

ESM 271 Carbon Footprints and Carbon Accounting

Instructor: Sangwon Suh
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Course hours: Mondays and Wednesday, 12:30pm – 1:45pm
Oct 1st – Dec 5th (term report due by Dec 12th)

Course credit: 4 credit

Course location: Bren 1424

Exam: Nov 26th (Monday) during the class hours

Quiz: Oct 29th (Monday)

Presentation: Carbon footprint presentations (Dec 3rd and 5th)

Term report: Carbon footprint report (Dec 12th)

Assessment:

Homework (2 X @10%):	20%
Quiz:	10%
Exam:	20%
Presentation (group work):	20%
Report (group work):	30%

Office hours: Tuesday 2:00-3:00 pm, or by appointment (use Google calendar).

Course schedule

Week 1 (Oct 1, 3): Introduction to carbon accounting

- What is carbon footprinting?
- Why carbon footprinting?
- Scope 1, 2, 3 emissions
- Standards and protocols for organizational, supply-chain and product footprinting
- Introduction to the term project (carbon footprinting in practice)

(a) Form a group of 6 students. Each group select one of the following five topics.

Group#	Scope	Examples
1	Bren Scope 1 & 2	Natural gas combustion, on-site fuel combustion, gas combustion for vehicle operation; Refrigerant leakages, land use and land use change, biological sequestration; Electricity use

2	Bren Scope 3	Flights used by Bren faculty; Employee committing, purchased goods and services, capital goods, non-flight faculty travel such as ground and lodging, meals
3	Local business #1	Company of the group's choice (mandatory: scope 1 & 2; scope 3 desirable but not required)
4	Local business #2	

- (b) Contact relevant people including Sage Davis, Kim Fugate, and Jordan Sager (for Bren), schedule a meeting, and acquire necessary data. List the information you will need in order to complete your task, and verify with the client whether they are able to give you the access to the information and if so by when.
- (c) Assess the quality of the data that you acquired in terms of e.g., (1) relevance, (2) completeness, (3) consistency, (4) transparency, and (5) accuracy.
- (d) By the end of the third week, hand-in a 2-page summary of the term project plan describing the following:
 - a. Meeting date and attendees.
 - b. Data requested and acquired.
 - c. Describe your methodology to calculate the emissions assigned to your group: include how you would like to draw the boundary, how the data acquired will be used?; which scope(s) will be covered?; what are the calculation procedures to be followed?

Week 2 (Oct 8, 10): Reading material: WRI/WBCSD Corporate GHG protocol:

- Corporate standard: <http://www.ghgprotocol.org/corporate-standard>
- Corporate value-chain: <http://www.ghgprotocol.org/standards/scope-3-standard>

Guest lecture: GHG management consultant and Bren alumnus, Summer Broekx-Smith on CDP Program (Oct 8th and 10th)

Oct 8th: CDP Intro

- What is CDP?
- Why do companies respond to CDP?
- How is CDP questionnaire organized?
- How to respond to CDP questionnaires?
- How is CDP score structured?

Oct 10th: CDP in practice

- Calculation process: scope 1
- Third party verification
- What is the Science-Based Target?
- What are the resources for CDP response preparation?

Homework 1 (due by Oct 17th): Scope 1 GHG emissions—emission factor exercise

Calculate the scope 1 GHG emissions for 2017 (calendar year) based on the following information, and submit a report detailing the calculations used (up to 2 pages, double spaced).

- A facility reported the following data. Calculate scope 1 emissions for the base year of 2017.
 - Bituminous coal consumption (ton/year) 560
 - Natural gas (sqf/year); 1030btu HHV/scf 896,010
 - Kerosene (liter/year) 500
 - Gasoline (gallon) 350
- Refrigeration (installed in 2010)
 - R134a
 - Volume: 80L
 - Leakage rate: 2%/year

Week 3 (Oct 15, 17): Scope 1 emission calculation (cont'd; Land use change emissions).

Reading materials: <https://goo.gl/mmTDTU>
<https://goo.gl/Dhdz3P>

Week 4 (Oct 22, 24): Scope 2 and Scope 3 emissions

Reading materials: <https://goo.gl/PYgQLb>
<https://goo.gl/Jsmz7q>

Oct 24: A brief presentation (5-10min) of the carbon footprint project progress

- Describe the client
- How the boundary was set
- Current progress of data collection
- Current progress of methodology and factors to be used
- Results thus far, if any

Week 5 (Oct 29, 31): **Oct 29th Quiz**
Scope 3 emissions

Week 6 (Nov 5, 6): Interpretation of carbon footprint results

- Identification of hotspots
- Envisaging the effect of changes
- Identification of effective strategies to reduce carbon footprint
- Sensitivity analysis
- Uncertainties

Homework 2 (due by Nov 7th): Using the data under “Hands-on exercise.xlsx” and other data provided, estimate the scope 3 emissions. Consider using ABC analysis for prioritization. Submit a report describing the method of calculation, assumptions used, results, and your interpretation of the results including a discussion of the major contributors and uncertainties.

Step-by-step guidance:

1. Run the ABC analysis for the entire spend data. In principle the "A categories" should cumulatively contribute at least 80% of the total spend. However, given the large number of A categories and the limited added educational value of mapping beyond a certain number of categories, it is OK to reduce the threshold to 50% (cumulative spend contribution to the total spend).
2. For the (reduced A) categories that cumulatively contribute 80% (or 50%) of the total spend (there will be 73 categories @ 80% threshold or 11 categories @ 50% threshold), try to match the closest CEDA or Ecoinvent category to each line item and multiply the spend to the per \$ emission factor of the corresponding category to calculate the scope 3 GHG emissions of the line item.
3. For the B and C category, add them up and apply an average emission factor for all CEDA categories or the emission factor of the most frequently appearing category as a proxy.
4. Sum up all the GHG emission calculations to generate total GHG emissions from purchased goods and services.
5. You may want to draw a pie chart to show the largest contributors.
6. You may also want to run some sensitivity analysis for the categories that you are not sure about the mapping.

Beware that the mapping takes quite some time and that it involves subjective judgement.

Week 7 (Nov 14): Validation and verification & Carbon offset and carbon trading

Week 8 (Nov 19, 21): Mitigation of GHG emissions

Reading material: <https://goo.gl/X6Z7mE>
<https://goo.gl/DjDvZs>

Week 9 (Nov 26, 28): Exam on Nov 26th

Guest lecture on GHG emissions accounting in practice (by UCSB employee and Bren alumnus, Jordan Sager on November 28th (TBC))

Week 10 (Dec 3, 5): Final presentation (2 teams on Dec 3th; 2 teams on Dec 5th)

Final report due Dec 12th. Maximum 20 pages including all the references.

Include the following items:

- Introduction (Background and Objectives)
- Method
 - o System boundary
 - o Calculation procedure
 - o Data and data sources
 - o Major assumptions used
- Results
 - o Main results
 - o Interpretation of the results (key contributors, sensitivity/uncertainty analysis)
- Mitigation opportunities
 - o Mitigation potential
 - o Feasibility
 - o Costs
- Limitations and future research