data, you are ready to start entering it into SIMAP. Below, please find instructions for each step of using SIMAP:



1. **Log-in and account set-up**: How to access and log in to SIMAP
2. **Import data**: Upload spreadsheets to automatically enter your data
3. **Enter data: Institution information**: Descriptive information about your campus
4. **Enter data: Inventory data**: This is the main data entry for your campus resource use
5. **Customize emissions factors**
6. **Documentation, validation, and verification**
4. **Viewing Results:** Review and compare your results
5. **Export Results**: Export all your inventory data, emissions factors, and results
6. **Resources and documentation:** Sources you can use for more information

5.1 Login and account setup

Please register for an account at the following URL: **UNHSIMAP.org**

User's agreement:
Review and confirm that you agree with the user's agreement.

Official Institution designation:

Please, check the box if you want to have this account designation as the official for your institution.

Check if you have membership discounts
You may be eligible for a discount if you are a member of an organization that has partnered with UNHSI. Please contact us (simap@unh.edu) if you are not sure if you are eligible for a membership discount.

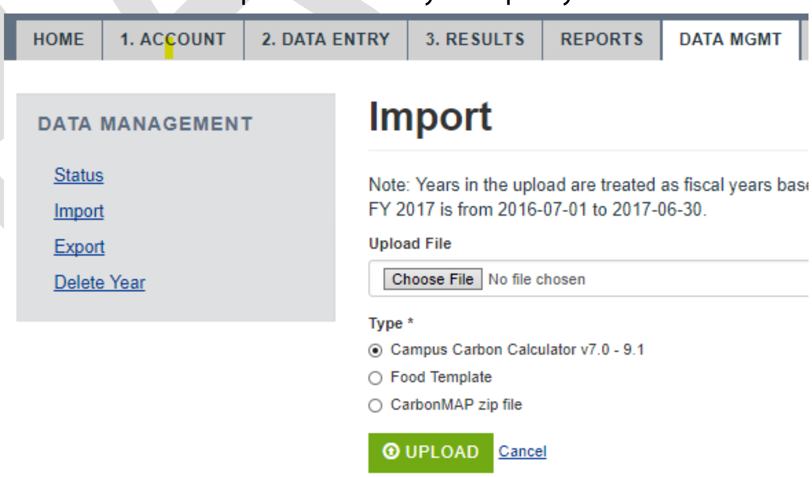
Add additional users to your account [Tier 1 feature]
The administrator can add additional users to your institution's account with different permission levels: In a Basic account there in only one user—the owner. No additional users can be added to a basic account.

- Owner – Creates the account and has full range of functionality.
- Super Users can do all the things an Owner can, including editing users and deleting years of data. However, Super Users cannot edit the user details for another Super User or Owner. That applies to Owners as well – they cannot edit the super users' account details. To edit your own name, follow the My Account link in the top right.
- Editors can add and update data and have access to all data entry fields. Editors can also run results/report, export data, etc. Editors do not have access to the 'Manage Users' page and cannot delete years of data.
- Reviewers can only view data and results. Reviewers cannot add/update source data or import/export. Reviewers can write notes in the Notebook (on the Account tab), which can be used for Reviewers to note any comments or questions they have.

5.2 Import Data

There are two Excel templates and one csv file that can be uploaded directly to import your data to SIMAP:

- Excel Campus Carbon Calculator v.7 – v9.1
- Food data template
- CarbonMAP zip file



These documents can be found under the 'Resources' tab and can be uploaded under the 'Import' tab.

If you have been using the Excel Campus Carbon Calculator v.7 or v9.0 to record your inventory data, you can upload your data right into SIMAP using the import tab. This will import your institution information (e.g., population, building space), your custom emissions factors, and your inventory data.

We also offer a new food data template for the new food sector in SIMAP. The template provides an easy-to-use interface where you can track your campus' food purchases. The secondary tabs of the spreadsheet include guidelines for food categories. This template can be uploaded directly to SIMAP, and your food purchases will be part of your footprint.

If you have been using CarbonMAP tool, you can request your data and it will be sent to you in a zip file which you can upload into SIMAP.

5.3 Enter data: Institution information

Your institution information will be used for normalizations and when data sets are aggregated to assess the state or sustainability at institutions.

Start with the "1. Account" tab, which can be found in the top left of the SIMAP web interface. Click the "Institution" link on the left panel and enter information about your institution. Note that anything marked with and asterisk [*] is mandatory.

Enter any other relevant information on the "1. Account tab" under the following links found on the left panel:

- Goals
- Programs/Initiatives
- Budgets
- Physical Spaces
- Populations

Note that these other sections are not mandatory to calculate your footprint. However, data sets describing institution characteristics (budgets, physical spaces, populations) will be necessary to view normalizations on the results tab.

The "Notebook" link is a space where you can record notes about your data entry, next steps, or anything else you would like to record.

5.4 Enter Data: Inventory Data

This section is the core of your campus data entry. This is where you enter your activity/inventory data that reports what your campus is actually doing, such as fuels your campus is consuming and how much food you are purchasing.

All campus activity/inventory data entry takes place under the "2. Data entry" tab. The data entry categories are organized by scope in the left panel, which are then sub-divided into more specific categories. The following categories are included:

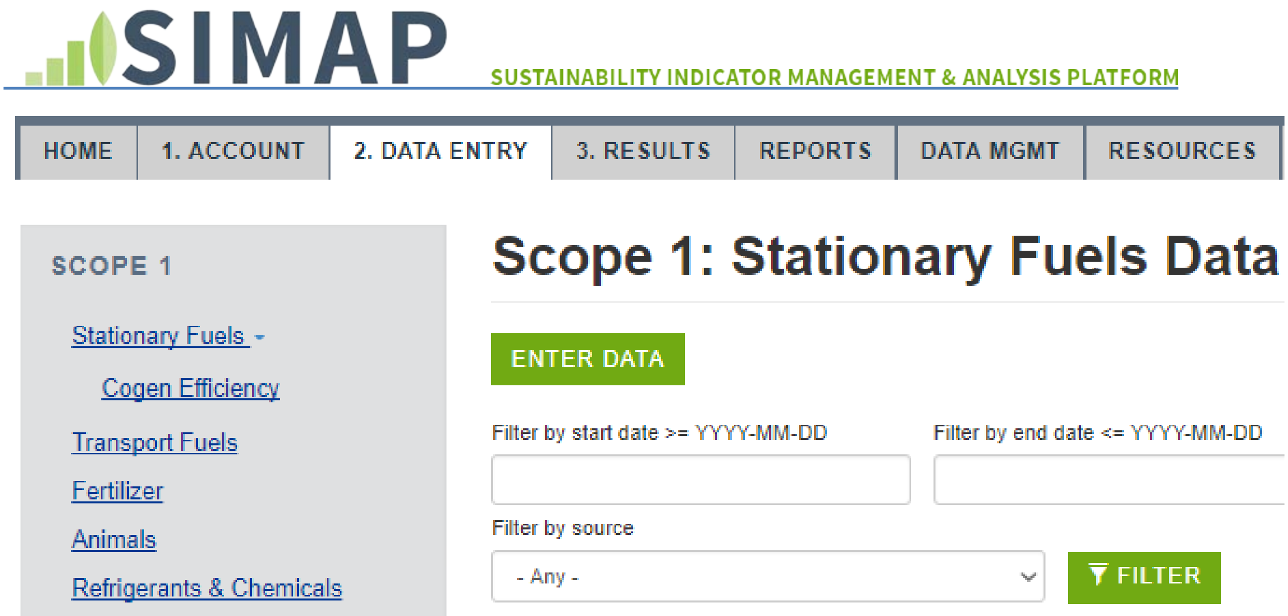
- Scope 1
    - Stationary fuels (co-gen efficiency, if applicable)
    - Transport fuels
    - Fertilizer
    - Animals
    - Refrigerants & chemicals
- Scope 2
    - Purchased electricity, steam / chilled water
    - Renewable energy certificates

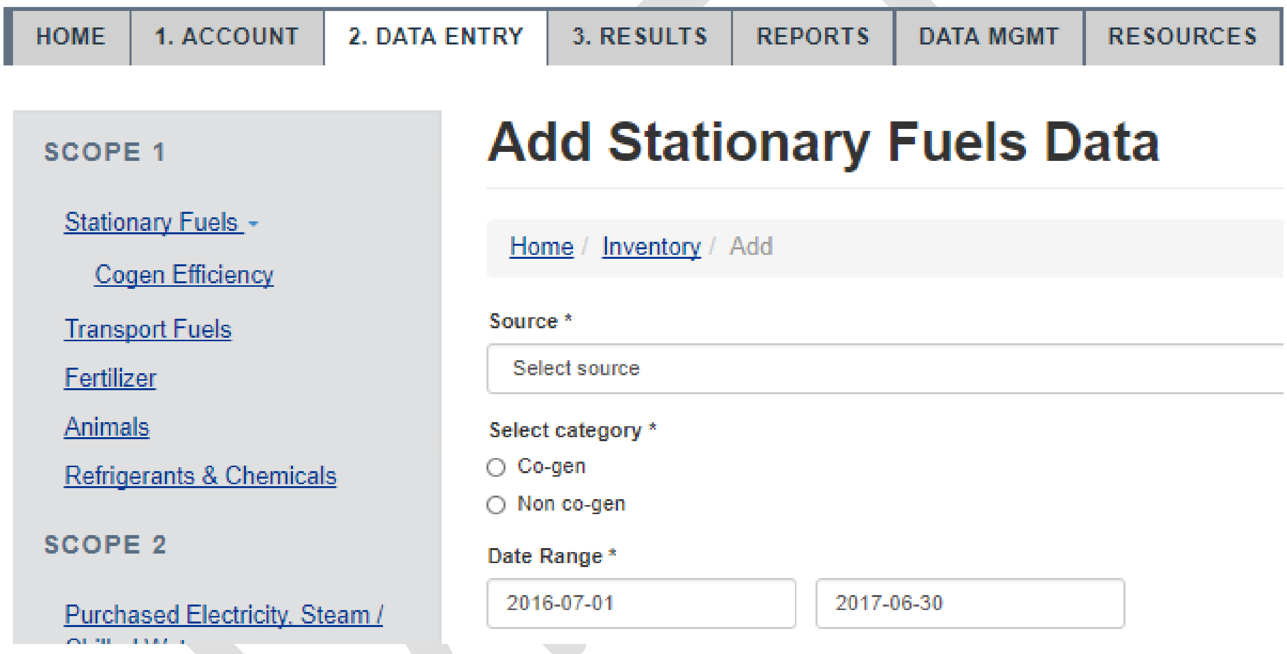
  - Custom fuel mix (electricity)
  - Custom fuel mix (steam)
  - Custom fuel mix (chilled water)
- Scope 3
  - Commuting
  - Business travel & study abroad
  - Student travel to/from home
  - Food
  - Paper
  - Waste & Wastewater
- Sinks and offsets
  - Compost
  - Non-additional sequestration
  - Offsets
- Customization
  - Emission Factors
  - Electric Emission Factors
  - Food Emission Factors
  - Global Warming Potential

Each link to a category will take you to a page with two sections: A green "Enter Data" button and a summary of the data already entered.

To enter a data point, please do the following:

- Click the appropriate link in the left panel in the "2. Data entry" section
- Click the green "Enter data" button
- Fill out the data entry form. Note that anything marked * is mandatory
- Click the green "Add data" button to add that data point to your inventory
- Continue this process until you have entered all data points for a given source





An alternative option is importing your Campus Carbon Calculator Excel spreadsheet. This link can be found in a tab across the top of the screen.

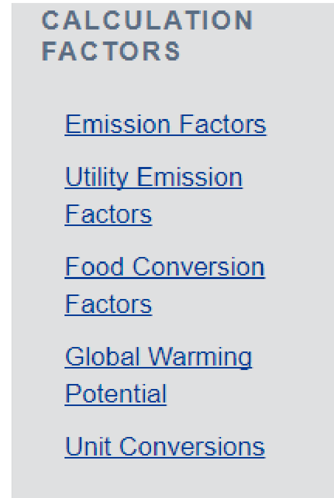
5.5 Customize emissions factors

Standard emissions factors are built into SIMAP. However, if your institution has specific emissions factors that more accurately describe its activities, you can customize the emissions factors.

The customization is on the '2. Data Entry' tab in the section in the left panel titled 'Customization.' There are several links here:

- Emission factors
- Utility emission factors

- Food conversion factors
- Global warming potential
- Unit conversions

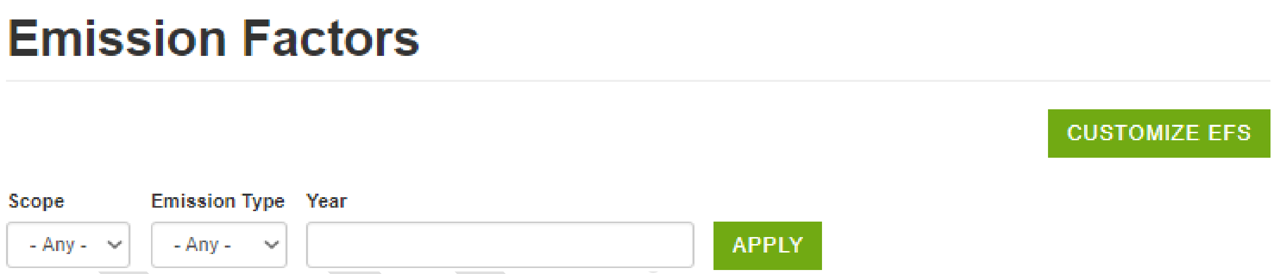


Note that the food conversion factors is the only sector that cannot be updated currently. If you would like to customize any of the food conversion factors, please contact us (simap@unh.edu).

For all other sectors, first you select the appropriate link. The table lists all emissions factors for that category that are in SIMAP by year.

If you would like to customize any of those emissions factors, please do the following:

- **Emission factors:** Click the 'Customize emission factors' link in the upper right corner of the web interface.
- **Utility emission factors:** Select the appropriate emission type you would like to update for which scope from a drop-down (CH4, CO2, N Loss, N2O, NOx), and enter your custom emissions factor.
- **Global warming potential:** If your campus uses a chemical with a global warming potential not on this list, please click 'Add chemical' in the upper right corner of the web interface. This chemical will then be visible in the 'Refrigerants and chemicals' data entry drop-down. To view that chemical, you would first select 'Other' and then select your custom chemical in the second drop-down that appears.
- **Unit Conversions:** A table containing conversions from one unit of measure to another



5.6 Documentation, validation, and verification

Be sure to check your data inputs, sources, and results before exporting or reporting any of your footprint data. Validate against your previous years and see if they are very different. Then check the customization numbers you entered.

You can compare your results from SIMAP with the individual carbon and nitrogen footprint tools:

- **CarbonMAP**: www.campuscarbon.com
- Campus Carbon Calculator
- Nitrogen Footprint Tool

The UNHSI team is also available to assist with some validation and verification.

5.7 Viewing Results

Once your data is entered into the appropriate section of the platform, and a few other parameters are specified (such as the regional electricity pool from which the institution purchases), calculations are made in the background. All formulas, conversion factors, and emissions factors are already built-in and are updated regularly with the latest information available. The beauty of this tool is that you do not have to get into the fairly complex math, science, and economics involved in estimating greenhouse gas emissions from the many activities associated with the operations of a college/university – simply enter the data required in the proper units into the Data Entry sections, and SIMAP will do the rest. Below, we explain how to view your campus data.

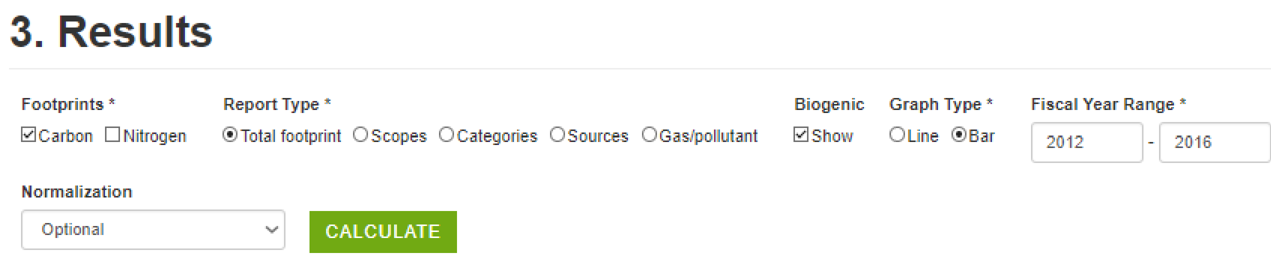
SIMAP provides your results and corresponding graphs for analysis. These totals are given in both the absolute weight of each of the gases, and in the internationally standard units of "Carbon Dioxide Equivalents, or eCO_2, according to their Global Warming Potential (GWP), a measure of each gas' contribution to climate change relative to that of carbon dioxide (colloquially referred to as "carbon"). For example, one molecule of methane (CH_4) is 25 times more potent than one molecule of CO_2 (whose GWP = 1) over the same timeframe.

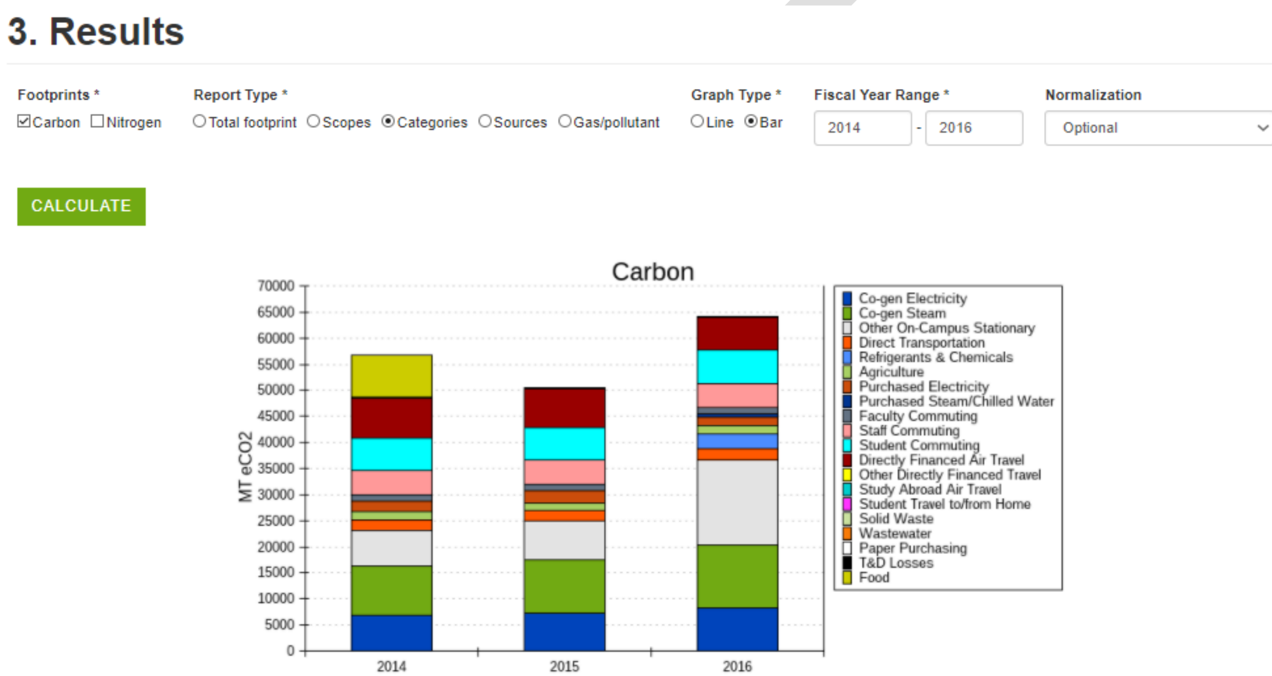
The results dashboard gives you the following options for viewing your data:

- **Footprints:** Select the carbon and/or nitrogen boxes to indicate which graph(s) you would like to view.
- **Report type:** Your institution's footprint results can be shown as the following:
  - Total footprint – this is the only view where you can also see your sinks/offsets and biogenic emissions
  - By scope
  - By category
  - By source
  - By gas/pollutant
- **Graph type:** You can view a line or bar graph and a pie chart if you select a single year
- **Normalization:** The options selected above can then be normalized by a variety of metrics. Note that you will have needed to enter your institution's relevant information under the "1. Account" tab to use normalizations.
- **Year range:** Make sure the selected year range matches up with the data sets you entered.

After selecting the above options, click "Calculate" to view your results. You will then see a carbon and/or nitrogen graph. The detailed results will be presented in tables below the graphs, organized by the report type you selected.

The results are displayed in a different format, but you will be able to see all the same data as in the CCC Excel.





You can select how you want to view your results and which years to show.

You can also see your results in a different view under Reports Tab.

There are two options:
Annual Report - which shows the categories, scopes, and total for either carbon or nitrogen footprint for a single year. This report is also a good way to check if you entered all your categories and validate the totals in line with previous years. You have the options to export these into a csv file.

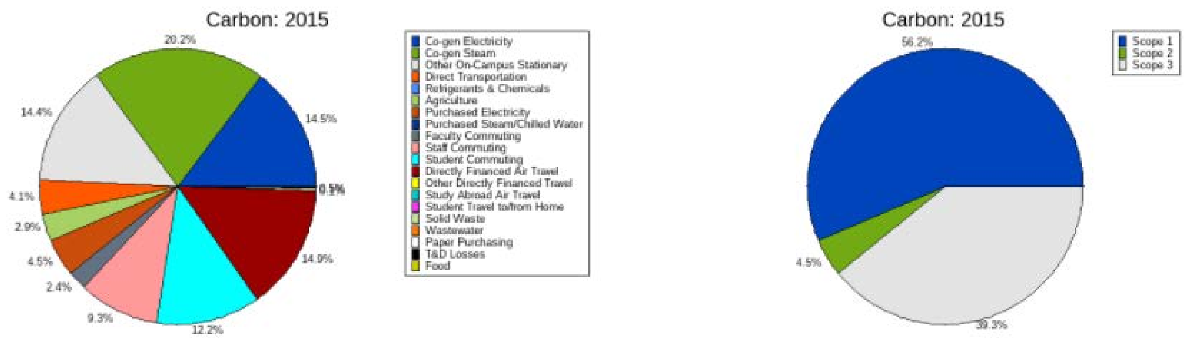
SIMAP SUSTAINABILITY INDICATOR MANAGEMENT & ANALYSIS PLATFORM

HOME | 1. ACCOUNT | 2. DATA ENTRY | 3. RESULTS | REPORTS | DATA MGMT

Reports

Report: Annual Report | Footprint *: (•) Carbon ( ) Nitrogen | Year *: 2017 | DISPLAY | EXPORT

Report: Annual Report | Footprint *: (•) Carbon ( ) Nitrogen | Year *: 2015 | DISPLAY | EXPORT



Categories

Fiscal Year	Scope	Source	CH4 (kg)	CH4 (MTCDE)	CO2 (kg)	CO2 (MTCDE)	N2O (kg)	N2O (MTCDE)	GHG MTCDE
2015	1	Co-gen Electricity	697	17.41	7,318,414	7,318.41	20	5.82	7,341.65
2015	1	Co-gen Steam	973	24.32	10,222,430	10,222.43	27	8.14	10,254.89
2015	1	Other On-Campus Stationary	709	17.71	7,273,298	7,273.30	21	6.25	7,297.26
2015	1	Direct Transportation	336	8.41	2,036,577	2,036.58	92	27.54	2,072.52
2015	1	Agriculture	54,857	1,371.44	0	0.00	366	109.13	1,480.57
2015	2	Purchased Electricity	256	6.39	2,238,512	2,238.51	38	11.20	2,256.10
2015	3	Faculty Commuting	251	6.27	1,188,321	1,188.32	84	25.09	1,219.68
2015	3	Staff Commuting	979	24.46	4,609,304	4,609.30	328	97.78	4,731.54
2015	3	Student Commuting	1,055	26.37	6,045,540	6,045.54	363	108.25	6,180.16
2015	3	Directly Financed Air Travel	74	1.86	7,509,756	7,509.76	86	25.50	7,537.12
2015	3	Solid Waste	-1,778	-44.45	0	0.00	0	0.00	-44.45
2015	3	T&D Losses	29	0.72	251,384	251.38	4	1.26	253.36

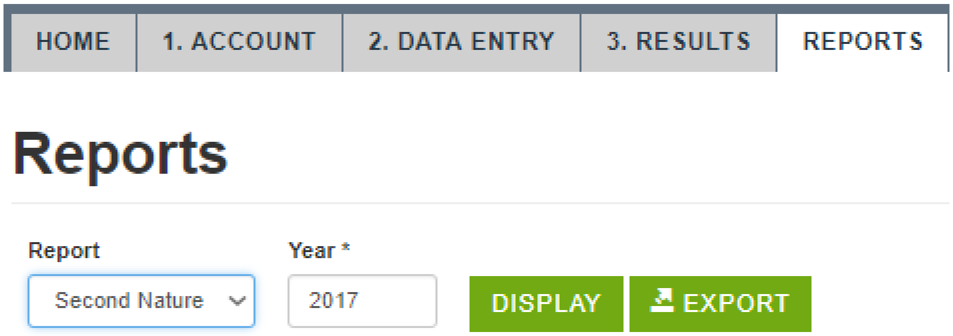
Scopes

Fiscal Year	Scope	CH4 (kg)	CO2 (kg)	N2O (kg)	GHG MTCDE
2015	1	57,572	26,850,719	526	28,446.89
2015	2	256	2,238,512	38	2,256.10
2015	3	609	19,604,305	865	19,877.41

Totals

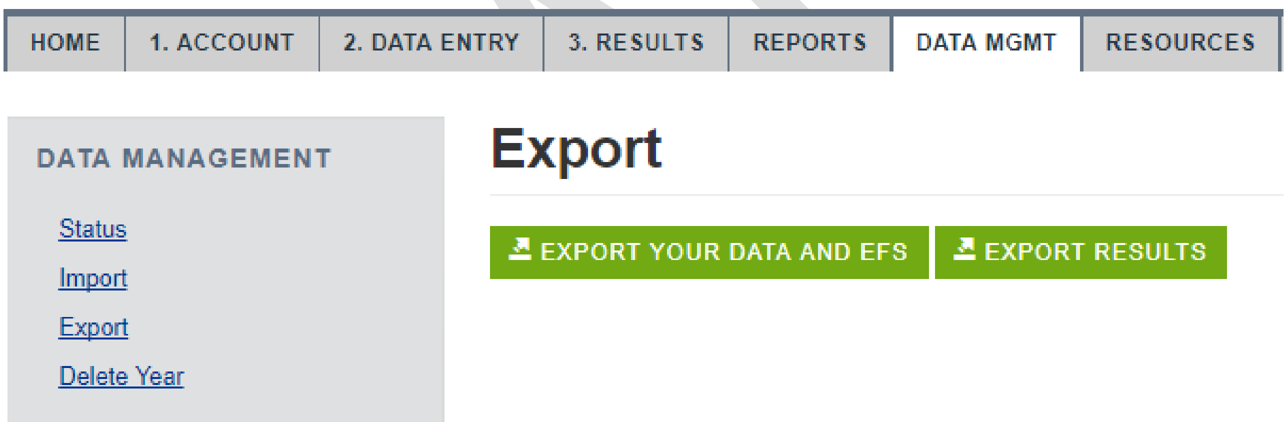
Fiscal Year	CH4 (kg)	CO2 (kg)	N2O (kg)	Gross MTCDE	Offsets	Compost	Non-Additional Sequestration	Biogenic	Net MTCDE
2015	58,437	48,693,535	1,429	50,580.40	0	-60	0	110,443	50,520.16

The second option is the Second Nature report. You can select it from the dropdown menu and then select the year. You can display the report or export it to the Second Nature reporting system into your institution's account.



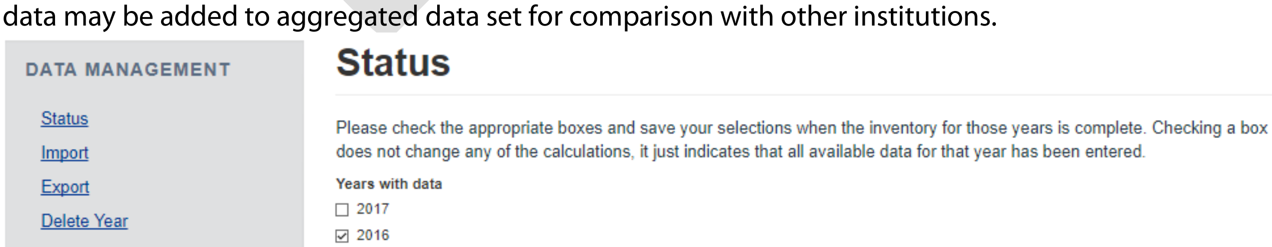
5.8 *Export Results*

You can export your inventory, emissions factors, and results under the Data Mgmt→Export tab. Once you download the data and results, you can save them and create any type of report of graphs for your institutional reporting.

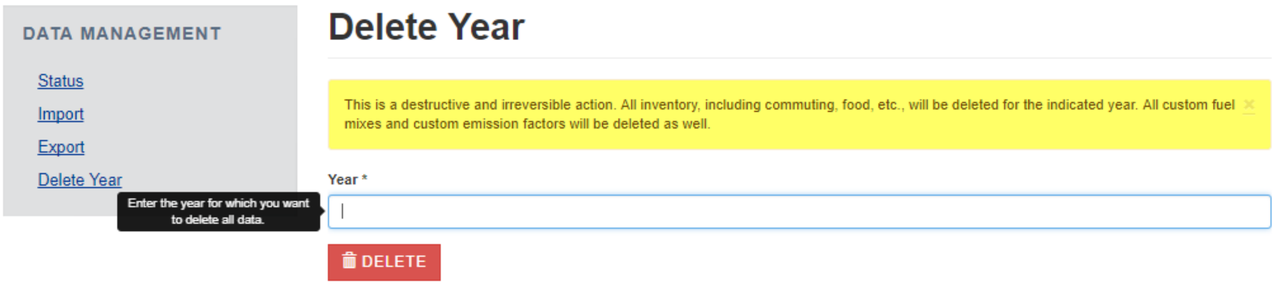


There are several other options that reside under the Data Management tab:

Status: once you completed all the data entry for a specific year, you should check that box to that the data may be added to aggregated data set for comparison with other institutions.



Delete Year: We added a very important feature to allow you to remove data. If you added or imported data for a year and then decide you do not want that year to be part of your complete data set, you can delete that year. Caution that once the data is deleted, you will not be able to retrieve it. You will have to add the data and the EFs for that entire year again.



5.9 Resources and documentation

The web-based SIMAP platform is supplemented and supported by additional tools and resources. The tools help you work with and track your data using Excel before uploading it to SIMAP, and the resources (like this user's guide) provide more background information to help you use SIMAP.

5.9.1. Excel templates for import

There are two Excel templates that can be uploaded directly to SIMAP to import your data. These templates can be found in SIMAP under the 'Resources' tab in the 'Additional resources' section.

Campus Carbon Calculator tracking template

The Campus Carbon Calculator can be uploaded directly to SIMAP to import your inventory data set. This inventory includes all the data you would need to enter to track your carbon footprint with one exception: food, which was not part of the Campus Carbon Calculator.

Although it will be possible to continue to upload the Campus Carbon Calculator inventory to SIMAP in the future, the emissions factors and calculations in the Excel template itself will not be updated beyond January 2018. At that point, it will be important to transition to SIMAP for the most up to date emissions factors and calculations.

Food Data Collection Template

This Excel template can be used to track your campus food purchases. Each column corresponds with a data entry point in SIMAP. Note that the food uploader data tab columns must not be altered for the upload to work properly, but you can add additional tabs and track notes. The food uploader can then be imported directly to SIMAP.

CarbonMAP data export

If you have data in CarbonMAP tool, please let us know and we will send you the files as a zip folder, which may be imported into SIMAP.

5.9.2. Resources

The '[Resources](#)' tab in SIMAP provides background information and documentation to help you collect, enter, view, and understand your campus footprint data. The resources available on SIMAP that describe and support SIMAP are:

- Tools – helpful tools and references, downloadable files for the food uploaded, the CCC Excel file, and Nitrogen Footprint Calculator Excel
- Users' Guide - you are reading it right now
- Changes in SIMAP – a list of changes from CarbonMAP and CCC made in the new platform and also a running list of all ongoing updates
- FAQ - this is a quick list of answers to simple questions. Please let us know if you would like to add anything to this list as we work through the new tool.
- Glossary - a list of words used
- Links - to useful resources
- Carbon References - publications, resources, and website used in the user guide and SIMAP
- Nitrogen References - publications, resources, and website used in the user guide and SIMAP

We also provide historical resources of previous versions of the Campus Carbon Calculator and the Nitrogen Footprint Tool for reference. The following historical references are made available on SIMAP on the Tools page:

- Campus Carbon Calculator Excel template
- Campus Carbon Calculator user's guide
- Nitrogen Footprint Tool Excel template
- Nitrogen Footprint Tool user's guide

5.9.3. Support at UNHSI

Our team is also available to answer any questions you have. You can contact us at simap@unh.edu or by filling out this form.

6. Interpreting and utilizing your results to inform goals and targets

You have completed your inventory and calculated your campus' footprints. If you have data for multiple years, you can look at how they have changes over the years. If not, you have taken the first step in being able to benchmark your current carbon and nitrogen footprints and start gathering the data for next year. In this section, we provide more information about how to interpret your footprint results and how to use them to achieve real change on your campus.

Please note that this section is still under development.

6.1 Normalizations and benchmarks

Comparing total campus footprints is often more of an indicator of size than of environmental impact. Normalizing your results can facilitate comparisons with other campuses and help you understand how your institution may fit into the larger picture. SIMAP currently supports the following normalizations:

- Per operating dollar (research budget, energy budget, total budget)
- Per gross square foot (research gross square foot, total gross square foot)
- Per population (full time equivalent students, weighted users)
- Climate (heating degree days, cooling degree days, total degree days)
- Purchasing/other (meals served)

Please note that normalization comparisons can still not be taken without some context, and a suite of comparison metrics is preferable to a single comparison metric. For example, normalizing your food footprint by the number of meals served helps explain your environmental impact per meal. However, campuses can differ for factors other than their food choices, such as the percent of students who eat on campus and the distribution of meal-serving locations (e.g., dining halls) and retail locations.

Benchmarking your footprint results is key for tracking a reduction goal. It is important to identify a base year and track your campus footprint on a regular basis to assess progress towards your goal.

6.2 Co-benefits of carbon and nitrogen mitigation strategies

There are several benefits to integrating these two footprints into a single tool. First, SIMAP provides a broader range of environmental impacts. Climate change is just one impact that results from campus activities. The nitrogen footprint broadens the scope to extend from global to local impacts such as biodiversity loss, eutrophication, water quality, smog, and acid rain.

Tracking the carbon and nitrogen footprints together is a win-win for most reduction strategies. Almost any time you reduce your campus carbon footprint, you will also reduce your nitrogen footprint (Leach et al. 2017). This is powerful for messaging and can highlight the broader impacts of mitigation strategies. Finally, from a practical perspective, combining footprints into a single tool reduces data entry and analysis. You can enter your campus use data set once into SIMAP and calculate both footprints.

A future version of SIMAP will support the assessment of mitigation strategies (projects) and projections into the future. Until then, you can assess your own strategies by downloading your results in Excel and running analyses. Please contact us if you have any questions.

6.3 Reporting and communicating results

After you have completed an emissions inventory and developed a list of reduction projects, you are well on your way to the foundation of a climate and/or nitrogen action plan. Drafting a plan will help unite your institution around common goals. Good climate and nitrogen action plans include emissions reduction targets, concrete plans to continue reporting annual emissions, a portfolio of carbon and nitrogen reduction measures, and an outline of how to finance them. Most schools will also describe how carbon and nitrogen reductions will be incorporated into the educational process. For more concrete examples of what to look for in a climate action plan, we recommend consulting Second Nature's ACUPCC implementation guide. No institution can foresee the exact path they will take, but what they do recognize is the need to start restructuring the definition of business as usual, and that process starts with a list of project ideas.

6.3.1. Second Nature Climate Commitment

We identified the data points which are required for the climate commitment report. Now, members of the Second Nature Climate Commitment are able to export these data points in a customized Second Nature report via an API. Get directions on how this works from Second Nature.

6.3.2. Other sustainability initiatives

The inventory and results from SIMAP can help with other sustainability initiative reports, such as AASHE STARS and The Real Food Challenge.

6.4 Coming soon….

An update planned for fiscal year 2019 will implement the Tier 2 functionality, which will include additional premium features.

The following are examples of the types of features that may be included in Tier 2:

- "Projections" and "solutions" analysis to assist in Climate Action Planning and nitrogen footprint reduction goals
- Complete Scope 3 reporting module (based on the World Resources Institute Scope 3 Protocol)
- Benchmarking capabilities based on sector averages and peer institutions
- Customizable report templates
- Auto-reporting to other platforms

7. Conclusion: The Power of Narrative

One of the most powerful ways people relate to sustainability is through the larger narrative of people connected by one common campus-wide/community-wide/international goal. By participating in carbon and nitrogen reduction on your campus, you are joining that story. Communications, admissions, even athletics can be a part of the story you will tell. Be it “students and administrators working together,” “dining services partnering with local dairy,” or “football team switches to biodiesel” the sound bites associated with your journey will add immeasurably to the sense of intentional community we’re all trying to foster at institutions of higher education.

It is important to recognize that what is happening on campuses in the US and around the world is more than just reducing emissions; these efforts are building a base of knowledge and hope strong enough to tackle the defining challenge of our generation. This process is not just about carbon or nitrogen—it is about relationships and building a microcosm of what needs to happen on a much greater scale. With your help, we can mobilize the next generation to action. Let’s get to work!

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Appendix 1: Data Collection Outline

This outline summarizes the data you will need to collect to complete an emissions inventory and offers suggestions of people to contact to find this information. This information may also me useful when collecting data for project ideas, so be sure to stay in touch with these key individuals.

Note: equations will be incorporated in a future version of this guide.

Institutional Data

It may seem odd to start a greenhouse gas emissions and nitrogen inventory by collecting data on your institution's budget, population, and physical size, but this data is important to normalize your emissions for a comparison with other institutions and for projecting future emissions trends. This data should be easy to find. That said, the number of full-time equivalent students, staff and faculty, and the number of gross square feet, are the most important pieces of information in this section—the rest is nice to know, but not worth spending a lot of time or effort on if not readily available.

a. Budget

Contact: Controller Office
Data: Annual operating, research, and/or energy budget
Definitions or parameters: The Operating Budget consists of all sources of funding the University has financial control of and is plainly considered as *the cost to operate* the institution. Research Dollars includes all sources of financial funding the institution *receives* for its cumulative research endeavors. The Energy Budget is total *spent* providing the energy needs for all operations.
Units: Nominal dollars (i.e. 2015 dollars for 2015 budget, 2016 dollars for 2016 budget)
Page: 1. Account/Institution/budget
Entry Info: Budget data is generally maintained in nominal dollar values for each year (2015 dollars in 2015, 2016 dollars in 2016, and so on). To allow meaningful comparisons across a historical timeframe, the data is automatically adjusted to budget data to 2005 dollars using the U.S. Bureau of Economic Analysis' chained GDP deflator values. Projected deflator values are taken from the U.S. Department of Energy's Annual Energy Outlook. These values will need to be updated as more accurate numbers become available, or if a new base year is selected. To ensure accurate adjustments in the future, it is very important that you enter budget information in nominal dollars from the appropriate year (enter the 2016 budget in 2016 dollars), and keep a record of these values. This should be easy because budget values will probably be reported in nominal dollars, so you need only enter these on the budget in the **1. Account** tab and then ensure they are not changed.

a. Population

Contact: Institutional Research and Assessment (best); or, try Registrar / Human Resources
Data: Annual number of faculty, staff, and full-time, part-time, and summer school students
Definitions or parameters: In the case of faculty and staff, you are looking for full-time equivalents (FTEs). Different institutions have different formulas for coming up with these

numbers; in fact, the same institution might have different formulas used for different purposes by different offices! The most important thing is that you are using a number derived from the same source/methodology from year-to-year. SIMAP counts part-time students as half-time; if your IR or Registrar's office has a different average equivalency for part-time students, you will need to adjust your input numbers. The number of summer school students is included for reference, but not used in any calculations (so don't spend too much time on this number!)

SIMAP now uses weighted campus user as a per capita metric to align with AASHE STARS. Weighted user is used for normalization and is calculated based on the data entered into the populations fields. The following language from AASHE STARS explains the weighted campus user metric: "Weighted campus user" is a measurement of an institution's population that is adjusted to accommodate how intensively certain community members use the campus. This figure is used to normalize resource consumption and environmental impact figures to accommodate the varied impacts of different population groups.

For example, an institution where a high percentage of students live on campus would witness higher greenhouse gas emissions, waste generation, and water consumption figures than otherwise comparable nonresidential institution since students' residential impacts and consumption would be included in the institution's totals.

SIMAP calculates the figure according to the following formula. Please note that users will not have to calculate this figure themselves; the result will be calculated automatically when the data are entered in SIMAP.

Units: Number

Page: 1. Account/ Institution/Populations

Entry Info: Number of staff, students, and faculty. See definition for FTE [full time equivalent]

b. Physical Size

Contact: Institutional Research and Assessment / Energy Manager / Director of Facilities

Data: Annual total building space and research building space

Definitions or Parameters: Typically, campus planners/development officers will keep records of square foot space which may include many details you would not normally consider in assessing building space, such as wall, stair and window space. We recommend using gross square foot data here. Remember, your organizational boundaries should guide your data collection; make sure they remain consistent (i.e., if your institution is renting out building space, include this gross square footage here only if information about the utilities for the space in question is also being included.) FYI, building space, like everything else, is meant to be tracked based on fiscal years.

Units: Gross square feet or meters

Page: Institution/Physical Spaces

Scope 1

a. Stationary Sources on Campus: all fuel used on campus, excluding vehicle fuel use

Contact: Energy Manager / Director of Facilities / Fuels Purchaser

Data: Annual on-campus stationary fuel use (residual oil, coal, natural gas, wood chips, etc..). Annual output and generation efficiency for electricity and steam from any cogeneration (combined heat and power) plants.

Definitions and Parameters: On-campus stationary sources generally account for most of Scope 1 emissions. The category includes all emissions from stationary fuel combustion – mostly oil, coal, or natural gas for heating campus buildings. If you have a cogeneration (combined heat and power) plant, its emissions fall in this category. NOTE: Following IPCC protocol, CO_2 emissions from biogenic sources are not reported as part of your Scope 1 emissions; they are calculated and reported separately. However, since the same "activity data" that results in biogenic carbon emissions also results in anthropogenic emissions of other greenhouse gases, the activity data for these sources (e.g. biomass burned in a physical plant or boiler) **are** included as part of your Scope 1 data inputs. For more information, see the "Biogenic Carbon" section. For the nitrogen footprint, stationary fuel use emits nitrogen in the forms of NO_x and N_2O.

Collection: Contact the Facilities Director or Energy Manager to find out the types and amounts of fuels used on-campus, excluding vehicle fuel use. If no such person exists, contact the Facilities Office and ask who is in charge of purchasing fuels. This person will probably also be in charge of purchasing electricity. If they have not already compiled the information, someone may need to dig through monthly bills or other statements. First ask if they can compile it but offer to do it yourself if they feel they don't have the time. If you want it done quicker than they can promise it, you may have to do it yourself.

Units: Gallons, short tons, MMBtu, kWh, or % generation efficiency

Page: 1. Data Entry/ Scope 1/Stationary Fuels/Enter Data

Entry Info: Enter the amount of each type of on-campus stationary fuel used in Scope 1 Data Entry/Stationary Fuels. There is a dropdown menu to select the source, e.g. coal, gas, wind, solar, etc. You can select whether it is cogen or non-cogen – if your fuel is burned in a cogeneration plant, you will need to set cogen efficiency in a separate field.

All fuels burned in stationary campus applications that are not cogeneration plants should be totaled and entered into each section provided in the dropdown menu. If you have one or more cogeneration plants you will need to find out their total electricity and steam production, as well as the production efficiency of each.[6] This allows emissions to be assigned correctly to either steam production or electricity production. If you do not enter these efficiencies, your emissions from cogeneration will not be calculated properly.

b. Direct Transportation Sources: all fuel used in university-owned vehicles

Contact: Director of Transportation

Data: Annual fleet vehicle fuel use (gasoline, diesel, biodiesel, etc.)

Definitions and Parameters: This category includes the emissions from any vehicles that are owned by your institution. Most universities keep a fleet of vehicles that are used for everything from moving equipment around campus, collecting solid waste or materials to be recycled, delivering campus mail, or managing the grounds and roads. The university will often have its

[6] If you have multiple cogeneration plants, you'll need to figure out the combined average steam and electricity production efficiency for all the plants

own fueling station that may be filled by the state (at state universities) or by private arrangement.

Collection: Contact the Director of Transportation to find out who is in charge of managing fleet fuel use.

Units: Gallons, Liters, MMBtu, or kWh

Page: 1. Data Entry/Scope 1/Transport Fuels/Enter data

Entry Info: On the Input sheet, enter the amount of each university fleet fuel used in the labeled units. If you want, you can also enter the electricity used by any electric vehicles. Note that emissions from electricity production are already accounted for under Scope 2, purchased electricity (if you purchase electricity from off campus) or Scope 1, on-campus stationary sources (if you generate all your own electricity). Do NOT subtract the values you enter in this column from anywhere else – doing so will result in an under-estimate of your total emissions.

c. Refrigerants and Other Chemicals

Contact: Director of Facilities / Plant Maintenance / Air Conditioning Managers

Data: Annual Perfluorocarbon (PFC), Hydrofluorocarbon (HFC), and SF_6 emissions

Definitions and Parameters: When chlorofluorocarbons (CFCs) were found to be damaging to the ozone layer, alternatives such as hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) were required. Unfortunately, these chemicals were later discovered to also be strong greenhouse gases. These emissions will be estimated in this section. IPCC and US EPA protocol does not include CFCs in greenhouse gas inventories because they are being phased out under the terms of the Montreal Protocol and US Clean Air Act.[7] You do not need to compile CFC release information, but the Campus Carbon Calculator has the capacity to include any other greenhouse gas, so you may want to include any CFC emissions as a sidebar in your report. Refrigerants do not have a nitrogen footprint, but other chemicals will be added in the future.

Collection: Information regarding the release of HFCs and PFCs should already be reasonably accessible, as universities are required to record all fluorocarbon releases for the EPA. You may need to be assertive, but this information should be available for use. The Energy Manager should know whom to contact for this information – it may be someone in charge of environmental compliance at your institution. This number may be estimated by subtracting the amount of recovered refrigerant from the purchased refrigerant.

Units: Pounds or kilos

Page: 1. Data Entry/Scope 1/Refrigerants and other chemicals/Enter data

Entry Info: enter the pounds of each chemical emitted. If a gas you need is not listed, go to the Calculation Factors/Global Warming Potential and enter your gas and enter the chemical's 100-year global warming potential in the field, and the source for this number in the notes section. Then return to the Refrigerants page, select "Other" from the drop-down list and select the gas you added.

d. Agriculture Sources: fertilizer and animals

[7] United Nations Environment Program, Handbook for the International Treaties for the Protection of the Ozone Layer, 5th Version 2000, http://194.51.235.137/ozat/protocol/main.html

Contact: Barn Managers / Grounds Managers / Agriculture-related departments

Data: Annual fertilizer use, type, and nitrogen content. Annual number of animals.

Definitions and Parameters: This section includes methane and nitrous oxide emissions from agriculture. Many animals, especially dairy cows, release methane generated by microbes in their guts. Methane is also released from decomposing manure. While this source will likely be only about 1% of total emissions, it is worth noting if your university has animals. Nitrogen is also lost to the environment during animal feed production and from manure management. A future version of SIMAP will account for animal N losses and research animals.

This section also includes fertilizer application on fields and grounds. Only a small percentage of the nitrogen-containing fertilizer applied to a campus (~30%) is retained by plants on a multi-year basis; the other 70% enters the environment (Wuest & Cassman, 1992). The total amount of nitrogen applied as fertilizer should be reported. The average amount of nitrogen taken up by vegetation will be subtracted from the reported fertilizer application figure to determine the nitrogen released to the environment. The greenhouse gas emissions from fertilizer application is the volatilization of nitrous oxide (N_2O).

Collection: To find this information, contact the people that manage the animal barns and agriculture. Look through a campus directory for "dairy barns," "agriculture," or any related department. You will need to collect headcounts of dairy cows, beef cows, pigs, goats, sheep, horses, and poultry that the university has maintained over the years. Herd size usually varies throughout the year and so you will need to develop an average annual herd size. You may need to take the first headcount of the year and average it with the last headcount of the year. Any small variations due to a changing herd size will probably be insignificant.

To estimate emissions from fertilizer use, you will need to know the total pounds of fertilizer (both synthetic and organic) applied and their percent nitrogen content. Synthetic fertilizers are labeled with their chemical makeup using three numbers to represent the percentages of nitrogen (N), phosphorus (P), and potassium (K). So 15-10-10 fertilizer is 15% nitrogen. Nitrogen contents for organic fertilizer are about 1% for manure and 4.1% for other organics.

Units: Pounds/kilograms, % nitrogen, or number

Page: 1. Data entry/Scope 1/Fertilizer and Animals/Enter data

Entry Info: Enter the pounds of fertilizer used and number of animals. Be sure to include the % nitrogen content of fertilizers.

Scope 2 Utility Consumption

a. Purchased Electricity

Contact: Energy Manager / Director of Facilities

Data: Annual purchased electricity. Annual electricity production fuel mix (if known)

Definitions and Parameters: Unless you have an electricity fuel production mix that is high in renewables or produce much of your electricity on campus, Scope 2 emissions from purchased electricity are likely to be a significant emissions source. Electricity is used in many ways on the campus: lighting, computers, refrigeration, air conditioning, and sometimes even cooking.

Collection: This data will hopefully already be compiled but may require digging through monthly records in the Energy Office. You will need to know how much electricity was purchased each year. This information will probably be gathered in kilowatt-hours (kWh) - one kWh is the amount of energy that will power ten 100-watt light bulbs for an hour.

Units: kWh

Page: 2. Data Entry/Scope 2/Purchased Electricity

Entry Info: Enter the annual electricity purchased in kWh. Your state and pre- and post-2006 eGrid region should be selected based on your zip code or region. This allows SIMAP to select the proper emissions factors and fuel mix for your electricity region from the EPA's eGrid database. If you know the exact fuel mix that your electricity provider uses, or you are outside the U.S. eGrid, use the "Custom Fuel Mix" next to the Enter Data button. Then enter the fuel mix of your electricity provider.

b. Purchased Steam / Chilled Water

Contact: Energy Manager / Director of Facilities / Steam or Chilled Water Provider

Data: Annual purchased steam and chilled water, production fuel mix, and transport losses

Definitions and Parameters: This section will estimate emissions from off-campus steam / chilled water production. If your campus produces its own steam and/or chilled water, the associated emissions will be captured in the "On-campus Stationary Sources" section (since it will be produced with the other fuels) and should not be included here. Imported steam is a common energy source for urban campuses in cities with centralized steam production.

Collection: This data will hopefully already be compiled but may require digging through monthly records in the Energy Office. Steam and chilled water use data will be collected in "MMBtus" (million British Thermal Units). Chilled water data may also be recorded in "tons," which refers to the equivalent of the amount of cooling from one ton of ice melting in an hour. (This factor is equivalent to 12,000 BTU/hour. Multiply "Tons" by 0.012 to get MMBtu). You will also need to know how the steam/chilled water was produced and the approximate loss of energy in the pipes between the generation facility and the campus. You may need to contact the steam provider to find the types of fuel used to produce the steam each year. The provider's website is a good place to start and you may find it there. This information will be in terms of percent fuel type. (For example, your steam production for the year 2000 could be 11.8% natural gas, 0.6% distillate oil, 25.7% coal and so on). The default fuel mix in SIMAP is 50% natural gas and 50% distillate oil, with 5% transportation loss between the generation facility and campus. This information is needed because the emissions associated with the production of the university's steam will be included in the inventory under Scope 3, transmission losses for steam / chilled water.

Units: MMBtu, % generation fuel use, and % transportation loss

Page: Data Entry/Scope 2/ Purchased Electricity, Steam / Chilled Water

Entry Info: On the Scope 2/Purchased steam page, enter the MMBtu purchased of steam and chilled water. This will set the production fuel mix and transmission loss.

c. Renewable Energy

Contact:

Data: Renewable Energy purchased/sold

Definitions and Parameters:

Collection: This data is not simple and may require some thought and judgement.
Units: MWh
Page: Data Entry/Scope 2/ Renewable Energy Data
Entry Info: Here are some examples of the possible scenarios you may encounter. If you have a small solar array or wind farm owned by your campus, enter it as Scope 1: On-Campus Stationary Sources: Wind and On-Campus Stationary Sources: Solar Electric. For each on-campus renewable data entry, check the box "my campus owns the RECs." If you have an on-site solar farm as part of a Power Purchase Agreement (PPA) for which you do not receive the RECs, then enter those solar PPA kWh (as a separate line item) under Scope 1: On-Campus Stationary Sources: Solar Electric. The box "my campus owns the RECs…" should NOT be checked. This will automatically add the PPA kWh to your Scope 2 purchased electricity totals, and it will also allow to track this as an on-site renewable installation.
Since keeping the RECs box unchecked will automatically add those PPA kWh to their Scope 2 totals, you should NOT include the kWh from this PPA array in their Scope 2 entry. Nor should you enter anything related to this in your Scope 2 Renewable Energy data entry form. (Since you don't own the RECs in the first place, you aren't buying or selling them; hence no Scope 2 transaction to enter.)
<u>Calculations of RECs example</u>
The following example explains the data entry and calculations for RECs:

1. Start with the total electricity consumption reported on the 'utility consumption' link on the '2. Data Entry' tab of SIMAP for 2015 (8,605,242 kWh for UNH for 2015).
2. Add any renewable energy sold, as entered on the 'renewable energy' form on the '2. Data Entry' tab in SIMAP (37,015,000 kWh for UNH for 2015)
3. Subtract renewable energy purchased, as entered on the renewable energy form (0 kWh for UNH for 2015).
4. SIMAP will calculate the net kWh:
   8,605,242 kWh + 37,015,000 kWh – 0 kWh = 45,620,242 kWh (UNH in 2015)
5. Note that the net kWh cannot be negative. If the result is negative, SIMAP will set the net kWh to 0. The net kWh is multiplied by the appropriate emissions factors for each of the three GHGs and NOx. Example: The footprints are 13,200,216 kg CO_2, 396 kg CH_4, and 239 kg N_2O, for UNH for 2015.

Scope 3

a. Commuting: daily commuting by employees, faculty, staff, and students
Contact: Director of Transportation / Human Resources / Registrar
Data: Annual number of commuters, mode of transportation, number and distance of trips
Definitions and Parameters: This category may be one of the most difficult to estimate. The goal is to estimate the number of annual miles traveled by faculty, staff, and student commuters. This estimation should be limited to home to school to home trips. This is included in university emissions because the university could influence this travel by offering alternatives (bus, shuttle, etc.). To estimate this, you will need to know how large these communities are, what their "average" commuter habits are (frequency of trips from home to school and back), the distance from home to school, and the number of commuting days.

Collection: The community size can be probably gathered from the Human Resources (Personnel) Office for employees and the Registrar for students. In addition, these offices may have a list of where these people live, which will assist in determining from where they are commuting. The Transportation Office may have completed a survey to estimate commuter habits in order to better meet commuter's needs with buses or shuttles, and a good deal of information may be able to be deduced from the vehicle parking permit database. If not, you may need to come up with your own estimates to approximate commuter habits. Faculty and staff are calculated separately because most staff will work 40 hours a week on campus while faculty may have more variable hours and habits. You may want to estimate the average fuel economy for faculty, staff, and students if there is a noticeable variation in vehicle preference in your region from the national norm (the default national averages for each year are already entered in the spreadsheets).
Units: % commuting, one-way trips per day, days commuting per year, miles per trip
Page: 2. Data Entry/Scope 3/Commuting/Add Commuting Data
Entry Info: On the page, enter the information on commuting. Note that the entry fields labeled "% [mode of transit]" refer to the % of the total number of faculty/staff/students that use that mode of transit – so in the "Faculty" section, "% Light Rail" means the percent of the number listed in the "Faculty" column that commute via light rail.

b. Directly Financed Outsourced Travel: travel paid for by the institution
Contact: Director of Transportation / Travel Office / Travel Agent
Data: Annual employee, faculty, staff and student miles traveled and mode of transportation
Definitions and Parameters: This category includes any travel that is paid for by the institution but uses vehicles that are not owned by the institution. The President's Climate Commitment requires signatories to report emissions from directly financed faculty and student air travel, to the extent that data are available. You may also choose to report directly financed travel via train, taxi, bus, ferry, rental car, or travel in personal vehicles that is reimbursed by the university.
Collection: This data should be collected in terms of "miles traveled" for students and faculty/staff and may be available through the university Travel Office, the Student Activities Office, or individual departments. If do not have the mileage, you can use the dollars spent on travel to enter it.
Units: Miles/kilometers or US dollar amount for air travel
Page: 2. Data Entry/Scope 3/Business Travel Study Abroad/Enter Data
Entry Info: Enter the vehicle miles traveled for each category or $ spent for air travel.

c. Study Abroad Air Travel
Contact: Study Abroad Office
Data: Annual air miles traveled by students studying abroad
Definitions and Parameters: Although student air travel for study abroad programs is rarely directly financed, many universities encourage or even require their students to study abroad and so feel a responsibility to estimate and report the emissions associated with this travel.

Collection: This number will almost certainly have to be estimated. The Study Abroad or Registrar's Office may be of assistance in this process.
Units: Miles/Kilometers
Page: 2. Data Entry/Scope 3/Business Travel Study Abroad/Enter Data
Entry Info: On the enter data page, enter the air miles/kilometers traveled by students studying abroad.

Air Travel calculation explanation
In addition to the EF for air travel, we also apply a Radiative Forcing Factor when calculating emissions from air travel. This is a multiplier of 2.7. This is to account for the fact that GHG's released at high elevations interact with clouds and atmospheric gases in a way that amplifies the global warming impact. This factor and calculation are based on best-practice guidance from the Intergovernmental Panel on Climate Change. There is variability in the magnitude of the radiative forcing effect, but 2.7 is an accepted average that was used in the CCC (and now SIMAP).

d. Students travel to/from home:
Contact: Registrar's Office
Data: Annual air and vehicle or train miles traveled by students traveling from home and returning home after their study or during holiday breaks
Definitions and Parameters: This metric is new to the calculator and you may need to find out how to collect this data and from whom.
Collection: This number will almost certainly have to be estimated. The Registrar's Office may be of assistance in this process if they can tell you how many out of state students are attending and where they are coming from.
Units: Miles/Kilometers
Page: 2. Data Entry/Scope 3/Students travel to/from home/Enter Data
Entry Info: On the enter data page, enter the air miles/kilometers traveled by students. Mode of transportation, if known, number of trips. For example, are they coming for the year and leaving at the end of the year or are they going home for breaks during the year as well. This would alter the data.

e. **Food**
Contact: Dining and purchasing
Data: Weight of food purchased, categorized by food category and whether it is organic or local. If you only have a partial data set, you can scale it to your full campus based on the % of total food weight represented, the % of the total year represented, or the % of total food purchases in dollars represented.
Definitions and Parameters:
The carbon footprint of food production accounts for emissions from fertilizer application, cattle enteric fermentation, manure management, and loss pathways during food production. The carbon footprint factors used in SIMAP represent conventional food production and were collected from Heller & Keolian 2014.

The food nitrogen footprint has two distinct parts: N losses from food consumption and N losses from food production. This section addresses food production; the food consumption N footprint is addressed in the wastewater section.

The food production nitrogen footprint is the total N losses that occur from fertilizer application through food consumption. The aspects reported by the N footprint are the N contained in food purchases, the food N wasted, the N emissions from transit, and the N lost on the farm. SIMAP uses an average protein content (nitrogen is contained in protein) to determine the N contained in all food purchases. Average US food waste factors (FAO) are used to calculate the amount of food purchased at a campus that is wasted. Average US food miles and truck N emissions factors are used to calculate the food transit N footprint. Finally, virtual N factors for conventional food production in the US are used to estimate on-farm N losses (Leach et al. 2012).

Users can identify whether food products are organic or local. Note that the food carbon and nitrogen footprint factors available in SIMAP only currently represent conventional food, but we will be adding organic factors in the future. The nitrogen footprint of local food is calculated when selected.

Collection: The ideal data set is a complete food purchase inventory for your campus. If that is not possible, then a subset of the total weight, year, or dollars spent can be used. Food purchase records must be processed in two ways.

First, each food purchase must be categorized into one of 18 food product categories (See Appendix 3). For a multi-ingredient food, you can select up to 3 food product categories. A food product should only be identified as multi-ingredient when a second or third ingredient makes up approximately half or one third of the total food mass, respectively. For example, pizza and lasagna would be multi-ingredient foods, whereas bread and fried chicken would be single ingredient foods.

Second, the weight of each food item must be calculated. Food purchase records do not always report the weight of food, so some calculations may be necessary. For example, food inventories often report the number of cases purchased and the weight of an individual case. When weights cannot be calculated from given information in an inventory, some research may be necessary. You can use the USDA Food Composition Database (https://ndb.nal.usda.gov/ndb/), weigh food products, or use our soon-to-be-available reference guides that provide common food weights based on research from other campuses.

A calculation of the reduction of greenhouse gas emissions from purchasing local food was incorporated into SIMAP. Selecting local food now results in 3% lower greenhouse gas emissions, following findings from Weber & Mathews 2008, which calculated that 4% of total greenhouse gas life cycle emissions from food result from the final delivery of that food.

Units: Weight of food (kg or lb). We will add volume and other units in the future.

Page: 2. Data Entry/Scope 3/Food/Enter Data OR import the food uploader

Entry info: On the 'enter data' page in the SIMAP interface, enter a descriptive label, weight (kg or lb), whether the food is organic or local, and up to 3 food categories. In the food uploader Excel spreadsheet, enter the same information in a table that can be imported to SIMAP.

f. Paper

Contact: Purchasing/Departments

Data: Annual purchase of paper and the percentage of recycled content

Definitions and Parameters: Institutions may have several ways of purchasing and recycling paper products. You may find that the institution has a centralized paper purchasing or you may find that each department and group buys their own paper products. You will also have to figure out how to track and report the recycling of that paper. Some institutions hire outside shredding and recycling companies. Some contract with recycling company to take it away with other recyclable products. Then, the recycling company can provide you with information about the weight of paper

Collection: You could ask the person in charge of purchasing how they handle paper purchasing. Then get in touch with person in charge of waste management to find out how they handle paper recycling.

Units: Pounds/Reams/Short ton

Page: 2. Data Entry/Scope 3/Paper

Entry Info: On the Entry data page, enter the paper purchasing in units of pounds, reams, or short tons, depending on your source of information.

g. **Solid Waste**

Contact: Waste Management Supervisor, Grounds and Roads department, or Director of Facilities. You may need to contact the landfill with questions regarding the type of landfill. The E.P.A. also has information on some landfills, check out: U.S. E.P.A's Landfill Methane Outreach Program (http://www.epa.gov/lmop/profiles.htm) for more info.

Data: Annual waste production and disposal method (incinerated, landfilled without methane control technology, landfilled with methane flaring, or landfilled with methane recovery)

Definitions and Parameters: Institutions have several methods for managing solid waste. The two most common are incineration and landfilling. Incinerated waste releases greenhouse gases when combusted and waste sent to landfills releases methane as it decomposes.

Collection: First, contact the person in charge of waste management to inquire about historical data for the amount of solid waste generated that is sent to a landfill or incineration. The institution will likely pay a tipping fee each month and will hopefully have records of the amount of waste disposed.

Second, find out where the waste goes: (1) a mass burn incinerator, (2) a refuse-derived fuel incinerator, (3) a landfill with no methane collection, (4) a landfill that collects methane emissions for flaring, or (5) a landfill that collects methane emissions for electricity generation. You may need to contact the landfill to find this information.

Units: Short tons

Entry Sheet: Scope 3/Data Entry/Waste & Wastewater

Entry Info: Enter the short tons of solid waste in each category. SIMAP uses emission factors for an "average" composition of solid waste. If you have access to specific information regarding the composition of your waste, you can use the EPA's Waste Reduction Model (WARM) to develop a specific emission factor for your institution.[8] Follow this (link)[9] and enter your waste mix as percent.

h. Wastewater:

Contact: Waste Management Supervisor or Director of Facilities. You may need to contact the wastewater facility with questions regarding the type of treatment.

Data: Annual wastewater production (volume) and wastewater treatment method. You should select the most advanced method found at your wastewater treatment facility:

- Central treatment system: aerobic
- Central treatment system: anaerobic
- Central treatment system: anaerobic digestion
- Septic system
- Other

Definitions and Parameters:

- Central treatment system: aerobic = This method of wastewater treatment occurs during secondary treatment. Oxygen is circulated through the wastewater to encourage aerobic bacteria to break down the waste.
- Central treatment system: anaerobic = This method of treatment occurs during secondary treatment. Oxygen is not circulated so that anaerobic bacteria can break down the waste. Examples include anaerobic lagoons or anaerobic reactors.
- Central treatment system: anaerobic digestion = Anaerobic digestion of sludge occurs in tertiary treatment. This process is in addition to either aerobic or anaerobic treatment and is more advanced.
- Septic system = This category accounts for wastewater that is collected in a septic system and is untreated.
- Other = If your system does not fit into the above categories, you can select 'Other'. However, you will need to enter custom emissions factors. Contact the SIMAP team for help with this calculation (simap@unh.edu).

For more information about wastewater treatment methods and the associated emissions factors, please see the EPA Inventory of US Greenhouse Gas Emissions and Sinks and IPCC report sections on wastewater.

Collection: First, contact the person in charge of waste management to inquire about the level of wastewater treatment (see above). You may need to contact your local wastewater treatment facility to find this information. Second, ask about historical data for the volume of wastewater generated that is sent to a wastewater treatment facility. The institution will likely pay a tipping fee each month and will hopefully have records of the amount of wastewater treated. If your campus processes wastewater in multiple ways, then you can enter those volumes of wastewater as separate data entry points. If your campus does not track its wastewater volume but you would like to determine the

[8] Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks, 2nd Edition, EPA530-R-02-006, May 2002. http://www.epa.gov/epaoswer/non-hw/muncpl/ghg/greengas.pdf

[9] http://yosemite.epa.gov/oar/globalwarming.nsf/content/ActionsWasteWARMOnline.html

footprints associated with your food consumption footprint, then follow the SIMAP Guidance for the NFT Network for the food consumption method.
Units: US gallon/liters
Entry Sheet: Scope 3/Data Entry/Waste & Wastewater
Entry Info: Select the wastewater treatment method and enter the volume of wastewater.

Sinks and offsets

i. **Compost**
Contact: Sustainability Coordinator / Energy Manager / Director of Facilities / Dining manager
Data: Annual offsets purchased or created (composting, forest preservation, renewable energy credits, retail offsets, etc.)
Definitions and Parameters: It is increasingly common for institutions to offset some portion of their greenhouse gas emissions in several ways. An offset is achieved when the campus invests in a reduction in GHGs outside of its institutional boundaries, such that it exerts some financial control on that entity and is therefore responsible for that entity's reduction in GHGs. Examples of offsets include on-campus carbon sinks, like compost. When managed properly, composting results in some carbon storage (associated with application of compost to soils) and does not generate CH_4 emissions. Composting can be entered as either dining waste or agricultural waste.
Units: Short tons, MT eCO2, kWh
Entry Sheet: Sinks/compost
Entry Info: For each entry option, enter the number or amount for each type of offset.

j. Non-additional sequestration

Contact: Sustainability Coordinator / Energy Manager / Director of Facilities
Data: Annual offsets purchased or created (forest preservation, land preservation)
Definitions and Parameters: It is increasingly common for institutions to offset some portion of their greenhouse gas emissions in several ways. An offset is achieved when the campus invests in a reduction in GHGs outside of its institutional boundaries, such that it exerts some financial control on that entity and is therefore responsible for that entity's reduction in GHGs. Examples of offsets include on-campus carbon sinks, like compost,
Units: MT eCO2
Entry Sheet: Sinks/Carbon/Nitrogen/non-additional sequestration
Entry Info: For each entry option, enter the number or amount for each type of offset.

k. Offsets

Contact: Sustainability Coordinator / Energy Manager / Director of Facilities
Data: Annual offsets purchased or created (forest preservation, renewable energy credits, retail offsets, etc.)
Definitions and Parameters: It is increasingly common for institutions to offset some portion of their greenhouse gas emissions in several ways. An offset is achieved when the campus invests in a reduction in GHGs outside of its institutional boundaries, such that it exerts some financial control on that entity and is therefore responsible for that entity's reduction in GHGs. Examples of offsets include

on-campus carbon sinks, like compost, off-campus institution-funded carbon reduction projects. Another type of offset is the purchase or protection of forest lands that function as a carbon sink. These lands could be near campus or in another country. Composting is an on-campus offset practice that many universities are engaged in, though often for reasons other than carbon sequestration. Retail offsets are available for purchase by institutions like yours, but there can be vast differences in offset quality in the booming offset market, so it's important that your campus community understands the difference between various calibers of offsets.

Collection: For information on RECs or retail offsets, contact your Campus Sustainability Coordinator, Environmental Affairs, or Energy Manager. For forest preservation, contact the Land Manager or Project Coordinator.

Units: Short tons, MT eCO2, kWh

Entry Sheet: Sinks/compost/non-additional sequestration/offsets/

Entry Info: For each entry options, enter the number or amount for each type of offset.

Appendix 2: Data checklist

This appendix provides a comprehensive list of all data inputs in SIMAP. You can use this list to prepare for your campus data collection and as a checklist to confirm that you have entered all of your data sets into SIMAP. The data sets are organized into these parts:
Account:

- Institution data

Data Entry

- Campus activity data (scope 1, scope 2, scope 3)
- Sinks
- Calculation Factors

Please note that this section is in development.

1.Institution data

Account

- Institution
    - Name of institution [select from drop down menu if higher education]
    - Type of institution: education/municipality/healthcare/lodging/other - demographic info
    - Location [country; enter zip code for US; select province for Canada; enter country if outside US and Canada and enter customized electricity factor in the customization section for your country. There are now pre and post 2007 eGrid zone options, make certain you select the pre-2007, if your data goes back to that time]
    - Fiscal year – defines the period for data collection based on your budget year
    - Campus setting – urban or rural, helps to identify the special circumstances
    - Climate zone – heating and cooling degree days estimated based on this
    - Methodology used to collect data - operational/equity share/financial control
    - Open field to state any circumstances in which some buildings are outside the bounds
    - Unit system used to collect data [this will set your default measurement for all data]
        - US standard/non metric
        - Metric
- Goals
    - Carbon and nitrogen reduction goals
    - Notes about any special reduction goals not listed above
    - Organizations to which you report
    - Notes about organization not listed
- Programs / Initiatives
    - Where does sustainability live in your organization and how you manage the daily tasks internally and externally
- Budgets
    - Add budgets
        - Year
        - Total operating budget
        - Research budget
        - Energy budget

    - Confidence factor – not used to calculate your footprint
    - Optional notes – information about your budget data collection
- Physical Spaces
  - Add space data
    - Year
    - Unit – gross square feet of meters [depending on your unit set on the institution page]
    - Total space – mandatory measure of the total building space
    - Research space – not mandatory; only enter if you have specially designated research space, may be used for the normalization
    - Parking structure – not mandatory, may be used for normalization
    - Dining space – not mandatory, may be used for normalization
    - Residential space – not mandatory
    - Athletic facilities – not mandatory
    - Confidence – not used to calculate your footprint
    - Notes – information about the space, add any information not listed above
- Populations
  - Add population -
    - Year – add year for which you are entering the population data
    - Full time equivalent students – mandatory – may be used for normalization
    - Full time staff - mandatory
    - Full time faculty - mandatory
    - Residential students - mandatory
    - Residential faculty - mandatory
    - Other on-site residents and/or in-patient hospital beds (Headcount) - mandatory
    - Students Enrolled in Distance Education (Headcount) - mandatory
    - Weighted Users Calculation – this is calculated automatically based on the numbers entered into the population fields
    - Full time commuting students – not mandatory
    - Part time commuting students – not mandatory
    - Non-credit students – not mandatory
    - Summer students – not mandatory
    - Meal plans – not mandatory
    - Meals served – not mandatory, may be used for normalization
    - Confidence - not used to calculate your footprint
    - Notes – enter information you want to remember about this set of data, contact person, etc..
- Manage Users
  - Add new user – add users to manage the data entry and to be delegate management
    - Name
    - Email address – must be unique, cannot add an address already in the system
    - Select reviewer/editor/super user role
- Notebook
  - Write notes about your special data sets, add contact information for collecting data, and add notes for additional users about your institution to help with data collection.
- Payments

  - Your membership start date, you can check when your membership expires on the My Account page

Campus activity data

2.Data Entry

Scope 1

- <u>Stationary Fuels</u>
  - Enter Data
    - Select Source from dropdown menu
    - Enter data range
    - Enter label – this is for your reference to identify any additional information about the source in addition to the name selected above
    - Unit – will provide a dropdown menu based on the source selected
    - Quantity
    - Confidence – not used to calculate your footprint
    - Optional Notes – add any notes about the data above
  - <u>Cogen Efficiency</u>
    - Year – enter fiscal year
    - Electric Outputs – enter data in KWh
    - Electric Efficiency – enter percent efficiency
    - Steam Output – enter in MMBTU
    - Steam Efficiency – enter data in percent efficiency
    - Confidence – not used to calculate your footprint
    - Optional notes – add notes about your data above
- <u>Transport Fuels</u>
  - Source – select source from dropdown menu
  - Date range – enter date for this set of data
  - Label – for your reference
  - Unit – will provide dropdown menu based on the source selected above
  - Quantity – enter numbers without any punctuation, the system will add punctuation to designate thousands and millions
  - Confidence – not used to calculate your footprint
  - Optional Notes – notes for this set of data
- <u>Fertilizer</u>
  - Enter data
    - Source – select from dropdown menu - synthetic/organic
    - Date range
    - Label
    - Unit
    - Quantity
    - Nitrogen percent
    - Confidence
    - Optional notes
- <u>Animals</u>
  - Enter data
    - Select source from dropdown menu, add your own if not listed

        - Date range
        - Label
        - Optional notes
- **Refrigerants & Chemicals**
    - Enter data
        - Select source from dropdown, you can enter additional values in 'other' option
        - Date range
        - Unit
        - Quantity
        - Confidence
        - Optional notes

Scope 2

- **Purchased Electricity, Steam / Chilled Water**
    - Enter data
        - Select source from dropdown menu
        - Date range
        - Unit
        - Quantity
        - Confidence
        - Optional notes
- Custom Fuel Mix (Electricity)
    - Add custom fuel mix – add mix for your on-campus fuel source
    - Optional notes – add information about your campus fuel mix
- Custom Fuel Mix (Steam)
    - Add custom fuel mix
    - Optional notes
- Custom Fuel Mix (Chilled Water)
    - Year
    - Mix
- **Renewable Energy Certificates**
    - Enter Data
        - Select source from dropdown menu
            - Purchased
            - Sold
        - Date range
        - Label
        - Unit
        - Quantity
        - Confidence
        - Optional notes

Scope 3

- Commuting
    - Add commuting data
        - Data range – enter date for the data you are entering
        - Category – select from dropdown menu

        - # of commuters
        - Trips per commuter per week – 10 trips for full time on site staff; 6 for part time commuters, etc.
        - Commuting Weeks per Date Range - enter number of week, for example: 40 weeks for faculty not teaching in summer; 50 weeks for regular staff
        - Faculty commuting – not mandatory. Percentages need to add up to 100%
        - Confidence – not used to calculate your footprint
        - Optional notes – add notes to explain any special conditions or where you found the data
- Business Travel & Study Abroad
    - Enter data
        - Source – select from dropdown menu
        - Data range
        - Label
        - Unit
        - Quantity
        - Confidence
        - Optional notes
- Student Travel to/from Home
    - Enter data
        - Data range
        - # of Students Traveling to/from Home to Campus *
            - Then breakdown by type of travel – percentages need to add to 100%
- Food
    - Add food
        - Date range
        - Label
        - Weight
        - Unit – select from dropdown menu: pounds/kilograms
        - Organic/local - check box, you can select for each food entry
        - Category 1* - select food category from drop down menu
        - Category 2 – optional
        - Category 3 – optional
        - Vendor
        - Dollars
        - Confidence
        - Optional notes
    - Add scaling factors for each year of data entered*
        - Year
        - Percent
        - Scaled by
            - By weight
            - By dollars
            - By time
- Paper
    - Enter data

        - Source – select from dropdown menu
        - Data range
        - Label
        - Unit
        - Quantity
        - Confidence
        - Optional notes
- Waste & Wastewater
        - Source – select from dropdown menu
        - Data range
        - Label
        - Unit - Varies based on selection
        - Quantity
        - Confidence
        - Optional notes

Sinks

- Compost
    - Enter data
        - Source – select from dropdown menu
        - Data range
        - Label
        - Unit
        - Quantity
        - Confidence
        - Optional notes
- Non-Additional Sequestration
    - Enter data
        - Source – select from dropdown menu
        - Data range
        - Label
        - Unit
        - Quantity
        - Confidence
        - Optional notes
- Offsets
    - Enter data
        - Source – select from dropdown menu
        - Data range
        - Label
        - Unit
        - Quantity
        - Confidence
        - Optional notes

Calculation Factors

- Emission Factors

- Customize EFs
  - **Scope**
    - Select scope
      - 1
      - 2
      - 3
  - Sinks
  - **Source**
    - Select source
  - **Emission Type**
    - Select emission type
    - CH4
    - CO2
    - eCO2
    - Loss
    - N
    - N2O
    - NOx
  - Note: Customizations are to this EF version only.

- Utility Emission Factors
  - Electricity
    - CO2
    - CH4
    - N2O
    - NOx
  - Steam
    - CO2
    - CH4
    - N2O
    - NOx
  - Chilled water
    - CO2
    - CH4
    - N2O
    - NOx
- Food Conversion Factors – reference list of existing factors
- Global Warming Potential
  - Add refrigerant of chemical
    - Refrigerant of Chemical name
    - 100 year global warming potential [see references section for table]
- Unit Conversions – reference list of conversions

3.Results

Footprints

- Carbon
- Nitrogen

Report types

- Total footprint
- Scopes
- Categories
- Sources
- Gas/pollutant

Graph Type

- Line
- Bar
    - If you select one year, you will see a pie chart for the graph selection

Fiscal Year Range

- Select one year for annual report or range of years for comparative results

Normalization

- Research budget
- Energy budget
- Total budget
- Research GSF
- Total GSF
- FTE Students
- Campus/user community
- Heating degree days [not available at this time]
- Cooling degree days [not available at this time]
- Total degree days [not available at this time]
- Meals Served

Note: Results may be exported with Tier 1 subscription.

Reports [Tier 1 feature]

Annual Report – carbon OR nitrogen footprint – based on the S_Annual tab in CCC with graphs and tables for each section: Categories, Scopes, Total
Second Nature report – matches the system requirements from Second Nature

Data Management

Status

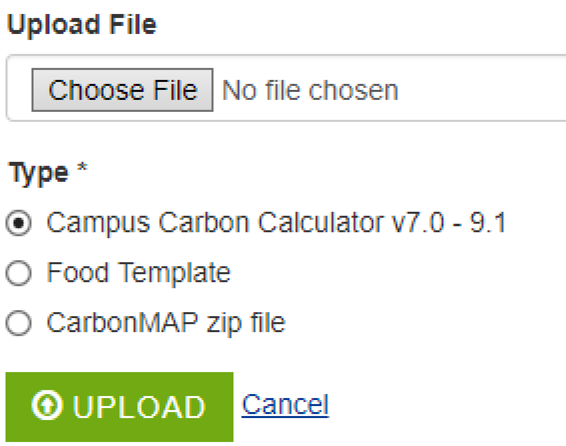
Please check the appropriate boxes and save your selections when the inventory for those years is complete. Checking a box does not change any of the calculations, it just indicates that all available data for that year has been entered. This is also important if you are importing your data into Second Nature system.

Years with data

- [ ] 2017
- [x] 2016
- [x] 2015

Import

Note: Years in the upload are treated as fiscal years based on the setting for your institution. Your fiscal year starts on Jul 1st, so FY 2017 is from 2016-07-01 to 2017-06-30.



Export

Exports all your data in csv files

- Export Inventory and EFs
- Export results

Delete Year

This is an irreversible action. All inventory input data, including commuting, food, etc., as well as budgets, populations, and physical spaces will be deleted for the indicated fiscal year. All custom fuel mixes and custom emission factors entered for that year will be deleted as well.

Year *

Enter the year for which you want to delete all data.

DELETE

About

Takes you to the UNH Sustainability Page

Resources

- Tools
- Users' Guide and Training
- Changes in SIMAP
  - Ongoing changes in SIMAP
  - Changes from CCC and CarbonMAP
    - Emission factors
    - Methodology
  - Changes from Nitrogen Footprint to SIMAP
- FAQs

- Glossary
- Links
- Carbon References
- Nitrogen References

Appendix 3: Food category guidelines

Please use the food descriptions below to categorize your institution's food purchases. We are also preparing guidelines for multi-ingredient foods and average weights of common food products.

Table A1. Food categories in SIMAP with examples of common foods in that category.

Multi-ingredient foods are noted with an asterisk (*), and more information about categorizing multi-ingredient foods can be found on Table A2.

Food categories in SIMAP	Foods in this category
Beef	Beef, steak, ground beef, hamburger, meatball, beef lasagna*, goat meat, sheep, and other ruminants
Pork	Sausage, bologna, bacon, pepperoni
Chicken	Chicken, turkey, and other poultry
Cheese	Cheddar, parmesan, cream cheese, feta, gouda, alfredo sauce, cheese pizza*, and other cheeses
Eggs	Eggs, liquid eggs
Milk	Milk, yogurt, ice cream, cream, butter, condensed milk, pudding, and other dairy products (other than cheese)
Fish	Fish, lobsters, shrimp, cod, anchovy, salmon, tuna, fried seafood
Beverages/Liquids	Fruit juice, soda, broth, beverage powders, sports drinks, soup*, vinegars, cooking wine, and other beverages. Exclude milk (report as milk) and coffee and tea (report as coffee and tea).
Grains	Wheat, bagel, bread, rice, biscuit, breakfast cereals, pita bread, cake, crackers, crepe (w/o filling), cookies, muffins, pastries, pancakes, noodles, pasta, pizza*, tortilla chips, barley, rye, oats, millet, sorghum, and other grains
Fruits	Apples, oranges, lemons, grapefruit, citrus, bananas, blueberries, strawberries, plantains, apples, pineapples, dates, grapes, avocadoes, melons, fruit/granola mix*, fruit cocktail, fruit preserves, and other fruits
Nuts	Cashews, almonds, walnuts, pistachios, peanuts, peanut butter, tahini paste, and other nuts
Oils	Vegetable oil, canola oil, olive oil, soybean-based oil, salad dressings, non-dairy creamer, mayonnaise, margarine, and other oils
Beans	Soybeans, tofu, black beans, kidney beans, cannelli beans, pinto beans, chickpeas, lentils, refried beans, hummus, and other beans and pulses
Spices	Pepper, pimento, cloves, mustard, other spices and seasoning
Potatoes	Potatoes, sweet potatoes, potato chips, fries, hash browns, yams, cassava, yams, and other roots
Coffee and tea	Coffee, tea, chocolate bars*
Sugars	Sugar, sweeteners, honey, candy, glaze, sprinkles, marshmallow, syrups
Vegetables	Tomatoes, onions, lettuce, greens, green beans, peas, string beans, carrots, corn, squash, vegetable soup*, and other vegetables

*Multi-ingredient

Table A2. Guidelines for categorizing common multi-ingredient foods.

As a general rule of thumb, food products should be considered multi-ingredient only when a second ingredient makes up at least 1/3 of the total food weight. These are often prepared products (e.g., sandwiches, pizza, trail mix). SIMAP accommodates up to 3 food category selections. If a food product has over 3 ingredients that are equally weighted, we recommend entering those ingredients as separate entries in SIMAP with the food weight divided appropriately.

Common Multi-Ingredient Foods	
Prepared meat sandwich	grains, meat, vegetables
Pizza (meatless)	grains, cheese, vegetables
Pizza (meat)	grains, cheese, vegetables, meat
Lasagna (meat)	cereals, cheese, vegetables, meat
Lasagna (meatless)	grains, cheese, vegetables
Bean and cheese burrito	grains, pulses
Stuffed pasta (ravioli, stuffed shells, etc.)	grains, cheese
Spanakopita	grains, cheese, vegetables
Candy bars	stimulants, nuts (if applicable), grains (if applicable)
Veggie burgers	pulses, vegetables
Soups	liquids, meat (if applicable), vegetables (if applicable), milk (if cream-based)
Trail Mix/Granola Mix	grains, nuts, fruits
Non-dairy creamers	oils, sugars
Filled pastries	grains, fruits, milk
Eggroll	grains, meat, vegetables
Sauces (e.g., teriyaki sauce, taco sauce)	vegetables, oilcrops
Condiments (e.g., ketchup)	vegetables, oilcrops
Mustard	spices, oils