greenhouse gas management institute

Greenhouse Gas Management Institute

Greenhouse Gas Emissions Inventory 2009

November 2010

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Greenhouse Gas Emissions Inventory 2009

Organization Name: Greenhouse Gas Management Institute

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Reporting Period: Calendar year 2009

Base Year: Calendar year 2009

Base Year Recalculation Policy: Consistent with WRI/WBCSD GHG Protocol. Exact procedures to be elaborated with 2010 inventory report.

GHG Emissions Reported: CO_2, CH_4, N_2O

HFCs, PFCs, and SF_6 as fugitive emissions are assume to be small and are therefore not estimated.

Reporting Protocol: Greenhouse Gas Protocol

Global Warming Potential Values: IPCC Second Assessment Report (1996)

2009 Gross Emissions (Scopes 1+2) = 0 metric tons CO_2-equivalent

2009 Gross Emissions (Scopes 1+2+3) = 23.1026 metric tons CO_2-equivalent

Verification: Estimates have not undergone external auditing by an independent third party, however, internal QA/QC procedures have been applied.

Prepared by: Anna Thode Stephens and George Gelb

Forward: Developing this greenhouse gas inventory

Letter from the Dean:

On behalf of the Greenhouse Gas Management Institute, I want to express gratitude to George Gelb and Anna Stephens for their exceptional work and dedication in preparing this greenhouse gas emissions inventory. They have provided the Institute with an invaluable service while helping us achieve our own mission to professionalize the field of carbon management through their own learning. I also want to express our appreciation to Don Bain for his proactive and generous leadership on this project.

This inventory will be the first of many annual accountings and reports to come, and will serve as the touchstone for future efforts. It also demonstrates the challenges for emissions accounting for organizations of the future while also demonstrating the potential and opportunities to achieve significant emissions reductions by embracing everything that modern information technology has to offer.

It is reasonable to ask "Why favor e-learning over traditional in-classroom learning?"
Our reasoning for e-learning delivery proceeds as follows:

- Learners can proceed at their own pace, an approach that has been proven to maximize knowledge and skill acquisition;
- The course is always "on," minimizing the delivery challenges associated with the classroom;
- The course can be taken "anytime, anywhere," improving access for learners in all locations, meaning opportunities are not limited to those in rich countries;
- The cost of training can be minimized without sacrificing quality; and
- We can avoid the emissions associated with traveling and commuting while still providing global access to world-class instructors.

And outcomes? Are we sacrificing on quality to reach more people and avoid travel? Actually, reviews of learning effectiveness point to e-learning as not only being on par with classroom-based learning, but one of the most widely accepted studies on the matter concluded that e-learning was in fact more effective than face-to-face instruction:

> "The meta-analysis found that, on average, students in online learning conditions performed better than those receiving face-to-face instruction"
> - *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies*, U.S. Department of Education, 2009

This study found that superior outcomes for students engaging e-learning were explained by students tending to spend more time on online courses than the face-to-face equivalent course.

This inventory report indicates that the greenhouse gas emissions from the Institute are 3 to 13 times less than traditional learning institutions. We hope that this report will serve as an example to peer organizations for what can be achieved through innovation and a commitment to 'practice what we preach' when it comes to addressing climate change.

Sincerely,

M.W. Gillenwater

Michael Gillenwater
Executive Director and Dean

Letters from the inventory compilers:

I felt very lucky to be invited to be part of the team developing the Institute's greenhouse gas inventory. It meant putting into practice all the lessons learned in the Institute's Basics of Organizational GHG Accounting course and getting first hand and in-depth insights into what is expected of practitioners and the many challenges in this young and developing field.

Starting work on this project, to create the greenhouse gas inventory for a "virtual" office organization, we all realized that there were not any concrete examples to use, thus we became "pioneers" in creating this type of greenhouse gas inventory. We realized that we would have to create something that could be used in the future as a sample or "template" by any other home based business or businesses that employ staff working remotely.

The challenges started from day one, from defining the type of boundaries and determining relevant data to be collected, to finding the most appropriate emissions factors. We determined it was necessary to cover all relevant upstream and downstream activities that would affect the total emissions attributable to GHGMI. In addition, we worked out how to present our findings in a manner that is easy to understand, relevant, and useful.

In conclusion, in addition to enjoying the friendly, helpful, and positive attitude of my teammate and leaders and mentors, this was an "eye-opening" project. I am very proud of what we learned and achieved, and I am very grateful for this unique opportunity and experience, which has given me full confidence to pursue a career in this field.

George Gelb
GHGMI Intern

I have been interested in greenhouse gas management for several years and had worked with several organizations as a carbon intern. I decided that if I really wanted to pursue a career in the field, I needed education and training in the area, and so I discovered the Greenhouse Gas Management Institute during my search for educational programs in the carbon management field.

Upon contacting the Institute, I learned of the opportunity to participate as an intern. This would involve coursework and the application of my new skills to projects within the Institute. What an excellent way to get involved and immediately implement my education!

I dove head first into my online coursework with a goal of a certificate in greenhouse gas accounting. The virtual environment of the Institute allowed me to participate from a remote corner of the globe on my own schedule and pace but still allowed me to contact instructors and other students at all times. The content of the course was well organized, in depth, and provided all the resources to be successful in a career.

Upon completion of my coursework, I collaboratively began work on a task to create a base year greenhouse gas inventory for the Institute. It was a valuable experience as we had to discover how to adapt what we learned to fit the challenges of accounting for the online nature of the organization. Overall, it was a very positive and educational experience, and I enjoyed working with the many talented individuals at the Greenhouse Gas Management Institute.

Anna Stephens
GHGMI Intern

1 Introduction

This report presents the base year estimates for the Greenhouse Gas Management Institute (GHGMI) greenhouse gas (GHG) emissions inventory. As a leader in education and professional development on greenhouse gas management, one of the Institute's objectives in developing this inventory is to lead by example, publishing an estimate of the GHG emissions related to our operations consistent with the international standards we teach.

Traditional universities and college campuses have large sources of emissions from purchased electricity, stationary combustion, and mobile combustion associated with campus buildings and student and faculty commuting. By creating an online, or virtual, learning environment and workplace, the GHGMI is able to effectively educate learners worldwide while minimizing emissions associated with traditional organizations and instruction. In addition to enabling and empowering others to manage GHG emissions and removals, GHGMI serves as a beacon for how an organization can minimize its own footprint on the environment. We hope others, especially environmental nonprofit organizations, will follow this example.

This report presents the data collection and methods used to estimate the Institute's GHG emissions. As this is the first emissions inventory for GHGMI, it will be improved upon in the future and used as a benchmark for analyzing trends over time.

2 Inventory Process

The implementation of the inventory preparation process began with the training of two GHGMI interns through the Institute's online courses. Upon completion of the coursework, the interns developed a plan for the inventory, which included emission sources and calculation methodologies. Because of the limited guidance available for specific emission sources associated with a virtual organization operated from a network of home offices, new methodologies were adapted from existing ones. The plan was then reviewed, discussed, and approved by GHGMI management. Data collection and calculation then proceeded. Final results were reviewed and approved internally. No external verification of results has been conducted at this time.

3 QA/QC and Uncertainty

Quality control and assurance was conducted through internal checking and review of the inventory spreadsheet calculations and report. The implementation of further QA/QC procedures, as well as a full quality management plan and uncertainty analysis system, is planned for future inventories.

4 Organizational Description

The GHGMI was founded as a nonprofit organization in 2007 to build and support a global community of qualified professionals to work on GHG measurement, accounting, auditing, and management. The Institute operates as a virtual organization, which is defined as an organized entity that does not exist in any one, central location, but instead exists and operates through the utilization of the internet. GHGMI was designed to serve as an example for the low carbon footprint organization of the future that utilized modern information technology tools to maximize the global impact of its programs while minimizing its

GHG emissions. The 2009 GHGMI staff consists of 4 full time employees and 5 part time contractors working from home offices around the globe. It is also staffed by numerous adjunct faculty members from around the world and does not own or lease any facilities or vehicles. GHGMI operates with a policy that all non-essential travel, especially air travel, is to be avoided.

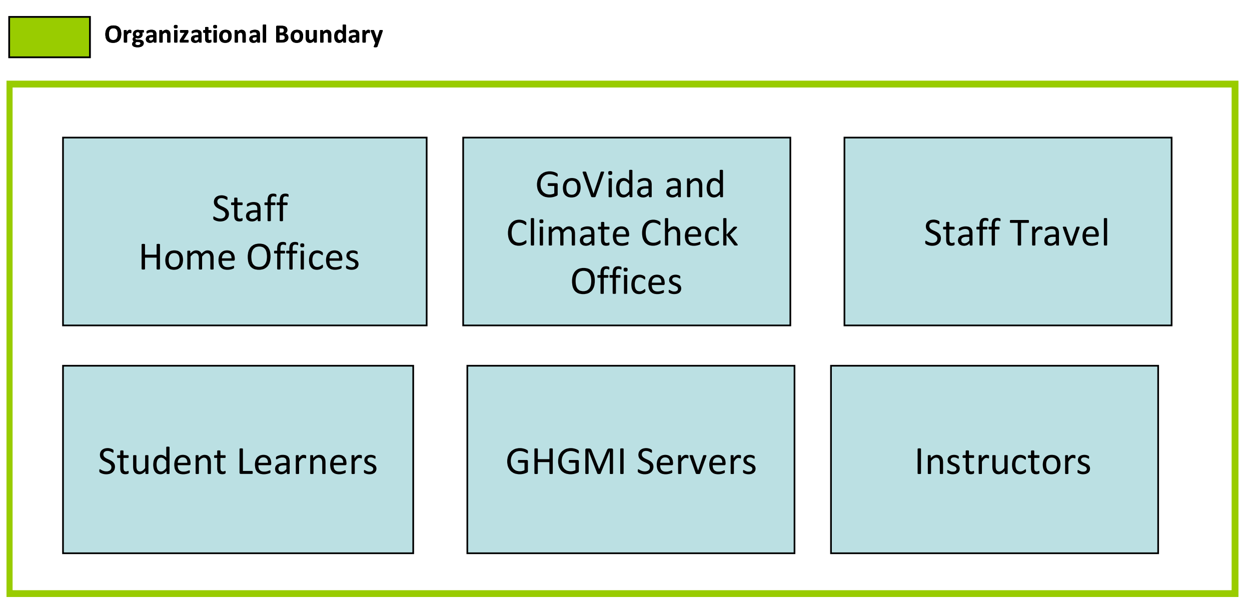
5 Establishment of Organizational Boundaries

The GHGMI has chosen to define it organizational boundaries by including staff, end users (e.g., learners), and other select behaviors associated with the organization. This includes employee, contract and part-time staff, students, instructors, staff travel, and business offices of other organizations where staff perform work for the Institute. All emissions associated with GHGMI's operations are reported as scope 3 as the organization, by design, does not own or operate any of its own facilities or equipment.

Specifically, GHGMI was designed by its founders to operate as a virtual organization as a case study in designing an office using advanced information technology. GHGMI intentionally does not own or lease any office space. Employees and contractors (hereafter "staff") perform work from dedicated home offices and GHGMI chooses to take responsibility for emissions from these home offices. The emissions attributable to GHGMI staff home offices are apportioned according to percent of space used for GHGMI business purposes and for part-time staff, the fraction of working time dedicated to GHGMI.

GHGMI pays for the use of a server to host its website and learning management system, which is also considered under operational control.

Figure 1: Emissions deemed relevant to GHGMI



6 Establishment of Operational Boundaries

Operational boundaries are used to identify which emissions are associated with operations within the organization.

Direct Emissions: Direct emissions are emissions from sources that a company owns or controls and are classified as Scope 1 emissions. GHGMI does not directly own or control any aspect of the organization's emissions. It therefore has no direct emissions to report under Scope 1.

Indirect Emissions: Indirect emissions are classified into Scope 2 and Scope 3 emissions.

Scope 2 emissions are emissions from the generation of electricity, heat, or steam that is purchased by a company from a source that is not owned and controlled by a company. GHGMI does not purchase power for offices including home offices. Instead, these emissions will be reported as a part of Scope 3 indirect emissions.

Scope 3 emissions include all other indirect emissions. Reporting of Scope 3 is generally treated as optional under most GHG Programs as well as the WRI/WBCSD GHG Protocol. GHGMI has opted to report Scope 3 emissions because they are the largest and only source of emissions for the organization.

7 Sources and Gases

For its 2009 inventory, GHGMI decided to include all identified major Scope 3 emission sources associated with the Institute's operations.

These sources include purchased electricity associated with home offices, servers, and student computer use, stationary combustion from home offices, and mobile combustion from travel associated with GHGMI-related work. The portion of emissions from the e-learning platform provider (GoVida) that is directly attributable to the online learning operations of GHGMI has also been included.

Emissions from these sources include the three major GHG categories: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) (see Table 1 for an outline of these emissions). Emissions of other man-made GHGs, such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6) were considered small and have not been reported.

Table 1: GHGMI Emissions and Sources

Description	Source	GHGs
Purchased Electricity	Home office electricity use	CO_2, CH_4, N_2O
Purchased Electricity	Power, Storage, and Cooling associated with Server and Data Center	CO_2, CH_4, N_2O
Purchased Electricity	Student Computer Use	CO_2, CH_4, N_2O
Purchased Electricity	Instructor Computer Use	CO_2, CH_4, N_2O
Home Office Stationary Combustion	Stationary Boilers, Water Heaters, Furnaces	CO_2, CH_4, N_2O
ClimateCHECK Stationary Combustion	Stationary Boilers, Water Heaters, Furnaces	CO_2, CH_4, N_2O
ClimateCHECK Office Purchased Electricity	Office electricity use	CO_2, CH_4, N_2O
ClimateCHECK Office Mobile Combustion	Employee travel associated with GHGMI business	CO_2, CH_4, N_2O
GoVida Office Purchased Electricity	Office electricity use	CO_2, CH_4, N_2O
GoVida Office Mobile Combustion	GoVida employee travel associated with GHGMI business	CO_2, CH_4, N_2O
Mobile combustion	Employee travel associated with GHGMI business	CO_2, CH_4, N_2O

8 Results

In 2009, the total estimated GHG emissions of the GHGMI were 23.1 metric tons of CO_2-e. To put this number in perspective, the average individual living in a U.S. city produces roughly 24.7 metric tons of CO_2-e annually.[1]

Emissions primarily resulted from Scope 3-related mobile combustion and Scope 3-related purchased electricity (Figure 1). Carbon dioxide was by far the dominant gas emitted (Figure 2). And emissions related to GHGMI staff and its e-learning contractor, GoVida, accounted for 78% of total emissions. Table 2 and Figures 1, 2 and 3 summarize the total emissions from the Institute in 2009.

Table 2: GHGMI Emission Totals

Indirect Scope 3 Emission TOTALS (metric tons)	**Total** CO_2-e	CO_2-e	CH_4 (CO_2-e)	N_2O (CO_2-e)
Purchased Electricity	9.3240	9.2017	0.0110	0.1113
Stationary Combustion	0.8424	0.8402	0.0011	0.001
Mobile Combustion	12.9362	12.7359	0.0716	0.1286
Total CO_2 metric tons equivalents	**23.1026**			

[1] Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle. EPA420-F-05-004, February 2005. http://www.epa.gov/oms/climate/420f05004.htm

Figure 1: Total emissions by emission source

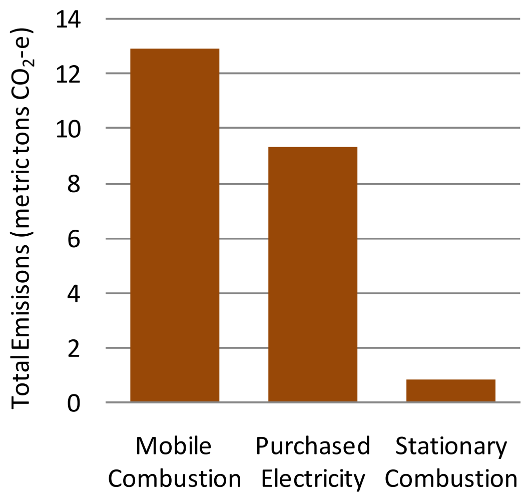


Figure 2: Total emissions by GHG

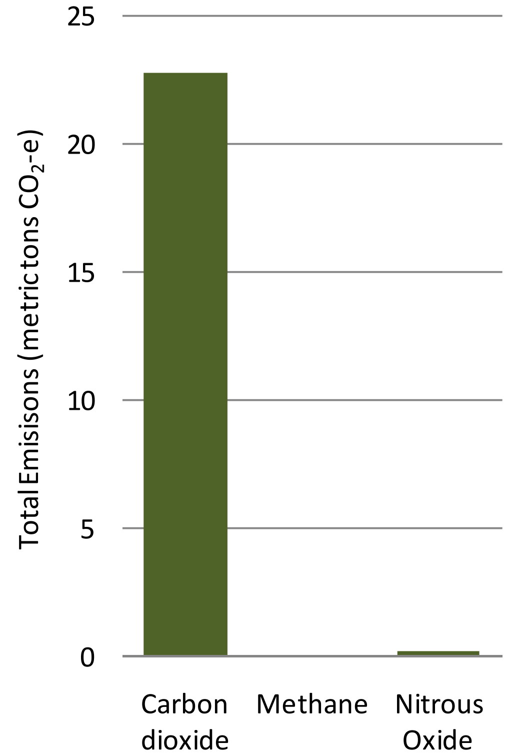
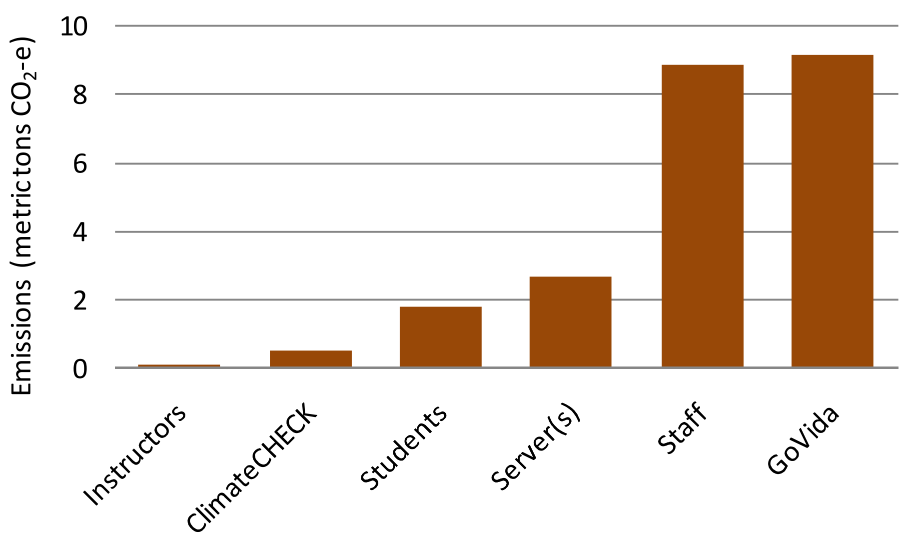


Figure 3: Total Emissions by sub-entity



8.1 Emission Source: Purchased Electricity

In 2009, purchased electricity accounted for 9.324 metric tons of CO_2 or 40.4% of GHGMI's emissions and comes from multiple sources (see Tables 2 and 3). The largest source is the electricity consumed by the GoVida office, which provides and manages GHGMI's e-learning system (see Table 3). The second largest source is GHGMI's server, which is housed in a large data center and runs the online software for operations. Other sources of purchased electricity include the electricity consumption of computers that students use to take online courses, the electricity consumption of home offices, and the electricity consumption of instructors' computers.

Table 3: Breakdown of emissions from purchased electricity

Indirect Scope 3 Emissions Breakdown	**Purchased Electricity (metric tons)**		
	CO_2	CH_4 (CO_2-e)	N_2O (CO_2-e)
Staff	0.9774	0.0007	0.0047
ClimateCHECK	0.0747	NE	NE
GoVida	3.6623	0.0023	0.0168
Server(s)	2.6417	0.0008	0.0093
Students	1.7103	0.0072	0.0799
Instructors	0.1355	0.0001	0.0006
TOTAL CO_2e	**9.2017**	**0.0110**	**0.1113**

Notation: Not occurring (NO), not estimated (NE).

8.2 Emission Source: Stationary Combustion

Stationary combustion emissions from the Institute are minimal and only accounted for 0.8424 metric tons of CO_2 or 3.6% of total emissions (Table 2). The only sources of stationary combustion come from natural gas and heating oil #6, both used in furnaces and water heaters to provide a source of heat to home offices (see Tables 4 and 5).

Table 4: Breakdown of emissions from natural gas combustion

Indirect Scope 3 Emissions Breakdown	**Heating- Natural Gas (metric tons)**		
	CO_2	CH_4 (CO_2-e)	N_2O (CO_2-e)
Staff	0.6379	0.0011	0.0009
ClimateCHECK	NE	NE	NE
GoVida	NO	NO	NO
Server(s)	NE	NE	NE
Students	NE	NE	NE
Instructors	NE	NE	NE
TOTAL CO_2e	**0.6379**	**0.0011**	**0.0009**

Notation: Not occurring (NO), not estimated (NE).

Table 5: Breakdown of emissions from heating oil #6

Heating – Oil #6 consumption (metric tons)	CO_2	CH_4 (CO_2-e)	N_2O (CO_2-e)
Staff	0.2023	NG	0.0002
ClimateCHECK	NO	NO	NO
GoVida	NO	NO	NO
Server(s)	NO	NO	NO
Students	NE	NE	NE
Instructors	NE	NE	NE
TOTAL CO_2e	**0.2023**	**NG**	**0.0002**

Notation: Not occurring (NO), not estimated (NE), and negligible (NG) defined as less than 0.0001 CO_2-e.

8.3 Emission Source: Mobile Combustion

Mobile combustion is the largest emission source, accounting for 12.9 metric tons of CO_2, or 56% of total emissions. However, to put this number in perspective, the total mobile combustion emissions of the entire Institute are equivalent to the amount of GHGs emitted from 2.5 passenger cars annually.[2]

The sources are employee business travel and employee and contractor commuting including car, shuttle bus, air, motorcycle, train, and light rail. Tables 6 and 7 provide a detailed breakdown of these emissions. The largest source of mobile emissions is air travel, which accounts for 54% of emissions (Table 7).

Table 6: Breakdown of emissions from car, taxi, and bus/shuttle travel

Travel	**Car**			**Taxi**	**Bus / Shuttle**
	CO_2	CH_4 (CO_2-e)	N_2O (CO_2-e)	CO_2	CO_2
Staff	0.4747	0.0004	0.0091	NE	0.0145
ClimateCHECK	0.0176	NE	0.0016	NE	NE
GoVida	1.0008	0.0021	0.0410	0.0823	3.1103
Server(s)	NO	NO	NO	NO	NO
Students	NE	NE	NE	NE	NE
Instructors	NE	NE	NE	NE	NE
TOTAL CO_2e	**1.4931**	**0.0025**	**0.0516**	**0.0823**	**3.1249**

Notation: Not occurring (NO) and not estimated (NE)

[2] Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle. EPA420-F-05-004, February 2005. http://www.epa.gov/oms/climate/420f05004.htm

Table 7: Breakdown of emissions from motorcycle, train, lightrail, and air travel

Travel	Motor /Tricycle		Train	Light rail	Air total
	CH_4 (CO_2-e)	N_2O (CO_2-e)	CO_2	CO_2	CO_2
Staff	NO	NO	0.0234	NO	6.5199
ClimateCHECK	NO	NO	NO	NO	0.4206
GoVida	0.0691	0.0770	NO	1.0717	NO
Server(s)	NO	NO	NO	NO	NO
Students	NE	NE	NE	NE	NE
Instructors	NE	NE	NE	NE	NE
TOTAL CO_2e	**0.0691**	**0.0770**	**0.0234**	**1.0717**	**6.9405**

Notation: Not occurring (NO) and not estimated (NE)

9 Performance Benchmarks

In order to evaluate and compare the level of GHG emissions from GHGMI to other organizations with related educational missions, a benchmark, or ratio indicator, in the form of GHG emissions per student instructional hour was used. The specific comparison references were select U.S. universities. The expectation is that the difference between a university's emissions and GHGMI's would indicate the approximate magnitude reduction of emissions achieved by GHGMI relative to an organization with a traditional instructional and workplace arrangement.

For the year 2009, GHGMI delivered a total of 12,104 instructional hours with total emissions estimated at 23.01 metric tons CO_2e. The resulting average emissions were calculated to be 1.91 kg CO_2e/ instructional hour.

The American College and University Presidents Climate Commitment (ACUPCC) tracks and reports the GHG inventories for 665 higher education institutions throughout the United States.[3] These include community colleges, colleges, universities, and specialized institutes which offer undergraduate and graduate degrees. We obtained the GHG emissions inventories and student credit hour data records[4] from the University of California, Davis, the University of California, Berkeley, and the University of Colorado, Boulder. All three universities have climate action plans and programs in progress to improve the sustainability of their campuses. Student credit hour data from each university were converted to equivalent instructional hours based on the assumption that each credit hour represented a 15 week semester and that one hour of lecture required one hour of out of class lab or homework.

Based on this analysis, the University of California, Davis had the highest emissions ratio, calculated at 7.6 kg CO_2e per instructional hour, followed by the University of Colorado at Boulder, with 7.0 kg CO_2e per instructional hour and the University of California, Berkeley with 6.0 kg CO_2e per instructional hour.

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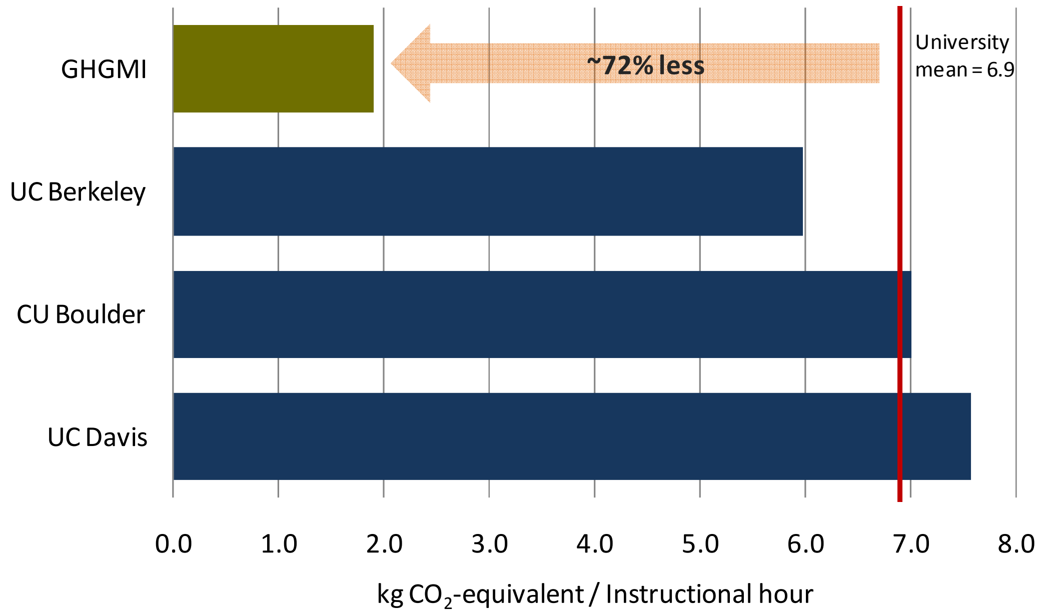
[3] Greenhouse gas inventories for teaching institutions are publicly available at the The American College and University Presidents Climate Commitment (ACUPCC) website. http://acupcc.aashe.org/

[4] The following websites provide student credit hour data
http://budget.ucdavis.edu/data-reports/documents
http://calprofilesplus.berkeley.edu/
www.colorado.edu/pba/records/fte/term0910.htm
www.colorado.edu/pba/records/fte/term0809.htm

Compared with GHGMI, the emissions per instructional hour for these universities range from to three to four times greater. In other words, this simple comparison suggests that educational organizations could reduce their emissions in the range of 60 to 75% by focusing on online learning and a virtual workplace (see Figure 4). The majority of emissions from these institutions are from purchased electricity and stationary combustion associated with buildings on cases and the mobile combustion emissions from commuters to community colleges.

Figure 4: Emissions per instructional hour benchmarking data



It should be noted that the number of instructional hours delivered by GHGMI is a fraction of those delivered by a large universities (roughly 0.04%). However, the incremental emissions associated with a doubling of output from a virtual classroom provider like GHGMI is likely to be small relative to a bricks-and-mortar institution. Therefore, the approach used by GHGMI is likely to be highly scalable without a significant increase in emissions.

The virtual environment for learning at GHGMI provides an example of how online education can successfully provide education while limiting large sources of GHG emissions associated with traditional institutions. However, further research and analysis is needed to better quantify the differences between operational models and to identify causal factors for those differences. This initial analysis is intended only as a scoping exercise to identify the order of magnitude emission reduction potential of GHGMI's organizational model.

10 Methodology and Data Sources

The methodology used to estimate GHG emissions for GHGMI were based on methods described in the GHG Protocol and the World Resources Institute, "Working 9 to 5 on Climate Change, an Office Guide."

Where methods did not exist for some sources, existing methods were adapted and new ones were created based on discussion with the team involved. Any new methodology was based on using data from peer-reviewed and published studies. A more detailed description of the calculation methods for each emission source is described below.

10.1 Purchased Electricity

GHGMI reports purchased electricity and home office heating emissions of full and part-time employees and contractors following a method similar to the "Building-specific data estimation method" outlined by the GHG Protocol.

Electricity emissions = Total annual home electricity x % *area of the home used for business* x % *working factor*

% *working factor*: 1.0 for full time, 0.5 for 50% time, 0.25 for 25%, etc.

The appropriate electricity emission factor was used to calculate emissions based on the regional location of the staff member, as described in section 12.

10.2 Stationary Combustion

GHGMI reports stationary combustion (natural gas and heating oil #6) for home office heating according to the same method used for electricity emissions.

Stationary Combustion Emissions = Annual emissions x % *area home for business* x % *working factor*

% *working factor*: 1.0 for full time, 0.5 for 50% time, 0.25 for 25%, etc.

The appropriate emissions factor for natural gas, heating oil #6, or other fuel was used, as described in section 12.

10.3 GHGMI Server Emissions

GHGMI accounts for electricity and heating/cooling emissions of its server, which is housed in a data center. This server and its components operate in a large data center in Texas. The Planet, owner of the server, has a policy of not divulging any of their energy consumption data. Therefore, emissions from the server are estimated using values from peer-reviewed studies on the energy consumption of servers and data centers.

Total Energy Consumption = PUE x *Power Consumption of Server* x 8760 hours/year

The appropriate electricity emissions factor was used for the location of the data center.

Power Usage Effectiveness (*PUE*) = Total facility power/ IT equipment power
Average PUE = 2.0 [5,6]
Average Server Energy Use = 251W [7,8]

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[5] EPA Report to Congress on Server and Data Center Energy Efficiency http://www.energystar.gov/index.cfm?c=prod_development.server_efficiency_study

[6] Lawrence Berkeley National Laboratory (LBNL) http://enduse.lbl.gov/info/LBNL-48581.pdf

10.4 Student Emissions

GHGMI reports electricity emissions associated with student use of personal computers for online courses. The suggested number of hours per course advertised by the Institute, the regions reported by students at registration, and the average rate of energy consumption of a computer (assumed 227 W) were used to estimate these emissions. Regional electricity emission factors are available from authoritative sources. Number of courses, number of students and regional representation of students are data available to the Institute.

Student Emissions = Annual course hours for a region x *power consumption of computer* x *regional emissions factor*

10.5 Instructor/Faculty Emissions

GHGMI only reports electricity emissions associated with instructor use of computers for teaching online courses and calculated similar to that of student emissions.

Instructor Emissions = Annual instruction hours x *computer power consumption* x *regional electricity emissions factor*

10.6 Mobile Combustion

GHGMI reports mobile transport emissions associated GHGMI staff business travel as well as employee and contractor commuting. Quantification is performed following methods outlined by the GHG protocol in "Sources of Mobile Combustion."

Air Emissions = distance travelled x *emissions factor*
Car Emissions = distance travelled/fuel consumption (miles per gallon) x *emission factor*
Train Emissions = distance travelled x *emission factor*

10.7 GOVIDA E-learning Provider Emissions

GHGMI reports emissions associated with its co-founder and e-learning service provider, GOVIDA. GOVIDA emissions associated with its work for GHGMI include purchased electricity, stationary combustion, and mobile combustion. Emissions for these sources are calculated according to the methods described above.

10.8 ClimateCHECK Emissions

As cofounder of GHGMI and provider of services to the Institute, ClimateCHECK staff and offices are involved with GHGMI and the fraction of emissions attributable to these activities are accounted for as part of GHGMI's GHG inventory. One ClimateCHECK employee worked 50% time and traveled for GHGMI, which was accounted for within GHGMI. Emissions associated with this staff member at ClimateCHECK included his home office. Three additional ClimateCHECK staff and offices where a limited amount of work was performed for GHGMI and emissions associated with travel related to GHGMI were

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[7] Power Provisioning for a Warehouse-sized Computer
http://static.googleusercontent.com/external_content/untrusted_dlcp/labs.google.com/en//papers/power_provisioning.pdf
[8] EPA Report to Congress on Server and Data Center Energy Efficiency
http://www.energystar.gov/index.cfm?c=prod_development.server_efficiency_study

accounted for in the GHGMI GHG inventory. Where home offices were involved, emissions were calculated as mentioned above. The ClimateCHECK office emissions were calculated using an energy consumption factor of 17.3 kWh/ft^2, published by The Climate Registry Protocol, and the specific emission factor for the location.

11 Renewable Energy Certificates

One staff member purchases renewable energy certificates for their home and home office through participation in a green power program. No adjustments were made to the GHGMI emissions inventory based on this fact.[9]

12 Emission Factors

Emission factors describe the emission rate from a given emission source relative to the intensity of a specific activity. To the extent possible, all emission factors used in our calculation estimates are referenced from published activity and emission factor data. For example, when estimating emissions for purchased electricity within the United States, emission factors for the specific location were sourced from the Emissions & Generation Resource Integrated Database (eGRID). Table 8 below details the values and references for these emission factors.

[9] For more information, see Gillenwater, M., "Taking green power into account," *Environmental Finance*, October 2008. <http://www.princeton.edu/~mgillenw/EF_CDP_Gillenwater_small.pdf>

Table 8: Emission and conversion factor sources

Emission	GHG	Value	[U/M]	Notes / Reference
Electricity	CO_2		[As per specific location]	For USA - see: www.epa.gov/cleanenergy/energy-resources/egrid/index.html
	CH_4		[As per specific location]	For Canada - see: www.eia.doe.gov/oiaf/1605/emission_factors.html and Environment Canada's National GHG Inventory Report (www.ec.gc.ca)
	N_2O		[As per specific location]	For Philippines - See: http://www.eia.doe.gov/oiaf/1605/emission_factors.html
Natural Gas	CO_2	53.060	[kg / MMBtu]	The Climate Registry, General reporting Protocol, V1.0 (2008), Table 10.1
	CH_4	5.000	[g / MMBtu]	http://www.theclimateregistry.org
	N_2O	0.100	[g / MMBtu]	
Heating Oil # 6	CO_2	11.000	[kg CO_2 / gallon]	The Climate Registry, General reporting Protocol, V1.0 (2008), Table 10.1
	CH_4	11.000	[g / MMBtu]	http://www.theclimateregistry.org
	N_2O	0.600	[g / MMBtu]	

Car		Value	[U/M]	Notes / Source
Fuel efficiency	F_e - City		[MPG]	For your car see: www.fueleconomy.org
	F_e - Highway		[MPG]	
	F_e - Effective		[MPG]	F_e - Effective = F_e-city x 55% + F_e-highway x 45% or actual measured
Engine - gasoline	CO_2	8.81	[kg CO_2 / gal]	For gasoline see: GHG Protocol Mobile Guide
	CH_4	0.0358	[g CH_4 / mi]	
	N_2O	0.0473	[g N_2O / mi]	
Engine - diesel	CO_2	0.233	[kg CO_2 / km]	For diesel see: GHG Protocol Mobile Guide
	CH_4	0.0249	[g CH_4 / mi]	
	N_2O	0.0393	[g N_2O / mi]	

Taxi	CO_2	0.2330	kg CO_2 / person / km travelled	GHG Protocol - Mobile Guide (03/21/05)
Bus	CO_2	0.2997	kg CO_2 / person / mi travelled	GHG Protocol - Mobile Guide (03/21/05)
Train	CO_2	0.0600	kg CO_2 / person / km travelled	GHG Protocol - Mobile Guide (03/21/05)
Light Rail	CO_2	0.4300	kg CO_2 / person / mi travelled	"WRI – Working 9 to 5 on Climate Change: An Office Guide"

Table 8 continued: Emission and conversion factor sources

Emission	GHG	Value	[U/M]	Notes / Reference
Air Travel	CO_2	Value	[U/M]	Notes / Source
Type of flight	Average distance			For air travel distances see: http://www2.icao.int/en/carbonoffset/Pages/default.aspx
(haul)	[km]			:
Short	up to 500	0.18	kg CO_2 / person / km travelled	GHG Protocol - Mobile guide
Medium	500 to 10000	0.126	kg CO_2 / person / km travelled	GHG Protocol - Mobile guide
Long	over 10000	0.11	kg CO_2 / person / km travelled	GHG Protocol - Mobile guide

OTHER CONVERSION FACTORS				
From	coefficient	Value	To	[U/M]
1 Metric ton =	C_{f-el} =	2204.62	Lbs	[lbs/metric ton]
1 cf =	C_{f-NG} =	0.001030467	MMBtu	[cf / MMBtu]
1 Therms =	$C_{f-NG-therms}$ =	98.8563	cf	[cf / Therms]
1 Ccf =	$C_{f-NG-ccf-cf}$ =	100	cf	[cf / Ccf]
1 m^3 =	C_f-m^3 =	35.31467	cf	[cf / m^3]
1 l =	C_{f-l-cf} =	0.03531467	cf	[cf / l]

Global Warming Potential factors

GHG	GWP	Notes
CO_2 =	1	Global Warming Potential for CO_2
CH_4 =	21	Global Warming Potential for CH_4
N_2O =	310	Global Warming Potential for N_2O

13 Level of Effort Estimate

Two GHGMI interns worked to complete this 2009 GHG inventory for GHMI. From June through November 2010, the two interns spent approximately 650 working hours. The process of producing a GHG emissions inventory for the Institute was used as a learning experience, and therefore is not representative of the level of effort required by an experienced practitioner to prepare an inventory.

14 Recommended Improvements for the 2010 inventory

Recommendations for improving future GHG inventories are based on the experiences developing the 2009 inventory. The following recommendations are suggested.

14.1 Data management improvements

- To expand the Library—the central place that contains all relevant parameters such as emissions factors, conversion factors, physical constants, GWPs values, etc.—by including all other parameters used only for specific individual data.
- To connect the formulas used for each individual staff member, contractor, server, students, and instructors, from their specific individual page / tab directly to the parameters listed in the Library and ensure that only one source is used in order to maintain consistency of parameters and formulas.

14.2 Data collection improvements

- When collecting individual data, make sure the units of measure are double checked and converted into a common unit of measure for that specific data. For example, natural gas measured in ccf, therms, and/or m^3 to be converted in cf, since the formulas are based on cf.
- To establish a procedure that will require each staff member to record even occasional travel performed on behalf of the business. This should include:
    - Using local public transportation such as bus, taxi, subway, trolley, street car, etc.
    - Travel from home to Airport, and vice-versa (e.g. private car – alone or shared, taxi, bus, light rail, train, etc.)
    - Exact number of legs of the flight trip to clearly identify short, medium and / or long haul and clearly specifying the departure and arrival airports.
    - To use the same source for identifying the length of the trip/flight

14.3 Uncertainties that could use more research

- Completion of a complete uncertainty analysis along with rigorous quality assurance investigations.
- To identify and address data gaps whether real or estimated data have been provided. Where estimates have been provided, to take the proper steps to ensure that for the next inventory real data will be provided, if possible.
- Regarding suppliers, to clearly define what percentage of their office activities and employee travel would be allocated against GHGMI inventory (0%, proportional % or 100%).
- To receive from the server host the exact values/parameters to calculate exact emissions instead of the current estimates, if possible. This was not possible with the current inventory.
- To establish a procedure to collect exact power, time usage, and local electricity emissions factors values from all students and instructors, to eliminate the use of current estimates. This could be implemented through the course survey provided at the end of each course.
- Further research into performance benchmarks, including an analysis based on a more detailed breakdown of emission sources and comparison of other institutions of a similar size and makeup of activities.

14.4 Potential or actual excluded sources or sinks

- Our preliminary analysis considered the inclusion of printed paper by the staff members, and especially printing the courses / lessons by students.
- Based on the collected data we found that staff members used a very small amount of printouts, while the amount printed by the students was mainly estimated.
- Overall, the emissions resulted from paper were less than 1% of the total emissions, so it was decided not to consider them at this time.

14.5 Quality management system improvements

- To make sure that only one individual performs the recording and updates in the centralized database and spreadsheet, for consistency of data input.
- To make sure that after each update the spreadsheet is saved by inserting the date of the update in the name of the document.
- To establish a procedure that would require another person to verify each update and report the findings to ensure that a feedback has been provided, and corrective action taken, if required.