Society for Conservation Biology
Ecological Footprint Committee

2008 Ecological Footprint Assessment

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The Society of Conservation Biology (SCB), being an organization committed to advancing knowledge of environmental conservation science, is naturally motivated to examine and reduce its own detrimental environmental impacts. To this end, SCB has formed an ad-hoc Ecological Footprint Committee, with the stated goal to "… move SCB to fully offset all its greenhouse gas emissions … and to reduce the ecological footprint of all SCB operations, purchases, and activities."[1] This mission is not a trivial one. SCB truly has a world-wide presence, with well-attended global scientific meetings, high-profile academic journals, a core staff of paid employees, and a headquarters office in Washington DC.

The Environmental Footprint Committee's first task is to "Work with the Executive Office to estimate our greenhouse gas emissions, amount of waste generated, and amount of energy and resources consumed by SCB activities, including SCB global meetings, Section meetings, Executive Office travel, office operations, and publications." This report presents both an annual greenhouse gas (GHG) emissions assessment and an initial Ecological Footprint assessment for SCB's 2008 operations.[2] These twin assessments, while related, provide different metrics for analyzing SCB's environmental impacts.

- A greenhouse gas assessment - typically termed a "carbon footprint" - converts activities such as travel and electricity consumption into the resulting amount of CO_2 emitted into the atmosphere.
- An Ecological Footprint assessment converts consumed resources into component raw materials, and finally to equivalent hectares of biologically productive land.

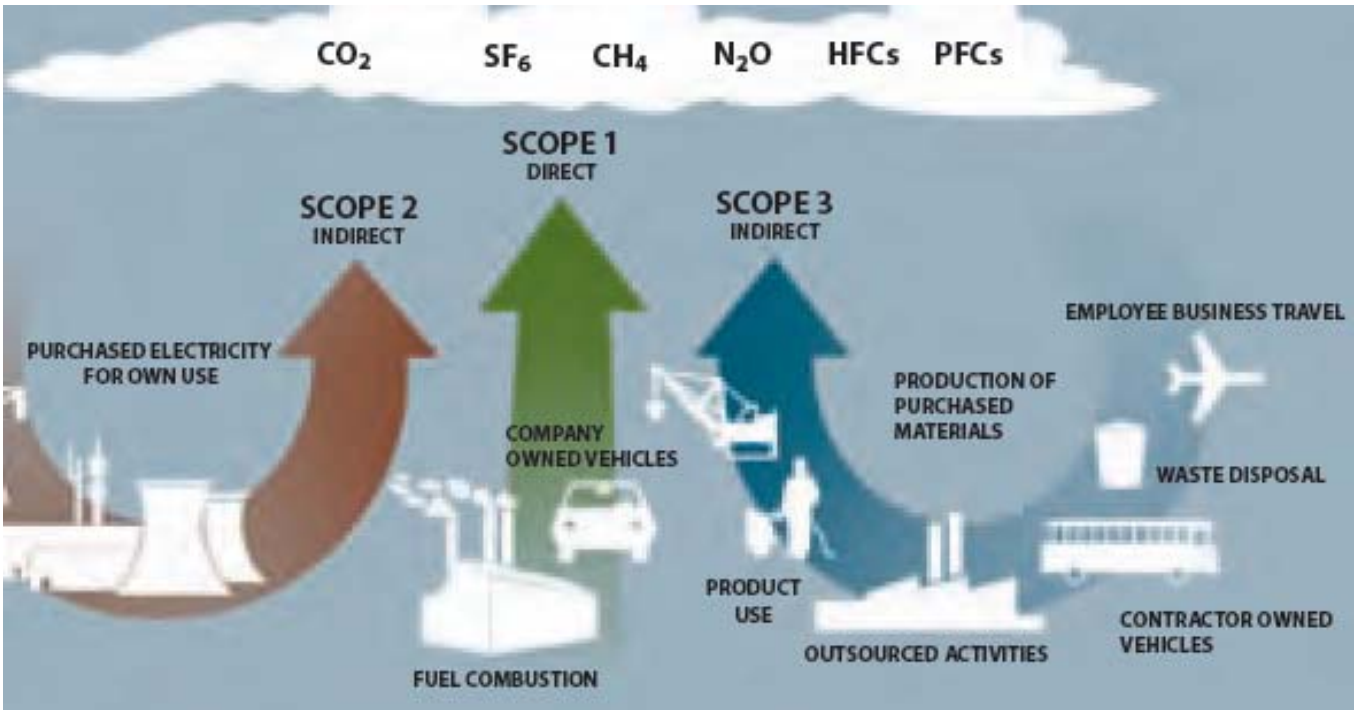
With both of these results in hand, the SCB can have an understanding of both its contribution to global climate change in metric tons of CO_2 equivalent[3], as well as its demand for productive land and sea.

SCB is committed to maintain its current operations and expand its scientific and educational outreach around the globe while simultaneously reducing its environmental impacts. This assessment is an important first step toward that goal. This is the first annual assessment of the Environmental Footprint Committee, which will establish an organizational baseline from which future improvements can be measured. The following sections explain the characteristics of this assessment, namely: the boundary of included activities, data gathering, calculation methods, and assumptions.

Assessment Boundary: included activities

SCB carries out many activities, some of which are not directly controlled by SCB. Thus, there is some grey area in terms of what should be included in an environmental assessment of SCB's operations. A useful way to organize an organization's functions is presented in the figure below.[4]

[1] See the Ecological Footprint Committee Terms of Reference, 2008, for a full description.
[2] See http://www.footprintnetwork.org/ for a more complete description of an Ecological Footprint.
[3] CO_2 equivalent, or CO_2 e, refers to the fact that emissions of all six classes of greenhouse gas are converted into an equivalent amount of carbon dioxide, based on relative global warming potentials.
[4] Modified from the World Resources Institute Greenhouse Gas Protocol – www.ghgprotocol.org.



Traditional Greenhouse Gas Assessments require only Scope 1 and Scope 2 activities to be included in the assessment, while Scope 3 (indirect) emissions can be included based on the desires of the organization. The Environmental Footprint Committee decided to take an ambitious approach and include as many Scope 3 activities as possible. The boundary for this evaluation includes:

<u>Scope 1 activities (owned or directly controlled by SCB)</u>
Physical area of SCB offices (for the Ecological Footprint Assessment)

<u>Scope 2 activities (purchased energy)</u>
Electricity use at SCB headquarters building
Natural gas use at SCB headquarters building

<u>Scope 3 activities (indirect impacts)</u>
Water use at the SCB headquarters building
Paper use at the SCB headquarters building
Waste disposal from HQ building
Company travel for SCB staff members
Employee commuting
Advertising and marketing

SCB Annual Meeting (2008, Chattanooga)
Air travel to and from the event for attendees
Car travel to and from the event for attendees
Travel during the event (field trips, shuttles)
Hotel accommodations
Catering (food and beverages)
Waste and recycling at the conference
Electricity use at the conference venue
Printing or advertising associated with the conference

Smith Fellows Program
Air travel to and from meetings for participants
Car travel to and from meetings for participants
Hotel accommodations
Catering (food and beverages)

Conservation Biology
Printing
Shipping and distribution

Conservation Magazine
Printing
Shipping and distribution

2008 SCB Newsletter
Printing
Shipping and distribution

This list covers most of SCB's direct and indirect environmental impacts. We excluded an activity from the list if it was too difficult to measure or presumed to be relatively small. For example, travel of exhibitors to and from global meetings was not measured because we do not have information on how many persons an exhibitor sends to our meeting, nor do we know where these people are traveling from. We ask readers to advise the Committee of any significant activity we inadvertently overlooked. This assessment boundary can be revised in future years.

Data Gathering

Data for this assessment came from a variety of sources, and in a variety of formats. Several people contributed information for this assessment, going above and beyond their regular job duties to ferret out electricity use at the Chattanooga Convention Center, or natural gas bills for the SCB office. Because this was an all-volunteer effort among people with other jobs, we had to balance precision and practicality. We made reasonable attempts to obtain hard data from primary sources, but in some cases we had to rely on "best guess" assumptions and memory. When we were unsure about an assumption or calculation, we chose values that tended to over-estimate, rather than under-estimate an impact.

Calculation Methods

<u>Calculation of greenhouse gas emissions</u>

Producing an estimate of GHG emissions from a particular activity can proceed in 3 ways, listed from most to least precise:

- Given a known quantity of fuel, energy, or raw material, we multiplied this by an emissions factor, which is a rate of tons or lbs of CO_2e emitted per quantity of the material consumed (for example, 25.34 lbs CO_2e/ gallon of gasoline).

- When the quantity of raw material is not known, or SCB's share of the total cannot be known, we used emissions factors based on secondary units of consumption, such as passenger air-miles flown (0.64 lbs CO_2e/passenger air-mile flown), or hotel room-nights (65 lbs CO_2e per hotel night).

- In cases where consumption data aren't available, we converted dollars spent on the activity into CO_2e emissions, using an Economic Input-Output Life Cycle Assessment (EIO-LCA) tool built by the Carnegie Mellon Green Design Institute. An EIO-LCA breaks an economic activity into its main component activities, estimates average CO_2e per dollar for the entire sector of the economy related to each activity, and sums the greenhouse gas emissions of each component activity.[5] For example, a dollar spent on "commercial printing" emits greenhouse gasses from several component sectors, including pulpwood harvesting, paper manufacturing, transportation, energy use, ink manufacturing, etc. Although EIO-LCAs are powerful tools, they rely on many assumptions and give outputs that represent an aggregated national perspective rather than a particular, localized activity. EIO-LCAs are becoming increasingly sophisticated; for instance some models discriminate between printing on recycled versus virgin paper.

[5] Please see http://www.eiolca.net/cgi-bin/dft/use.pl for complete information on this particular tool and LCAs in general.

Calculation of ecological footprint

The Ecological Footprint or an organization measures the amount of biologically productive areas required to support the consumption activities of that organization. SCB's Ecological Footprint, for example, includes the forest needed to grow the trees that become the paper distributed in SCB journals and magazines, the cropland needed to provide the meals served at SCB meetings, the area needed to absorb the fossil carbon dioxide emitted from electricity use in the SCB office, and many other activities.

In simplest terms, the Ecological Footprint of a material (e.g., 1 kg of paper) is calculated by first translating that material back into it's primary product equivalent (e.g., 1 kg of paper requires 2 kg of raw wood to be harvested), which is then divided by the yield, in tonnes per hectare each year, of the land from which the material was harvested. This provides an Ecological Footprint in units of hectare-years, representing the area required to produce that material over the course of a year. Most Ecological Footprint analyses normalize these hectares into *global hectare-years*, or hectares with world average biological productivity, for the purposes of adding areas together and comparing results across land types.[6] We follow this convention.

The Ecological Footprint of fossil carbon dioxide emissions generally forms a substantial part of the total Ecological Footprint of an organization. The Footprint of an organization's carbon dioxide emissions is calculated as the productive area of world-average forest required to absorb that amount of carbon dioxide. This method is designed to produce conservative values, as using carbon dioxide absorption yields for non-forest land types would yield higher Ecological Footprint estimates. We used an estimate of 0.2771 ha per per tonne fossil CO_2 emitted; the assumptions underlying this estimate are provided in the last page of the Appendix.

[6] Please see the papers listed at http://www.footprintnetwork.org/en/index.php/GFN/page/methodology/ for more details on Ecological Footprint accounting methodology.

2008 Estimates of Greenhouse Gas Emissions and Ecological Footprint

Activity (by Scope)	**2008 Consumption** (raw units or dollars spent)	**2008 GHG Emissions** (metric tons CO_2e)	**Ecological footprint** [g] (global ha-years)
Scope 1 activities (owned or directly controlled by SCB)			
Physical area of the SCB office (for Ecological Footprint assessment)	3,235 sq ft	Not applicable	0.04
Scope 2 activities (purchased power)			
Electricity use at SCB headquarters	$2,638.46[a]	8.21	
Natural gas use at SCB headquarters	$737.50 [a]	8.46	
SUB-TOTAL (Scope 1 and 2)		16.67	
Scope 3 activities (indirect impacts)			
Water use at the SCB headquarters	$568.11 [a]	0.06	
Paper use at the SCB headquarters	$78.98[b]	0.03	0.10
Waste from HQ building	720 gal/year	Not converted	
Recycling at HQ building	720 gal/year	Not converted	
Company air travel for SCB staff	30 trips w/ origins and destinations [c]	37.56	
Company car travel for SCB staff	685 driving miles (approx.) [c]	0.38	
Employee commuting	2,800 driving miles (approx.) [c]	1.53	
Advertising and marketing	$42,925.74 [b]	6.49	
SUB-TOTAL (SCB Operations)		46.05	
2008 SCB Global Meeting (Chattanooga, TN)			
Attendee air travel to and from the event	1192 attendees, work country and city information [c]	3026.63[f]	
Attendee car travel to and from the event	Same as above [c]	5.29	
Travel during the event (field trips, hotel shuttles, etc)		Still gathering	
Hotel and dorm room accommodations		Still gathering	
Catering (food and beverages)	$89,158.86 [b]	56.50	1.32
Waste and recycling at the conference		Not available	
Electricity use at the conference venue	101,161 kWh [d]	74.26	
Printing or advertising	$1,784.22 [b]	1.01	
SUB-TOTAL (SCB Global Meeting)		3163.69	

Smith Fellows Program			
Participant air travel to and from meetings	51 trips w/ origins and destinations [c]	81.98	
Participant car travel to and from meetings	6,188 driving miles (approx.) [c]	3.39	
Hotel accommodations	206 hotel-nights [e]	6.07	
Catering (food and beverages)	565 meals, 157 snacks [b]	9.87	0.49
SUB-TOTAL (Smith Fellows Program)		101.31	
Conservation Magazine			
Printing and design	$110,830.82 [b]	57.72	16.86
Shipping and distribution	$20, 961.21 [b]	4.18	
Conservation Biology [h]			
Printing		Not available	41.95
Shipping and distribution	Provided by W-B	25.00	
2008 SCB Newsletter printing			
Printing	$15,739.00 [b]	8.77	2.28
Shipping and distribution	$6,007.52 [b]	1.20	
SUB-TOTAL (Publishing)		96.87	
GRAND TOTAL ECOLOGICAL FOOTPRINT (EXCLUDING CO_2e)			63.04
GRAND TOTAL CARBON FOOTPRINT		**3424.59**	949.0
GRAND TOTAL ECOLOGICAL FOOTPRINT			**1012.04**

[a] converted to GHG based on known pricing rates
[b] converted to GHG using EIO-LCA tool from Carnegie Mellon Green Design Institute
[c] converted to distance traveled, then calculated GHG with a standard emissions factor
[d] GHG calculated directly based on a known emissions factor
[e] GHG calculated based on an indirect emissions factor (lbs $CO2_e$ / hotel-night
[f] Over a 3-year period, SCB is attempting to fully offset this impact using a surcharge on registration. The first 3-year effort will end after the 2009 Global Meeting.
[g] Until the last 2 rows of the table, the footprint **excludes** land needed to store the GHG emissions that may be listed in the previous column. For example, the entry for catering reflects hectares of agricultural land needed to grow the food, but does not reflect GHG emissions (related to transport, preparation, and serving the food) listed in the previous column.
[h] In 2006, Wiley-Blackwell, the publisher of *Conservation Biology*, adopted a policy to offset the GHG emissions associated with printing and distribution of their periodicals. However, their initial internal GHG audit has been deemed out-of-date and they are currently working to improve their GHG emissions accounting. The number of offsets purchased in 2008 is not immediately available.

Results: GHG emissions and ecological footprint

In 2008 SCB was responsible for a total of about 3425 tonnes of CO_2e emissions, of which 88% was due to air travel by registrants at our Global Meeting in Chattanooga. SCB purchased about 2105 tonnes of offsets, leaving a net impact of 1320 tonnes. If Wiley-Blackwell successfully offsets its emissions related to publication and distribution of Conservation Biology, SCB's net GHG emissions would be reduced by a further 25 metric tons CO_2e. As it stands, core SCB operations (Scope 1, 2, and 3) account for only 1.8% of the total carbon footprint, while publishing and the Smith Fellows Program each account for an additional 3% of the total.

SCB's Ecological Footprint is about 1012 global hectare-years, meaning that about 10 km^2 of land worldwide is needed to support or offset our operations. The vast majority (94%) is comprised of global hectare-years of forest land that would be required to sequester SCB's GHG emissions. Of the remaining 6% of the Ecological Footprint, the majority of the footprint is comprised of forestland required to produce paper for Conservation Biology (4%) and Conservation Magazine (1.4%). Our calculations for catering at the Global Meeting and for the Smith Fellows program are based on rough assumptions, but they still represent a small relative impact. Deciding to hold the SCB Global Meeting every other year will reduce the Ecological Footprint of SCB by about 44%. The 2008 assessment does a crude job of estimating impact of printing and paper use for publications.

A full offset of SCB's emissions requires offsetting 5 major activities:

- Global Meeting: We are currently offsetting about 75% of this impact.
- Smith Fellows Program: Probably fully offset.
- SCB headquarters and staff operations: We recommend spending about $600/year to offset this.
- Journals: under analysis
- Activities of SCB Sections: Board discussion item.

Results: Offsetting GHG emissions of our Global Meetings

In 2006, the SCB Board of Governors authorized SCB to pursue a triple-benefit project (carbon storage, direct benefit to biodiversity, and poverty alleviation) to offset the impact of air travel to the SCB Global Meeting. We chose restoration of subtropical thicket in the Baviaanskloof Megareserve, Republic of South Africa, as the offset project for the first 3 years of the program. Details of the project are at http://www.conbio.org/projects/carbonoffset/.

For the 2007, 2008, and 2009 Global Meetings, we imposed a carbon surcharge on registration fees ($20 for a registrant from a developed country, $5 for a registrant from a developing country or a student, $5 for a 1-day registration). In 2007, these fees amounted to $13,315. In 2008, these fees amounted to $12,335. In 2008, the Smith Fellows donated an additional $1850 to offset their impact. In addition, individuals donated $415 in 2008. The Executive Office will also transfer dollars from the 2009 International Marine Conservation Congress into the Baviaanskloof project. Because donors make these contributions to offset their impacts, we avoid counting non-SCB donations against SCB's impacts.

The SCB website has not accepted on-line contributions during 2008 and at least half of 2009 (due to abuse of the website by hackers). There would probably be more donations from individuals if donors could contribute on-line. Until June 2009, the website also failed to provide the important information that donors should use a cost of $6/tonne CO_2e if they want their donation

to cover a particular amount of emissions. This is now being fixed.

We calculated the CO_2 impact of travel to the Global Meeting based on a spreadsheet of cities closest to the home addresses of registrants; this came to 2810 metric tons CO_2E for the 2007 Global Meeting in Port Elizabeth, and 3027 tonnes for the 2008 Global Meeting in Chattanooga.

To offset the 2007 Global Meeting, our contract with Eastern Cape Parks purchased 4473 metric tons CO_2e (1220 metric tons of increase in organic carbon stocks) for ZAR 190,000 (about USD $17,800, including registration surcharges and other donations). The project implementers estimate that these tons of new carbon will be sequestered by 2029 (20 years). If we assume that the carbon accumulates linearly ($1/20^{th}$ of the total each year for 20 years) and apply a 4% discount rate to future tons, 4473 nominal tonnes over a 20-year period is worth 3040 tonnes of CO_2e to SCB today. Thus the contract represents a cost of $5.86/tonne CO_2e. Our informal scan of websites in June 2009 shows that consolidators are selling offsets for an average of about $10 to $12 per tonne (range $3 to $30). We believe $5.86 is an excellent price for a triple-benefit project.

At $5.86 per tonne, the $13,315 from registration fees in 2007 bought about 2272 tonnes, which is about 20% less than our estimated impact of 2810 tonnes. Due to a combination of increased planting efficiency and a stronger dollar, we expect the $12,335 from registration fees in 2008 will buy cheaper carbon, but again we will fall 20% to 30% short of our estimated impact of 3027 tonnes. (At $5.86/tonne, $12,335 buys 2105 tonnes). Starting with the 2010 annual meeting in Edmonton, SCB should raise the offset fees enough to increase revenues by 25%[7]. The Board needs to decide whether to raise fees by the same percentage for registrants from both developing and developed countries. To accommodate planning needs of meeting organizers, the Board should make this decision by October 2009.

The EFC does not recommend raising the fees to retroactively cover the deficits of the first 3 Global Meetings. However, the Board could decide to do so. We are learning as we go, and we'll never be perfect. We feel it is more important to get better at learning and adjusting than it is to go back and correct past mistakes.

Recommendations for Future Assessments

This report is only as accurate as the data and assumptions that feed the calculations. To improve data and assumptions in future assessments, we offer the following recommendations:

- The EFC and EO, working with local organizers of our global meetings, should reduce the time lag between collecting offset fees, calculating emissions from the meeting, calculating how many tonnes of CO_2e our dollars can buy, and making adjustments to future registration surcharges. The current time lag is over a year. We should reduce this to 4 months.
- The Executive Office and organizers of our Global Meetings should strive to record more detailed information to upgrade components of the assessment. For example, if we tracked the number of hotel-nights for a sample of attendees at our global meetings, we could more accurately estimate that component,

[7] The EFC recommends increasing fees from $5 to $6 for registrants from developing countries/students and from $20 to $26 for registrants from developed countries. Given that about 2/3 of our registrants are students or persons from developing countries, every $1 increase in surcharge for student/developing countries increases our total offset revenue by about 7.2% and every $1 increase for registrants from developed countries increases our revenue by about 3.2%. SCB could achieve a 25% increase in revenue by (a) "Increasing tax only on the rich" = fees of $5 (student/low income) and $27.87 (high income), (b) "Increasing tax only on the poor" = $8.46 low/student and $20 high or (c) various combinations in between.

instead of using an assumed ratio of registrants per hotel room. We could use the post-meeting email survey to collect information on hotel-nights, sharing of hotel rooms, and extended travel taken by meeting participants. The latter represents a carbon impact abetted by our global meetings. SCB probably will choose not to assume responsibility for meeting-enabled carbon impacts, but we can use these data to make our members and other professional societies aware of the magnitude of this impact.

- The Executive Office should modify its accounting procedures to track raw figures of resources used (instead of dollars spent) wherever possible. For instance, SCB should record actual kWh of electricity, therms of natural gas, reams of paper used in printing newsletters, etc. This will make calculations more accurate, avoiding assumptions on electricity delivery charges or printing costs. Our goal is to use the EIO-LCA models as rarely as possible.
- The Executive Office should track employee travel (plane trips taken, car trips taken) as they happen so the Committee doesn't have to rely on personal recollections at the end of the year.
- If greenhouse gasses emissions for publications continue to be included in future assessments, the Executive Office and this committee should work with the various publishing teams to ensure a consistent approach for each publication. Wiley-Blackwell is currently revising their internal methods for estimating their greenhouse gas footprint. Perhaps *Conservation* magazine could adopt these same methods.
- Well over 90% of SCB's emissions and ecological footprint are due to air travel and printing costs for *Conservation Biology* and *Conservation*. In the future, if this committee changes the type of data collected, or the assumptions and emission factors related to these activities, the committee should report both the old and new metrics for a 3-year transition period. This will enable readers to discern changes in performance from changes in accounting procedures. Otherwise, improvements in the assessment procedures could create a false perception of improvement or deterioration.

Decisions to be made by SCB Board of Governors

This report provides two metrics of SCB's environmental impact. These are a baseline from which to compare future performance, as SCB moves to reduce greenhouse gas emissions and Ecological Footprint values. Simply going through the process of data-gathering and assessment has made SCB staff more aware of the organization's activities. The Executive Office staff can and will make decisions that will reduce some of SCB's impacts.

The Committee reminds each SCB Section that the Section may offset its greenhouse gas impacts by adding Section dollars to SCB's offset project (currently restoration of subtropical thicket in the Baviaanskloof Megareserve, RSA). For example, the Marine Section plans to do so for their 2009 International Marine Conservation Congress. Sections may also invest in another offset project of their choosing. For instance the Europe Section is charging an offset fee for the 2009 European Congress of Conservation Biology in Prague. They have decided to have an open request for proposals for offset projects in Europe. The Committee encourages Sections to use our Table as a way to assess the impacts of their Section Meetings and other activities.

We recommend that the Board of Governors consider the following issues, and respond either by a formal Board vote, or communicating the

sense of the Board to our Committee and to the staff of the Executive Office:

- We recommend increasing the registration surcharge for carbon offsets from $5 to $6 for registrants from developing countries/students and from $20 to $26 for registrants from developed countries. Details behind these calculations are presented above.

- This report includes an estimate of greenhouse gas emissions that are currently not covered by SCB's existing offset program, which covers only the emissions of registrant air travel to the global meeting. The Committee recommends that SCB use the offset fee for registrants to cover not only air travel, but also electricity use at the conference venue (74 tonnes at the 2008 Chattanooga meeting) and catering (56.5 tonnes at the 2008 meeting) and other emissions. These other emissions total only about 4% of the emissions due to air travel. Because SCB sets the registration surcharge to cover impacts over a 3-year moving window, this would not require calculating the carbon surcharge to the nearest dollar every year, but it does require that SCB "top off" our annual offset dollars to ensure we do not fall behind.

- If the Board chooses to follow the previous recommendation, the SCB meetings coordinator will have to ask the venue operators and event organizers to track figures for attendee travel at the event (organized trips; busses), hotel accommodations, energy use at the convention center and reception venues, and printing/advertising associated with the event. A significant number of hours will be spent by the Meetings Coordinator and by volunteers on the local organizing committee. A factor beyond our control is the degree to which venue owners will provide the information we need. SCB should advise venues submitting proposals to host a meeting that we expect cooperation on this issue.

- The Committee also recommends that SCB offset the 18 tonnes of utility use at the SCB headquarters, the 44 tonnes generated by staff air travel, and other greenhouse gas emissions. At $10 per tonne, this would be an annual cost of about $600. We believe tracking these costs will not be burdensome on SCB staff. It seems inappropriate to roll this cost into the surcharge for registration at the Global Meeting.

- How much responsibility does SCB wish to assume for Section Meetings? To do a good job of assessing impacts, each Section would have to keep track of the home town of each registrant, and the other data needs outlined in the previous paragraphs.

- How much responsibility does SCB wish to assume for the Smith Fellows Program? To do a good job of assessing impacts, the Smith Fellows Coordinator would have to be charged with collecting appropriate data.

APPENDIX

2008 Greenhouse Gas Emissions – Sector Breakdown

This Appendix is included to provide detail on the data gathered for each segment of the GHG Assessment, and the assumptions and calculation methods used to arrive at a final emissions output. In order to be transparent with our approach and to allow for consistency in calculation methods across years, we have included as much information as possible.

Sectors of the SCB Carbon Footprint that were calculated using the Green Design Institute EIO-LCA tool are not included in an extended format, but the process for using the tool is as follows:

- Convert current dollar value into 1997 dollar value. We used http://www.westegg.com/inflation/infl.cgi to complete this step, which is necessary because the EIO-LCA is based on 1997 US Department of Commerce figures.
- Find the appropriate Industry Group List and Industry Sector for the desired activity (Commercial printing, Advertising and related services, Postal service, etc.)
- Enter the input in 1997 dollars and change the output results to GHG Emissions

Electricity use at the SCB headquarters building

Electricity use for this assessment is based on the 12-month period from March 2008 to March 2009.

Date [1]	Amount [1] ($)	Minus delivery charge [2] ($)	Rate [2] ($/kWh)	kWh	Line loss multiplier [3]	Emissions factor [4] (lbs CO2e/kWh)	Lbs CO2e	Metric tons CO2e [5]
03/28/2008	90.64	75.68	0.15	498.30	1.07	1.09	582.79	0.26
04/16/2008	77.60	62.64	0.15	412.44	1.07	1.09	482.37	0.22
05/20/2008	70.49	55.53	0.15	365.63	1.07	1.09	427.62	0.19
06/19/2008	144.57	129.61	0.17	784.73	1.07	1.09	917.78	0.42
07/24/2008	306.36	291.40	0.17	1764.29	1.07	1.09	2063.42	0.94
08/20/2008	299.24	284.28	0.17	1721.18	1.07	1.09	2013.01	0.91
09/17/2008	276.55	261.59	0.17	1583.80	1.07	1.09	1852.34	0.84
10/15/2008	196.04	181.08	0.17	1096.35	1.07	1.09	1282.24	0.58
11/19/2008	195.75	180.79	0.15	1190.38	1.07	1.09	1392.21	0.63
12/19/2008	267.54	252.58	0.15	1663.07	1.07	1.09	1945.04	0.88
01/26/2009	228.24	213.28	0.15	1404.30	1.07	1.09	1642.41	0.74
02/20/2009	253.24	238.28	0.15	1568.91	1.07	1.09	1834.92	0.83
03/13/2009	232.20	217.24	0.15	1430.38	1.07	1.09	1672.90	0.76
Total	2638.46						**Total**	**8.21**

[1] = Monthly electricity use figures from Pepco electric bill
[2] = Delivery charge from Pepco rate sheet, http://www.pepco.com/home/
[3] = Standard line loss for electricity transmission = 7.2% (http://climatetechnology.gov/library/2003/tech-options/tech-options-1-3-2.pdf)
[4] = Emissions factor from the EPA eGRID data, 2005
[5] = 1 metric ton = 2205 lbs

Natural gas use at the SCB headquarters building

Natural gas use for this assessment is based on the 12-month period from February 2008 to February 2009.

Date [1]	Amount [1]	Minus delivery charge [2]	Rate [2]	Therms	Emissions factor [3]	Total building area	SCB office area [4]	Metric tons CO2e [5]
	($)	($)	($/therm)		(metric tons CO2e/ therm)	(sq. ft)	(sq. ft)	
01/26/2009	151.52	143.57	0.3873	370.6946	0.00546	4495	3235	1.456644036
01/14/2009	101.80	93.85	0.3592	261.2751	0.00546	4495	3235	1.026680186
12/08/2008	14.07	6.12	0.3592	17.03786	0.00546	4495	3235	0.066950269
11/06/2008	7.95	0.00	0.3592	0	0.00546	4495	3235	0
10/03/2008	7.95	0.00	0.3592	0	0.00546	4495	3235	0
09/05/2008	7.95	0.00	0.3592	0	0.00546	4495	3235	0
08/08/2008	7.95	0.00	0.3592	0	0.00546	4495	3235	0
07/09/2008	7.95	0.00	0.3592	0	0.00546	4495	3235	0
06/05/2008	9.61	1.66	0.3592	4.621381	0.00546	4495	3235	0.018159713
05/09/2008	104.04	96.09	0.3592	267.5111	0.00546	4495	3235	1.05118486
04/23/2008	225.79	217.84	0.3592	606.4588	0.00546	4495	3235	2.383079507
03/20/2008	90.92	82.97	0.3592	230.9855	0.00546	4495	3235	0.907657486
February 2008 (est)	150.00	142.05	0.3592	395.4621	0.00546	4495	3235	1.553968252
Total	737.50						**Total**	8.464324308

[1] = Monthly natural gas use figures from Washington Gas bill
[2] = Delivery charge and rates from Washington Gas rate sheet, http://www.washgas.com/pages/TariffsandRateSchedules
[3] = Emissions factor from the EIA Voluntary Reporting Protocol, http://www.eia.doe.gov/oiaf/1605/coefficients.html. We assume 1000 cubic feet = 10 therms.
[4] = Because natural gas use is metered for the entire building, the total consumption is scaled down based on the percentage of the total building area occupied by SCB.
[5] = 1 metric ton = 2205 lbs

Water use at the SCB headquarters building

Natural gas use for this assessment is based on the 12-month period from March 2008 to March 2009.

Date [1]	Amount [1] ($)	Minus delivery charge [2] ($)	Rate [2] ($/ccf)	CCFs	Gallons [3]	Emissions Factor [4] (kWh/ 1000 gallons)	kWh	Metric tons CO2e [5]
03/28/2008	92.11	88.11	5.77	15.27	11423.03	1.55	17.71	0.009
05/12/2008	105.17	101.17	5.77	17.53	13116.19	1.55	20.33	0.011
06/12/2008	26.31	22.31	5.77	3.87	2892.38	1.55	4.48	0.002
07/24/2008	26.31	22.31	5.77	3.87	2892.38	1.55	4.48	0.002
08/20/2008	26.31	22.31	5.77	3.87	2892.38	1.55	4.48	0.002
09/17/2008	37.99	33.99	5.77	5.89	4406.64	1.55	6.83	0.004
10/15/2008	32.15	28.15	5.77	4.88	3649.51	1.55	5.66	0.003
11/12/2008	34.53	30.53	5.77	5.29	3958.06	1.55	6.13	0.003
12/19/2008	35.80	31.80	5.77	5.51	4122.71	1.55	6.39	0.003
01/15/2009	67.25	63.25	5.77	10.96	8200.05	1.55	12.71	0.007
02/20/2009	48.38	44.38	5.77	7.69	5753.65	1.55	8.92	0.005
03/16/2009	35.80	31.80	5.77	5.51	4122.71	1.55	6.39	0.003
Total	568.11						**Total**	**0.06**

[1] = Monthly natural gas use figures from Washington DC Water and Sewer Authority bill
[2] = Delivery charge assumed to be $4, rates from Washington DC Water and Sewer Authority rate sheet, http://www.dcwasa.com/
[3] = 1 CCF = 748 gallons of water
[4] = Because natural gas use is metered for the entire building, the total consumption is scaled down based on the percentage of the total building area occupied by SCB.
[5] = Standard line loss for electricity transmission = 7.2% (http://climatetechnology.gov/library/2003/tech-options/tech-options-1-3-2.pdf), Emissions factor from the 2005 EPA eGRID data = 1.09 lbs CO2e/ kWh, 1 metric ton = 2205 lbs

Company air travel for SCB staff

This calculation is representative of how GHG emissions from air travel were calculated from the Smith Fellows program as well. This method assumes a single-leg plane flight with no layovers, which undoubtedly results in a substantial underestimate of overall air travel GHG emissions (two short-haul flights produce more GHGs than a medium-haul flight of equivalent distance, for example, due to the greater number of takeoffs and landings).

Flight Origin [1]	**Flight Destination [1]**	**Round-trip distance [2]** (miles)	**Per-flight emissions [3]** (Metric tons CO2e)	**Number of trips**	**Metric tons CO2e**
SFO	DC	4870	2.33	5	11.63
SFO	Bozeman	1612	0.89	3	2.66
SFO	Chattanooga	4124	1.97	2	3.94
SFO	Seattle	1360	0.75	1	0.75
DC	Chattanooga	1042	0.57	8	4.59
DC	NYC	425	0.33	1	0.33
DC	Costa Rica	4000	1.91	2	3.82
Gainesville	Chattanooga	813	0.45	2	0.90
Seattle	DC	4640	2.22	1	2.22
Seattle	Boston	4974	2.38	1	2.38
Seattle	Chattanooga	4166	1.99	1	1.99
Seattle	San Diego	2100	1.00	1	1.00
Burlington	DC	872	0.48	1	0.48
Burlington	Chattanooga	1822	0.87	1	0.87
			Total	**30**	**37.56**

[1] = Flight activity data provided in written format by SCB staff

[2] = Distance between airports calculated using the Time/Distance calculator at http://www.airrouting.com/content/TimeDistanceForm.aspx

[3] = Emissions factors for short, medium, long, and extended flights (0.64. 0.45, 0.39, and 0.39 lb CO2/mile, respectively) are taken from the World Resources Institute GHG Protocol for Mobile Sources (http://www.ghgprotocol.org/). Short flights are up to 300 miles, medium flights are 300-900 miles, long flights are 900-2,500 miles, and extended flights are over 2,500 miles (single-leg distances). We also include a Radiative Forcing Index of 2.7 (IPCC 2007). 1 metric ton = 2205 lbs

Company car travel for SCB staff

This calculation is representative of how GHG emissions from car travel were calculated from employee commuting, the Smith Fellows program, and the 2008 SCB Global meeting. For employee commuting, each employee responded to a questionnaire asking how many times they drove to work in a typical week in 2008 and the distance of their commute. Walking, biking, and public transportation were all assumed to be zero-emissions modes of transportation for this assessment. All other driving distance estimates were calculated by Google maps.

For the SCB Global meeting, attendees whose trip originated within 4 hours driving distance (as calculated by Google maps) were assumed to have driven to Chattanooga, and of these 50% were assumed to have car-pooled with another driver.

Distance driven (miles)	**Average MPG [1]** (miles/gallon)	**Gallons of gasoline**	**Emissions factor [2]** (lbs CO2e/gallon of gasoline)	**Metric tons CO2e [3]**
686	21	32.67	25.34	**0.38**

[1] = Average vehicle fuel efficiency for the US vehicle fleet is assumed to be 21 miles per gallon
[2] = from the Argonne National Laboratory Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model (http://www.transportation.anl.gov/software/GREET/)
[3] = 1 metric ton = 2205 lbs

Air travel for 2008 SCB Global Meeting

This calculation is representative of how GHG emissions from air travel were calculated from the 2008 SCB Global Meeting in Chattanooga, TN, because it would be impractical to list the raw data for all 1192 attendees. Because so many of the meeting attendees travel from overseas and throughout the USA, a different method was employed to more accurately reflect the number of short flights and layovers in a typical travel itinerary. This method strikes a balance between over-estimating on a given leg of an itinerary, but underestimating (most likely) the number of flights taken per attendee.
For each attendee, SCB records show the work city, state, and country. Online travel sites (Orbitz.com, Travelocity.com, etc) were used to construct a "typical" travel itinerary for a registrant's particular city or country, based on the cheapest and most direct travel options. The typical itineraries were split into numbers of short, medium, long, and extended flights, as defined by the World Resources Institute GHG Protocol for Mobile Sources (http://www.ghgprotocol.org/). Short flights are up to 300 miles, medium flights are 300-900 miles, long flights are 900-2,500 miles, and extended flights are over 2,500 miles (single-leg distances). Rather than calculating individual itineraries for each individual city of origin, nearby origin locations were grouped together and given the same profile of short, medium, and extended flights. For the USA, these clusters were adjacent states within a region of the country. Outside of the USA, neighboring countries were placed in the same group. For example, travelers from Minneapolis and Madison received the same flight itinerary, as did travelers from Columbia and Venezuela.

Origin Country [1]	Origin City [1]	Number of flights in each category [2]				Metric tons CO2e [3]
		Short	Medium	Long	Extended	
Argentina	Jujuy	1	1		1	6.11
Australia	Townsville	1		1	1	7.62
Bolivia	Cochabamba	1	1		1	6.11
Brazil	San Domingos	1	1		1	6.11
Canada	Vancouver	1		1		2.86
Canada	Toronto		2			1.76
China	Beijing	1		1	1	7.62
Colombia	Bogota	1		1		2.86
Egypt	Aswan		1		2	10.4
France	Paris	1			1	5.23
India	Coimbatore	2		1	1	8.09

[1] = Neighboring cities and countries were grouped into similar travel zones according to the description above.
[2] = Flight distances were assumed to be the maximum allowed in each category, mentioned above.
[3] = Emissions factors for short, medium, long, and extended flights (0.64. 0.45, 0.39, and 0.39 lb CO2/mile, respectively) are taken from the World Resources Institute GHG Protocol for Mobile Sources (http://www.ghgprotocol.org/). We also include a Radiative Forcing Index of 2.7 (IPCC 2007). 1 metric ton = 2205 lbs

Electricity use at the 2008 SCB Global Meeting

For electricity use in Chattanooga Convention Center, it was necessary to use the overall electricity use for the month and divide by the number of days in the month and the percentage of the total space occupied by SCB activities. This process is outlined below:

Energy use at the Chattanooga Convention Center for July 2008:	765,866 kWh
Total square footage of the Chattanooga Convention Center:	Daily energy use at the Chattanooga Convention Center for July 2008
312,000 sq. ft.	24,705 kWh
Area occupied on Day 1 of the meeting:	Calculated energy consumption on Day 1 of the meeting:
189,960 sq. ft.	15,042 kWh
Area occupied on Day 2 of the meeting:	Calculated energy consumption on Day 2 of the meeting:
205,904 sq. ft.	16,304 kWh
Area occupied on Day 3 of the meeting:	Calculated energy consumption on Day 3 of the meeting:
221,770 sq. ft.	17,561 kWh
Area occupied on Day 4 of the meeting:	Calculated energy consumption on Day 4 of the meeting:
220,782 sq. ft.	17,482 kWh
Area occupied on Day 5 of the meeting:	Calculated energy consumption on Day 5 of the meeting:
219,970 sq. ft.	17,418 kWh
Area occupied on Day 6 of the meeting:	Calculated energy consumption on Day 6 of the meeting:
219,158 sq. ft.	17,354 kWh
Total energy use for the SCB Global Meeting:	101, 161 kWh
GHG Emissions (metric tons CO2e): [1]	**74.26**
[1] = GHG emissions are calculated from electricity use by applying an emissions factor of 1.51 lbs CO2e/kWh (from the 2005 EPA eGRID data), and a transmission line loss factor of 7.2%. 1 metric ton = 2205 lbs.	

Hotel Accommodations for the Smith Fellows Program

Hotel stays obviously involve use of several resources: electricity, natural gas, water use, etc. Unless hotel guests are staying at a hotel that has already completed a full greenhouse gas and resource use assessment, it is difficult to translate one night's stay at a hotel into greenhouse gas emissions. Based on several studies of hotels and resorts, per-night emissions factors that can be broadly applied do exist, however rough they may be. For this GHG assessment, hotel accommodations were handled as follows:

Trip:	Hotel stays:
Montana	74
Michigan	42
Washington, DC	90
Total:	206
Emissions factor (Lbs CO2e/ hotel-night) [1]	65
Metric tons CO2e [2]	**6.07**
[1] = See http://www.epa.gov/chp/documents/hotel_casino_analysis.pdf from the EPA	
[2] = 1 metric ton = 2205 lbs.	

2008 Ecological Footprint – Sector Breakdown

For the following sections, please refer to the following color codes:

	Data directly from SCB
	Assumptions
	Data directly from National Footprint Accounts (Global Footprint Network)
	Ecological Footprint in hectares or global hectares

The source for all of the following calculations is the Global Footprint Network, National Footprint Accounts, 2008 Edition. (Available at www.footprintnetwork.org)

Office space

Built-up area for office space

3235	sq feet
0.00001	ha / sq ft
3	building floors
0.0100	ha built up area for office space

1.46	US YF cropland
2.64	EQF cropland

0.0386	global ha for office space

Food and Beverage

565	meals Smith Fellows
266	meals Chattanooga
157	snacks Smith Fellows
3800	snacks Chattanooga
1800	boxed lunches Chattanooga
831	total meals
3957	total snacks
1800	total boxed lunches

Meal compositions assumed below

	meal	snack	boxed lunch
chicken	0.25		
turkey			0.1
bread			0.1
wheat	0.5	0.5	0.3
apple		0.5	0.5
lettuce	0.25		

0.75	kg food / meal
0.05	kg food / snack
0.75	kg food / boxed lunch
0.0004	ha / kg of meal
0.0002	ha / kg of snack
0.0003	ha / kg of boxed lunch

	ha / kg	gha / t
chicken	0.0010	2.64
turkey	0.0010	2.64
bread	0.0003	0.81
wheat	0.0004	0.93
apple	0.0001	0.21
lettuce	0.0000	0.12

EQF crop: 2.64

2.64	EQF cropland
0.2727	ha world avg cropland for all meals
0.0427	ha world avg cropland for all snacks
0.3728	ha world avg cropland for all boxed lunches
0.7199	global ha for all meals
0.1128	global ha for all snacks
0.9842	global ha for all boxed lunches
1.8168	total global ha for food

	Smith Fellows	Chattanooga
meals	565	266
snacks	157	3800
boxed lunches		1800

Global hectares

meals	0.49	0.23
snacks	0.00	0.11
boxed lunches		0.98
total	0.49	1.32

Paper Use

20	reams paper SCB office (30% recycled)
2.265	kg / ream

45.3	kg paper SCB office
22,000	sheets of 25"x30" paper for SCB newsletter
10.16	8.5"x11" sheets in one sheet 25"x30" paper
223,520	equivalent number 8.5"x11" sheets of paper for SCB newsletter
500	sheets in a ream
447	equivalent number reams paper for SCB newsletter
2.265	kg / ream
1,013	kg paper SCB newsletter
7,480	kg paper Conservation Magazine
18,608	kg paper Cons Bio
27,146	total kg paper all sources
0.004	m3 roundwood / kg paper
2.3600	world avg forest yield (m3 roundwood / ha)
46.01	ha world average forest
1.33	EQF forest land
61.19	global ha, of which -->

0.17%	% SCB office	0.10
3.73%	% SCB newsletter	2.28
27.55%	% Cons Magazine	16.86
68.55%	% Cons Bio	41.95

Carbon Sequestration

3,425	tonne fossil CO2 emitted from SCB operations
3.59	world-average forest absorption (tonnes CO2 / ha)
25.20%	% of emitted fossil carbon sunk by surface ocean
714	ha world-average forest for carbon absorption

1.33	EQF forest land
949	global ha for carbon absorption
0.2771	global ha per tonne fossil CO_2 emitted