ESM 271 Carbon Footprints and Carbon Accounting

Instructor: Sangwon Suh
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Course hours: Mondays and Wednesday, 12:30pm – 1:45pm
Oct 2nd – Dec 6th (term report due by Dec 11th)

Course credit: 4 credit

Course location: Bren 1510

Midterm exam: Oct 30th (Monday) during the class hours

Final exam: No final exam. Carbon footprint presentation (Nov 27th and 29th) and report (Dec 11th) are used as final evaluation

Assessment:

Homework (3 X @10%):	30%
Midterm:	20%
Presentation (group work):	20%
Report (group work):	30%

Office hours: Tuesday 10:00-10:30am, Wednesday 11-11:30am.

Course schedule

Week 1: Introduction to carbon accounting

- What is carbon footprinting?
- Scope 1, 2, 3 emissions
- Standards and protocols for organizational, supply-chain and product footprinting
- Introduction to the term project (carbon footprinting of the Bren school)
- **CDP Program** (**Guest lecture by a CDP consultant and Bren alumnus, Summer Broekx-Smith on Oct 4th**)

(a) Form a group of 4 students. Each group select one of the following five topics.

Group#	Scope		Examples
1	1	Fuel-related emissions	Natural gas combustion, on-site fuel combustion, gas combustion for vehicle operation
2		Non-fuel emissions / sinks	Refrigerant leakages, land use and land use change, biological sequestration
3	2	Electric utility-related emissions	Electricity use
4	3	Faculty air travel	Flights used by Bren faculty

5		All other scope 3	Employee committing, purchased goods and services, capital goods, non-flight faculty travel such as ground and lodging, meals

(b) Contact relevant people including Sage Davis, Kim Fugate, and Jordan Sager, schedule a meeting, and acquire necessary data for Bren School's carbon footprint. You will need to figure out what information you will need to complete your task. Bren school is your CLIENT.

(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) Submit 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, what allocation method, if any will be applied, what emission factors to be used, etc.

Week 2:

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
- Product standard: http://www.ghgprotocol.org/product-standard

Scope 1&2 emissions

- How to calculate scope 1 emissions
- eGRID
- Additional data for different technologies
- Consequential thinking
- Process flow diagram

Homework 1 (due by Oct 16th): Scope 1 GHG emissions—emission factor exercise

Calculate the scope 1 GHG emissions based on the following information, and submit a report detailing the calculations used (up to 3 pages, double spaced).

- ☐ A facility reported the following data. Calculate scope 1 emissions for the base year of 2014.
  - ☐ 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: 15%/year

Week 3: Scope 1 and 2 emission calculation in practice. Guest lecture by Jordan Sager, UCSB Department: Physical Facilities

Homework 2 (due by Oct 23): A progress report that describes the first draft calculation of GHG emissions (up to 5 pages). Include

- Description of the client
- Background and objective
- Boundary setting
- Data, methodology and factors used
- Results thus far

Week 4: Scope 3 emissions

- Introduction to GHG protocol categories

Week 5: **Midterm exam (Oct 30th)**
Guest lecture on GHG emissions accounting in practice (by UCSB employee and Bren alumnus, Jordan Sager on November 1st)

Week 6: Scope 3 cont'd

Homework 3 (due by Nov 8th): 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.

Week 7: Term project progress discussion (Nov 6th)

- 10-15 min per each group; discussion on the progress of the term project. Describe the methodology, main results thus far obtained, and interpretation of the results, and discuss how the analysis can be improved. As any questions.

Interpretation, validation, and verification of the carbon footprint results

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

Week 8: Miscellaneous topics

- Validation and verification
- Project accounts
- Carbon offset and carbon trading

Week 9: Mitigation of GHG emissions

Final presentation (2 teams on Nov 27th; 3 teams on Nov 29th)

Final report due Dec 11th. Maximum 20 pages including all the references. Include the items in HW2. In addition discuss:

- Interpretation of the results (key contributors in terms of the fuel type, gas type, and/or input type, and the quality of the results using the criteria used in HW1).
- Limitations, future improvement opportunities/future research.
- Discuss the target areas to reduce client's GHG emissions.