Proposal:

Greenhouse Gas Emissions Inventory at St. Mary's College of Maryland

An Independent Sustainability Project
Submitted for Consideration to Professor Barry Muchnick
for ENST450: Applied Sustainability Practicum

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Executive Summary

In order to see progress towards climate neutrality, and sustainability in general, a baseline measure of campus emissions must exist. The goal of this project was to build a foundation for this baseline measurement by augmenting St. Mary's College's current efforts to quantify greenhouse gas emissions with other institutions' metrics and practices such that St. Mary's College could eventually publish its own greenhouse gas emissions inventory report. This would have many benefits for the college including more targeted efforts to reduce environmental impact, increased financial savings, an engaged student body with an expanded educational experience, and increased value of the institution as a whole. After summarizing current efforts at St. Mary's College and reviewing other institutions' greenhouse gas emissions inventories, I developed a list of emissions metrics that should be used at St. Mary's College, as well as the sources, or likely sources, of those data. Further, I outline a system of reporting these data that incorporates individuals across campus, including students, faculty, and staff, into a relatively effortless and highly educational collaborative process of updating the emissions inventory. While this project was limited by time, the next step is clear: contact and organize the various individuals (outlined in this proposal) necessary for data collection. Successfully doing so initiates the process of annual reporting necessary for a greenhouse gas emissions inventory at St. Mary's College of Maryland.

Introduction

"Data begets information, which sparks action."
Jonathan Bloom

This proposal describes how St. Mary's College of Maryland can take advantage of the opportunity to organize and optimize its greenhouse gas (GHG) emissions data collection strategies to both streamline its own operations and underscore its commitment as a leader in campus sustainability. Many recognize that the first step in working towards a sustainable campus is measuring the various operations of the university as a baseline of energy and resource use (Uhl, 2004). Largely, that starts with a measure of an institution's greenhouse gas emissions. Efforts to measure and compile the GHG emissions of the St. Mary's College Campus do exist, but a review of the literature surrounding the development of GHG emissions inventories by other institutions of higher education reveals opportunities to augment our efforts. Through collaboration and expertise that is characteristic of our institution, St. Mary's College could implement a complete, campus-wide inventory of GHG emissions, taking an important and powerful step forward to reaching goals associated with climate neutrality, sustainability, and the overall flourishing of our institution.

I have developed a comprehensive and organized proposal for greenhouse gas emissions data collection on the St. Mary's College of Maryland campus. My goal was to establish a strategy for obtaining the realistic 'baseline' impact of the campus from which the progress of sustainability initiatives in future years can be usefully measured. First, I will describe the context of this project; how it fits into the overall picture of campus sustainability and how we can use the efforts of other institutions to provide a foundation for a successful project at St. Mary's College. Second, I will discuss current practices at

St. Mary's College, including the campus' data collection and reporting procedures, and look for possibilities of optimization, creativity, and innovation. Third, we will examine the methodologies and practices of other institutions to establish 'best practices' in relation an GHG emissions inventory, from which a GHG Emissions Inventory at St. Mary's College could draw. After analyzing these practices in light of the current efforts and institutional culture of St. Mary's College, we will pinpoint areas in which St. Mary's College has room to develop, and we will make recommendations for implementation on our campus based on that research.

Context

"Institutions measure only what is important to them."
Christopher Uhl

As institutions of higher education steadily adopt sustainability as an agenda, an assortment of practices and initiatives have emerged to try to achieve sustainability goals. However, an underlying obstacle to progress remains: gathering data and reporting is often non-comprehensive and inconsistent (Rappaport, 2008). This leads to an inability to draw helpful conclusions about which practices or initiatives garner the best results (Rappaport, 2008). Organizations, such as STARS (Sustainability Tracking, Assessment & Rating System), promote widespread data collection among educational institutions (Urbanski, 2014), but participation in collaborative efforts such as these is voluntary and relies on self-reported data. While there are accountability measures associated with reporting (such as public access and approval of data by college presidents) third party verification has yet to be established (Martin and Samuels, 2013). This means that, in order to contribute meaningfully to these important worldwide efforts, institutions must take the initiative to rigorously collect and report accurate and representative information.

Data gathering and reporting can have significant impacts on an institution itself. A greenhouse gas emissions inventory is a report of the various sources and quantities of emissions associated with an institution. They are widely recognized as the first step in setting and measuring progress towards sustainability goals (Mascarelli, 2009; Uhl, 2004). The attainment of these goals improves institutions, from increased operational efficiency and financial savings to a more engaged student body and increasing value of education at that institution.

This added value is accomplished by harnessing the creativity and drive of various members and groups in the campus community to contribute to the project. Not only does this kind of campus-wide collaboration advance the interests of the institution, creating a richer learning environment, but also it is entirely necessary to achieving success (Decarolis et al., 2000). Without institutional support, meaningful progress is impossible. By engaging the campus community in the completion of sustainability initiatives, like an emissions inventory, the effort required for their completion can be situated in the pedagogy of the institution. Other institutions have seen great success in fostering collaboration between students, staff, faculty, and administration to accomplish practical and useful ends. Working on a project like the GHG inventory simultaneously cultivates students' education, by teaching them 'hard' skills so often decried as absent from liberal arts institutions, and the professional flourishing of all other parties involved (Maloni and Paul, 2011; Decarolis et al., 2000). St. Mary's College is a unique and tight-knit community already devoted using partnerships between students and faculty to provide students a high-level liberal arts education, and therefore is ripe for this kind of collaboration.

While St. Mary's College, namely Physical Plant and the SGA Environmental Protection Committee, is already working to collect emissions data, there is an opportunity to augment our efforts to be more centralized and complete. With emissions data centralized and analyzed in a singular report, members of the campus working on reducing the school's emissions will have simple access to the information needed to spark their creativity and innovation, and a record of the school's current efforts.

This proposal is the most likely avenue to result in both a tangible end product and the advancement of sustainability at St. Mary's College as a whole. Rauch and Newman (2009) provide evidence that broad institutional and administrative support is gained through a cyclical process of vision and implementation; that is, projects start as visions and end in implementation, which give rise to more visions, propagating across campus. The vision of a GHG emissions report must be followed by an implementation plan in order to make it an actuality. Further, as we have already argued, the vision of St. Mary's as a sustainable institution starts with the implementation of a GHG emissions inventory report: such a document provides the data-based foundation from which to begin truly targeted and effective sustainability initiatives at St. Mary's College.

Lastly, as one of the most singularly important steps towards sustainability that an institution can take, following through to develop a GHG emissions inventory report would propel St. Mary's College towards becoming a leader in campus sustainability in its own right. Each school has its own method of completing a GHG emissions inventory report, from using the efforts of graduate students (Groode, 2004; Moerschbaecher and Day, 2010) to hiring outside resources (Malten, 2009). While many of our peer institutions are currently defining the cutting edge of campus sustainability, St. Mary's has the potential to be alongside them in the near future. By creating a more comprehensive GHG emissions inventory we join groundbreaking institutions like Yale University, which used their emissions inventory to widen the boundaries of its analysis to an unprecedented level among higher education institutions (Buttazzoni et al., 2005). St. Mary's College could pioneer its own brand of GHG emissions report, incorporating a level of student and campus community involvement fully worthy of our school's guiding ethic, the St. Mary's Way. It is truly an opportunity for St. Mary's College to manifest all that makes it unique and great.

Technical Terminology and Concepts

First, it is necessary to define key terms and concepts. Like many colleges and universities, St. Mary's College uses the Clean Air Cool Planet Campus Carbon Calculator (specifically, v5.0) to analyze greenhouse gas emissions data. This calculator uses a 'scopes' approach to categorize emissions. There are three scopes. **Scope 1** consists of *direct* emissions from sources owned or controlled by an institution (Moerschbaecher and Day, 2010; Anon, n.d.). For instance, if St. Mary's College owned a waste-to-energy incinerator, the emissions from that incinerator would count under Scope 1. **Scope 2** emissions are *indirect* in the sense that the source of these emissions is not owned or operated by the institution, but are still connected to the energy consumption of the institution (Moerschbaecher and Day, 2010). This is commonly understood to include the emissions produced by the generation of electricity purchased by an institution (Anon, n.d.). **Scope 3** are also *indirect*, sometimes called 'outsourced', emissions (Moerschbaecher and Day, 2010); they include upstream and downstream emissions involved in the consumption and production of an institution (Anon, n.d.).

Prominent, and interconnected, examples of Scope 3 emissions include materials consumption and solid waste disposal. While some institutions may choose to limit their measure of Scope 3 emissions to the borders of campus, Knuth et al. (2007) recommends drawing this line along the college's responsibility for emissions rather than arbitrary geographical boundaries.

Another technical term and concept is 'emissions factor'. "Emissions factors (EF) are a representative value that attempts to relate the quantity of a pollutant released into the atmosphere with an activity associated with the release of that pollutant" (Groode, 2004). Essentially, an emissions factor tells you how much, on average, of a certain greenhouse gas, pollutant, etc., is formed and released when a certain action is performed. For instance, 0.0265 metric tons of carbon are emitted into the atmosphere when 1 MmBTU (Million British Thermal Units) of coal is burned (Groode, 2004). Because St. Mary's College uses a carbon calculator, which uses pre-existing emissions factors to calculate emissions, I do not refer to any novel emissions factors in this report.

Case Studies

Current Efforts at St. Mary's College: Climate Action Plan

The Climate Action Plan is the official directive under which St. Mary's College works to incorporate sustainability into the pedagogical goals of the institution and to achieve climate neutrality, thereby fulfilling its commitment under ACUPCC (American College and University Presidents' Climate Commitment). The ACUPCC was signed by former President Jane Margaret O'Brien in 2008, and signed again by our current president, Dr. Tuajuanda Jordan. The Climate Action Plan also represents the sum of current efforts of GHG emissions data collection and compilation at St. Mary's College of Maryland. The plan, and the update status of the information contained therein, has waxed and waned since its inception, but, in the 2014-2015 school year, the Student Government Association (SGA) Environmental Protection Committee undertook the most recent update[1]. This committee used the previous version of the Climate Action Plan and the framework of the Clean Air Cool Planet Campus Carbon Calculator v5.0 to define the boundaries of their efforts. Members then tracked down GHG emissions data across campus and compiled them into the updated plan. Their efforts are summarized in Table 1.

Scope 1, 2, and 3 emissions were calculated by inputting data into the Clean Air Cool Planet Campus Carbon Calculator v5.0. Scope 1 emissions were measured in fuel oil and propane use. While distillate oil and gasoline use data are collected separately, no distinction between them is made in the Climate Action Plan; they both fall under the 'Fuel Oil Use' category. Total fuel oil and propane consumption data were directly available and collected from the fiscal administrator at Physical Plant in the Office of Planning and Facilities. Scope 2 emissions were measured in purchased electricity, data for which was contained within the school's utility bills, which the school is required to submit to the Maryland State Energy Database.

Scope 3 emissions were quantified in faculty and staff commuting, student commuting, travel associated with varsity athletics programs, and travel associated with the Office of International Education. Emissions data associated with faculty and staff commuting were calculated by using anonymous city and state location of individuals' residences to determine the distance traveled during a round trip commute from city

[1] Katelynne Cowart '15, the committee's chairperson, led efforts to update the plan.

center to campus. Emissions from student commuting were calculated in the same way. Athletic team automobile travel emissions were estimated by calculating the round trip distance between the St. Mary's campus and the locations of all the 'away' games and events. Athletic team air travel distance (specifically associated with the sailing team) was determined from the team schedule of 'away' regattas and self-reported flight schedules. Air travel emissions associated with study abroad programs were estimated in the same way from data (provided by the Office of International Education) on the total number of miles study abroad students traveled in the 2013-2014 school year, based on airports that students would likely arrive at and depart from.

St. Mary's College collects emissions data from sources that would ostensibly fall under the Scope 3 category, but were not included in the Climate Action Plan. These include sewage, fertilizer application, and solid waste.

Table 1. Summary of the GHG emissions data metrics and methods used in the St. Mary's Climate Action Plan in the 2014-2015 school year.

	Metric	Description	Methods	Contact
Scope 1	Fuel Oil Use	Includes emissions associated with both gasoline and distillate oil use.	Direct data	**Joyce Goodwine** Fiscal Administrator at Physical Plant
	Propane Use	Includes emissions associated with propane use.	Direct data	**Joyce Goodwine** Fiscal Administrator at Physical Plant
Scope 2	Purchased Electricity	Includes emissions from the total amount of	FY14's data collected from Maryland State Energy Database,	**Maryland State Energy Database**

		electricity purchased by the school.	which collects energy data from submitted utility bills.	
Scope 3	Faculty and Staff Commuting	Includes emissions from car travel by faculty and staff.	Calculated based on round trip from city centers to campus (City, State reported anonymously).	**Catherine Pratson** Director of Human Resources
	Student Commuting	Includes emissions from car travel by student commuter.	Calculated based on round trip mileage from city centers to campus (City, State reported anonymously).	**Jodene Hernandez** Accounts Receivable Specialist
	Athletics Travel	Includes emissions from bus travel to and from games and events. Includes emissions from air travel undertaken by the sailing team.	Bus mileage was calculated based on round trip mileage to away game locations and back (team schedules). Air mileage was calculated from round trip mileage to away tournament and back (team schedules, self-reported flight schedules).	**Nairem Morem** Sports Information Director **Adam Werblow** Director of the Waterfront/Head Sailing Coach
	International Education Travel	Includes emissions from student air travel during 2013-2014 school year as part of their study abroad experience.	Mileage based on the study abroad destinations and an estimate of the cities they would have traveled into and out of.	**Mandy Reinig** Director of International Education

Other Institutions: ‘Best Practices’ of GHG Emissions Inventories

In this section, we review sustainability data collection ‘best practices’ at other colleges and universities in order to lay a strong foundation for our recommendations for

St. Mary's College. These best practices rely on the previous efforts of other institutions, many of them at the forefront of research and development of campus sustainability. They provide a source of ideas and creativity to envision how best to implement a greenhouse gas emissions inventory at St. Mary's College.

Origin of GHG Emissions Inventories

The origin of GHG emissions inventories at other institutions is highly context dependent. Especially after sustainability has been institutionalized, schools seem to rely on their distinct characteristics and resources to undertake such projects. An early developer of an emissions inventory simply organized a small group of students to begin quantifying emissions (Uhl, 2004), but others have relied on PhD students (Groode, 2004; Moerschbaecher and Day, 2010) or teams of researchers (Knuth et al., 2007) to integrate emissions inventory research into their published work. These efforts may or may not have standard and periodic practices in place to collect emissions data; earlier inventories, in particular, relied on retrospectively quantifying emissions based on whatever data were available by the time the inventory was being conducted (Groode, 2004).

Metrics and Methods

Greenhouse gas emissions metrics vary widely based on institutional characteristics. For clarity's sake, we exclude discussion of metrics that obviously do not apply to St. Mary's College of Maryland, such as the emissions associated with energy production at Yale University's or MIT's cogeneration power plants (Buttazzoni et al., 2005; Groode, 2004). We divide this section into Scope 1, 2, and 3 emissions, and provide a survey of the metrics used to measure each scope, as well as a summary of the methods used to obtain the data for each metric or category, if available and pertinent.

Scope 1 emissions metrics include use of all types of hydrocarbon fuels, fuel use by a school's vehicle fleet, fugitive emissions leaking from on-campus equipment, and agricultural emissions. Emissions from the total use of hydrocarbon fuels on campus are primarily sourced from utilities, estimated to comprise up to 80-90% of total emissions (Groode, 2004). These can be separated by fuel type; because different kinds of fuels burn in different ways, their emissions are calculated differently (Groode, 2004). While this calculation process may not need to take place outside of the Clean Air Cool Planet calculator, it remains useful to know which fuels result in the highest eCO_2 in order to make effective source reductions. Data are often collected directly from college personnel, and rely primarily on documented purchase of energy by the institution (Moerschbaecher and Day, 2010). In some cases, previously completed studies of a campus' energy consumption patterns may be available, and provide solid foundations on which to base estimates (Moerschbaecher and Day, 2010). One non-utility source of direct emissions is an institution's vehicle fleet, including those used by facilities, campus security, and for general transportation (Groode, 2004; Tilley et al., 2007). Because these vehicles are often either refueled from an on-campus source of gasoline or fuel use is completely reimbursed by the school, these emissions are relatively simple to track (Moerschbaecher and Day, 2010). Another non-utility source is fugitive emissions, such as the emissions that are released from machinery and equipment on, or belonging to, the campus, including refrigerants (Moerschbaecher and Day, 2010; Tilley et al., 2007). Lastly, agricultural emissions include those associated with fertilizer and livestock

(Moerschbaecher and Day, 2010; Tilley et al., 2007). Data for agricultural emissions can be obtained from fertilizer purchase records and a survey of livestock owned by the institution. Fertilizer, as a purchased product that is consumed by an institution, can also be categorized under Scope 3.

Scope 2 emissions metrics are straightforward: indirect energy use of an institution is most often associated with the amount of purchased electricity (Groode, 2004; Moerschbaecher and Day, 2010; Anon, n.d.). However, there are some necessary considerations in the calculation of these emissions. For instance, emissions from purchased electricity must take into account transmission and distribution losses from production at the power plant to consumption by the purchaser (Groode, 2004).

As the most ambiguous category of emissions, Scope 3 emissions metrics can include a variety of measures; these may include metrics associated with transportation (commuting and driving habits, public transportation, and air travel), consumption (solid waste, materials consumption, wastewater treatment), and infrastructure (primarily construction). The commuting and driving habits of campus members are a significant source of the emissions associated with transportation. Institutions vary on how these are measured; for instance, while MIT tracks commuters by the number of parking permits purchased (Groode, 2004), Penn State University applies GIS modeling to collect accurate commuter data (Knuth et al., 2007). Public transportation is included in this analysis, easily tracked by offering public transportation passes through the institutional (Groode, 2004). Air travel associated with the college has various proximate causes; Moerschbaecher and Day (2010) define the school's responsibility at 'official business', though they lament the exclusion of study abroad travel when drawing this line. They include air travel financed (and tracked) by the school, accrued by students (especially athletes), faculty, staff, and administrators (Moerschbaecher and Day, 2010).

Emissions associated with solid waste do not include any recycled or composted material, however, the term is otherwise broadly construed; solid waste can include demolition debris (Groode, 2004). The metric of materials consumption, representing emissions due to materials being produced off-campus but consumed on-campus, presents the challenge of remaining distinct from that of solid waste. However, there are aspects of campus materials consumption, namely food, paper, and objects sold on campus (such as at the bookstore or convenience store), that do not necessarily overlap (Moerschbaecher and Day, 2010). The amount of wastewater, or sewage, produced by the school, and its treatment, can be tracked through the facility providing treatment (Moerschbaecher and Day, 2010). Lastly, emissions associated with the materials and construction of school infrastructure are tracked through materials purchases and vehicle use (Moerschbaecher and Day, 2010).

Table 2. Summary of greenhouse gas emissions metrics.

	Metric	Description	Method	Source
Scope 1	Hydrocarbon Fuels	Carbon dioxide, methane, nitrous oxide	Utilities data is tracked through bills.	(Groode, 2004)
	Vehicle Fleet	All vehicles that service the campus and beyond	Gasoline pumps on campus and reimbursements for gasoline used for campus activities track fuel use.	(Groode, 2004; Moerschbaecher and Day, 2010)
	Fugitive Emissions	Equipment leaks, including	**N/A**	(Moerschbaecher and Day, 2010)

		refrigerants		
	Agricultural Emissions	Methane associated with livestock; nitrous oxide associated with fertilizer application	Tracked through the purchase of fertilizer for campus use and update of the number of livestock owned by the school.	(Moerschbaecher and Day, 2010)
Scope 2	Purchased Electricity	Emissions associated with the generation of purchased electricity	Energy use data is tracked through bills.	(Groode, 2004)
Scope 3	Automobiles	Private commuters determined by parking permits	Various methods: survey, GIS modeling, sale of parking permits, etc.	(Groode, 2004; Knuth et al., 2007)
	Public Transportation	Public commuters determined by the number of passes bought through the school	Sale of public transportation vouchers through the institution.	(Groode, 2004)
	Air Travel	Both financed by the school (Athletics, Admissions, other official travel) and accumulated through the International Education	School financed travel and study abroad travel tracked by the Office of International Education.	(Moerschbaecher and Day, 2010)
	Solid Waste	All solid waste that is not composted or recycled.	Office of Environmental Health and Safety tracks waste disposal and recycling trends.	(Groode, 2004); (Moerschbaecher and Day, 2010)
	Materials	Materials	Tracked through the	(Moerschbaecher

	Consumption	produced elsewhere but consumed on campus.	purchasing agreements of the institution.	and Day, 2010)
	Wastewater Treatment	Emissions associated with campus wastewater	Tracked by the relevant wastewater treatment plant.	(Moerschbaecher and Day, 2010)
	Infrastructure Construction	Emissions associated with campus construction	N/A	(Moerschbaecher and Day, 2010);

GHG Emissions Inventory in Practice

Greenhouse gas emissions inventories are almost invariably undertaken as a project by some motivated group or individual within the campus community. As we have already mentioned, these can range from a dedicated professor working with a group of students (Uhl, 2004), PhD students working on their theses (Groode, 2004; Moerschbaecher and Day, 2010), or teams of researchers working together to publish academic work (Knuth et al., 2007; Tilley et al., 2007). Most of these efforts involved members of the working group seeking out data and information across campus through personal communication and research (Tilley et al., 2007). Only Knuth et al. (2007) indicated that certain staff members were responsible for collecting emissions data to have on hand. This holds true for the parties responsible for compiling the information, as well. While Knuth et al. (2007) use a spreadsheet that can be easily update by staff periodically, other institutions rely on the motivation and efforts of the working group to compile the data into a report (Uhl, 2004; Groode, 2004; Tilley et al., 2007; Moerschbaecher and Day, 2010). This indicates a difference in the rationale in which different institutions approach GHG emissions inventories; while many institutions undertake the project based on the momentum available to complete it, Knuth et al. (2007) made the project routine, connecting specific positions with the collection of certain data and made sure that the data were easy to centralize and update in a spreadsheet.

The results of GHG emissions inventories are primarily used to prioritize and guide emissions mitigation strategies (Tilley et al., 2007; Knuth et al., 2007), over which an institution's Climate Action Plan often wields authority. This guidance comes in the form of recommendations; whatever emissions metrics will yield the highest reduction in emissions overall, as well as those mitigation strategies with the lowest institutional effort or cost are recommended for further development (Tilley et al., 2007). Through this feedback loop between the GHG Emissions Inventory and the Climate Action Plan, an institution can effectively and efficiently work towards carbon neutrality.

Some of the major hardships encountered in pursuing a GHG emissions inventory are the availability of retrospective data and institutional cooperation in collecting these data. These obstacles are affected by campus attitudes, particularly starting with the campus' leadership and the pedagogical commitments of the institution, and available capital (Rauch and Newman, 2009). On a broader scale, institutional attitudes towards sustainability, and energy use in particular, wax and wane with local, regional, and national attitudes about energy and the ebb and flow of energy markets (Decarolis et al., 2000). For instance, the energy crisis of the 1970-80s provided an immediate impetus for Clark University to find ways of reducing their energy consumption, while in periods when resources are not so immediately unavailable, motivation wanes (Decarolis et al., 2000). Another obstacle is the youth of the field of campus sustainability at large; due to this youth, most contextual and practical support for sustainability projects is found in case study or 'best practices' reports, not unlike this one, which creates little cohesion and a fair amount of redundancy when undertaking foundational research (Stephens and Graham, 2010).

Project Overview

This project was a synthesis of information found through literature review and institutional knowledge gained from personal experience. I surveyed existing GHG emissions inventories published by other institutions to find two things: 1) metrics of GHG emissions that St. Mary's College currently does not collect data to measure, whether those data are available or not, and 2) methods used by other institutions to complete GHG emissions inventories successfully, at regular intervals, and with the least amount of coordinated effort. By looking at a variety of examples, I was able to determine what metrics and methods worked more effectively than others, as well as which would work best at St. Mary's College. This turned out to be very informative; as I did research, I began to see patterns and similarities emerge among different institutions.

My experience working in the 2014-2015 Climate Action Plan (CAP) update was useful in determining the need for this project and having access to the kind of information needed to compare and contrast St. Mary's College's efforts to those of other institutions. I knew that it had taken an immense amount of effort to track down and collect the emissions data needed to update the CAP and I wanted to ensure that the next updating group did not have to face the same difficulties. I had direct access to information about the metrics, methods, and data collected for the CAP, as well as experience of the difficulties encountered in working on that project. This allowed me to see how and where the metrics and methods used by other institutions could be utilized by St. Mary's College to build a more effective system. Further, because of my experience on the CAP project I was able to communicate readily with Katelynne Cowart '15, leading efforts to update the Climate Action Plan, and participate in ongoing meetings regarding the collection, compilation, and analysis of emissions data. This was a dynamic process, and participating in it ensured that my project changed and adapted along with it.

The results of my efforts are recommendations of what metrics St. Mary's College should use to measure GHG emissions and what system the school should employ to effectively and periodically complete emissions inventories. My recommendations for a complete set of metrics, as well as the campus staff with access to emissions data, or likely places to begin looking for those data, are detailed below (Table 3). They include both maintaining our current efforts and adding metrics used by other institutions to provide a more complete picture of campus emissions at St. Mary's College.

Table 3. Metrics and staff contacts connected to relevant data.

	Metric	Description/Calculation	Contact/Source
Scope 1	Fuel Oil Use	Includes emissions associated with both gasoline and distillate oil use	**Joyce Goodwine** Fiscal Administrator at Physical Plant
	Propane Use	Includes emissions associated with propane use	**Joyce Goodwine** Fiscal Administrator at Physical Plant
	Vehicle Fleet	Includes emissions from fuel used by all vehicles that service the campus and beyond	Physical Plant
	Fugitive Emissions	Includes emissions from equipment leaks, including refrigerants	Physical Plant

	Livestock Emissions[2]	Includes methane emissions associated with livestock	Campus Community Farm Manager
Scope 2	Purchased Electricity	Includes emissions from the total amount of electricity purchased by the school	Maryland State Energy Database
Scope 3	Faculty and Staff Commuting	Includes emissions from car travel by faculty and staff	**Catherine Pratson** Director of Human Resources
	Student Commuting	Includes emissions from car travel by student commuters	**Jodene Hernandez** Accounts Receivable Specialist
	Athletics Travel	Includes emissions from bus travel to and from games and events. Includes emissions from air travel undertaken by the sailing team.	**Nairem Morem** Sports Information Director **Adam Werblow** Director of the Waterfront/Head
	International Education Travel	Includes emissions from student air travel as part of their study abroad experience.	**Mandy Reinig** Director of International Education
	Sewage/Wastewater Treatment	Includes emissions associated with campus wastewater.	N/A
	Fertilizer Application	Includes nitrous oxide emissions associated with fertilizer application.	Grounds Department
	Solid Waste	Includes emissions associated with landfill waste that is not recycled or composted.	Grounds Department
	Official College Travel	Includes emissions from staff, faculty, and administrative travel (both surface and air) that are not contained in other categories. Examples include International Education or Admissions Office travel.	Business Office
	Materials Consumption	Includes emissions associated with materials produced	Business Office/Various

[2] While St. Mary's College does not currently own livestock, there are plans to raise chickens at the Campus Community Farm; the inclusion of this metric is preemptive.

		elsewhere but consumed on campus.	Academic Departments
	Infrastructure Construction	Emissions associated with campus construction	Office of Planning and Facilities

My recommendations for the data collection, compilation, analysis, and publishing of the GHG emissions report are outlined below (Figure 1). I propose that the SGA Environmental Protection Committee (EPC) be the party ultimately responsible for the GHG emissions inventory. Based on the connections between metrics and specific staff (Table 1), I propose making individuals responsible for the annual collection of data to measure certain metrics, following Knuth et al. (2007). Initially, this would require briefing each individual about what data it is necessary to collect and how to do so. However, after this initial briefing, the details of this task can be passed on through standard job training as new individuals are employed in those positions. After collecting these data, the individuals responsible would then update their metric on the **Master Emissions Data** spreadsheet, a Google spreadsheet associated with Climate Action Plan Gmail account. By giving the relevant individuals access to edit the spreadsheet, this task could be accomplished remotely, minimizing the effort and coordination necessary to compile emissions data. To analyze[3] data the EPC should work with professors to negotiate how certain classes can be put to multiple purposes: learning necessary material and applying knowledge practically to the benefit of the St. Mary's community and the world at large. In this way, analysis of emissions data can become a practical educational experience for students. Finally, the EPC itself should take on the responsibility of

[3] 'Analyze' is intentionally vague: the way in which emissions data can be used by different disciplines to augment the report and enhance the education of students can be determined both by need (the EPC should therefore coordinate participation) and by interest (professors may ask to become involved).

entering data into the Clean Air Cool Planet Campus Carbon Calculator, developing figures to display data, and writing the report itself.

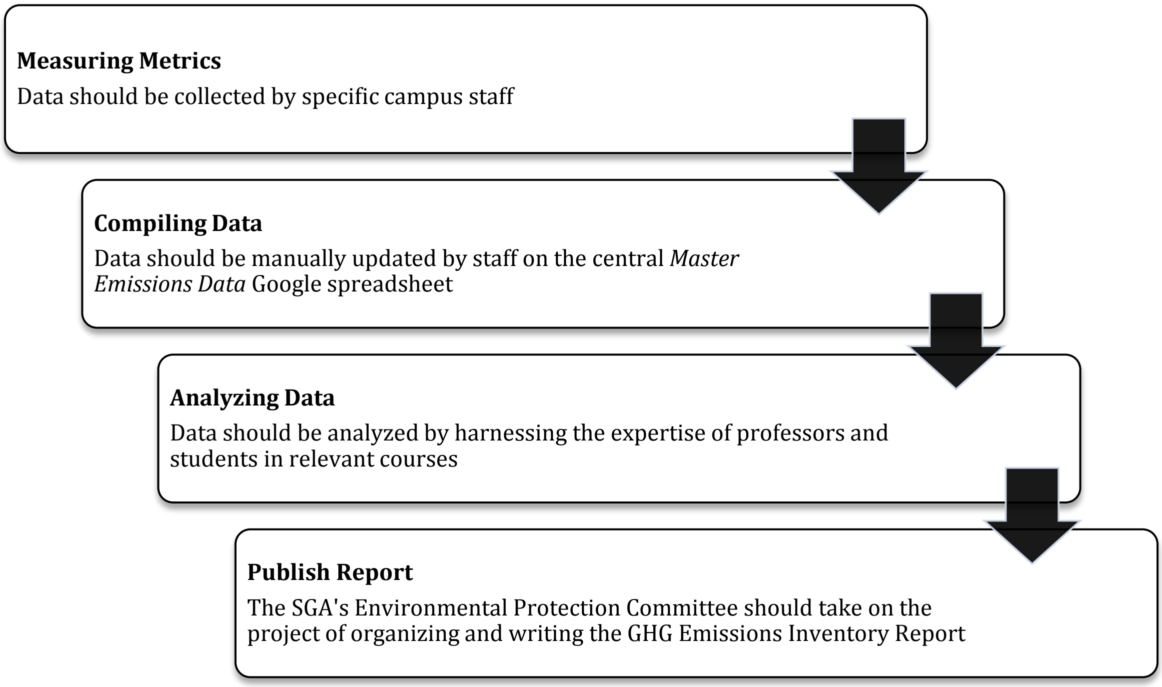

Figure 1. A schematic of the tasks necessary for completion of a GHG emissions inventory report, the parties responsible for completing those tasks, and the order in which the tasks should be completed.

Outcomes

In researching this proposal, I noted many patterns, similarities, and differences between the GHG emissions inventories conducted by different institutions. Specifically, I noticed how defining the extent of the project affected what sources of emissions were included in the report, which emissions scopes held most of the differences in metrics between institutions, and the authority and systems employed to complete the project itself. When defining the scope of the GHG emissions inventory, it is necessary to walk the line between comprehensiveness of the report and fruitless labor. For instance, while some institutions choose to include little to no emissions categorized under Scope 3, arguably making these inventories non-comprehensive, others tracked down very small sources of emissions, such as public transportation, which, in terms of overall emissions reduction, is not a valuable use of time or resources. Scope 3 was also where the most difference could be found between the inventories conducted by different institutions. At St. Mary's, it will be necessary to define and refine the extent of the GHG emissions inventory as the campus itself changes.

The systems in place at other institutions to conduct GHG emissions inventories were also notable. At almost every school I researched, a dedicated team or individual undertook the project. This was a surprise; from the outset, a GHG emissions inventory seemed to lend itself to collaboration, and having a single team undertake the project each time it was necessary to update seemed inefficient. I knew that if people perceived that the inventory would add significantly to their workload, there would be little support for the project. Furthermore, I felt that spreading out the efforts among students, faculty, and staff could give the project educational potential. I found inspiration for this collaboration in Knuth et al. (2007) at Penn State, where individuals across campus updated emissions data annually on a central spreadsheet. Not long afterwards, I found out that such a spreadsheet actually existed at St. Mary's College, so I decided to incorporate it into my plan for our own GHG emissions inventory.

Obstacles to the completion of this project related primarily to the time frame available to complete it, and ironically, isolation. The original goal of the project was to have tracked down the sources of data for each of the new metrics and to have met with all the individuals collecting those data by the end of the semester. However, as the semester drew to a close, those meetings did not occur. If this project is to come to fruition, meeting with the relevant individuals on campus is the next tangible step.

Conclusions

While this project was ultimately limited, my goal of developing the right questions (in terms of metrics) and procedures to produce a comprehensive greenhouse gas emissions inventory at St. Mary's College of Maryland is on its way to being achieved. Through synthesizing research from other institutions and experience and research from St. Mary's College, I have developed an outline for a collaborative, educational GHG emissions inventory process. If this project is undertaken, sustainability efforts at St. Mary's College will benefit. By consolidating campus emissions data, a GHG emissions inventory provides the empirical foundation to target sustainability efforts more effectively by reducing the largest sources of emissions on campus. Furthermore, by making the compilation of these data periodic, an inventory would provide both a baseline of emissions and the evidence of their reduction as we become a more sustainable campus and near our ultimate goal of climate neutrality. Development of this project is truly a foundational step for sustainability at St. Mary's College of Maryland.

Recommendations for St. Mary's College of Maryland

"If we cannot do these things within this small community that prides itself on the unifying ethos known as the St. Mary's Way, the world is much worse off than I ever imagined and St. Mary's College of Maryland is just another small school filled with average, self-centered people doing unspectacular things."
Dr. Tuajuanda Jordan

Moving forward, I have several recommendations for the further development, and improvement of this project. First and foremost, the project should be continued in the direction that I proposed in the Project Overview; that is, individuals should be contacted across campus to build the collaborative system of reporting that I have envisioned in this proposal. Second, the metrics that I have detailed here are very broad; splitting them into smaller categories would make them more useful. For instance, the fuel energy use metric is combined, with no distinction between sources of energy use. To improve the GHG emissions inventory, these broad categories could be split up based on source. While this is a difficult project, separating information in this way will, upon completion of the report, allow for more targeted source reduction. This will be most effective for Scope 1 and Scope 2 emissions as these are likely (based on data from other institutions) to hold the highest proportion of campus emissions.

On the more practical side of the project, St. Mary's College should consider updating its version of the Clean Air Cool Planet Campus Carbon Calculator. Moerschbaecher and Day (2010) used version 6.1 in 2010, while we currently use version 5.0. Newer versions of this calculator help to quantify financial savings from reduced emissions, among other new features, which could add value to both GHG emissions inventory and the Climate Action Plan. Finally, a GHG emissions inventory is a very quantitative way to measure sustainability efforts on campus. However, sustainability is not solely a quantitative project; its ultimate goal is to make the institution, and the lives and livelihoods contained within that community, flourish. I propose that, ultimately, the GHG emissions inventory be expanded into a Sustainability Report that includes both quantitative and qualitative indicators of sustainability at St. Mary's College of Maryland.

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