Details
Time: Tuesday and Thursday, 10-11:30am (Winter B term only)
Location: Computer Lab, 3rd Floor of the Dana Building
Instructor: Dr. Nolan Orfield
nolan.orfield@gmail.com
cell: (612) 396 – 5827
Office Hours: Fridays, 2-3:30pm
Computer Lab, 3rd Floor of the Dana Building

Description
This course is intended for students who have taken (or are enrolled in) Industrial Ecology and wish to expand their life cycle assessment (LCA) skill set. The course covers advanced LCA methods and key software tools used to conduct LCA studies including SimaPro and GaBi.

Examples of the skills that will be covered include advanced impact assessment methods, consequential vs. attributional LCA, allocation rules, and transportation fuel and vehicle technology modeling using the new GREET.net program. The course will also cover tools for generating and characterizing results such as uncertainty analysis using RiskSim Monte Carlo simulation software and sensitivity/scenario analyses using Excel “What-If Analysis” tools. At the end of the semester a final project will allow students to demonstrate these advanced LCA methods/tools.

Outline

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<tr>
<th>Tool</th>
<th>Methods</th>
<th>March</th>
<th>April</th>
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<tbody>
<tr>
<td>Introduction</td>
<td>Functional Unit, ISO 14040, Co-Products, Syst. Boundaries</td>
<td>11 13 18 20 25 27</td>
<td>1 3 8 10 15 17 22</td>
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<tr>
<td>GREET.net</td>
<td>Inventory Analysis, Allocation &amp; Syst. Expansion</td>
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<td>SimaPro</td>
<td>Impact Assessment, Comparative Assertion</td>
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<tr>
<td>Excel</td>
<td>What-if, Scenario Analyses, Consequential LCA</td>
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<td>RiskSim</td>
<td>Uncertainty Analysis, Rebound Effect, ILUC</td>
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<td>GaBi</td>
<td>Improvement Analysis</td>
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<tr>
<td>Final Project Presentations</td>
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Course Format
Each session will consist of a lecture/discussion section and time working on the computer workstations. GREET.net, SimaPro, and GaBi have been installed on the workstations and therefore will not need to be installed on the individual students’ computers. The RiskSim Excel Add-In will need to be installed and used outside of the computer laboratory. The Add-In includes a 30 day free trial, however, so purchasing the tool is not necessary.

The objective of the course is to expose the students to the most common LCA tools used in the industry and provide an opportunity to learn the basic functions and capabilities of each of those tools. Time does not allow students to become experts in the tools but rather gain some basic competency and a foundation upon which to learn more when the need arises.

Grade Calculation

Homework: 40% (10% for each assignment)
Final Project: 40% (20% for report, 20% for presentation)
Participation: 20%

Course Policies

Homework Submission: Homework should be physically (on paper) submitted at the start of the lecture on the assignment’s due date. Extensions will only be granted if requests are made in advance.

Attendance: Attendance represents a portion of the participation grade and is highly encouraged.

Final Project
Completing a final project is a requirement of this class. Projects will be completed individually and will be presented to the class during the final two lectures. The presentation will last 10 minutes and should present results from a small study as well as key takeaways for students in the course. A 3-4 page report (including figures) will also be submitted on the day of the presentation. This report should be brief and include the following sections:

- Background (0.5-1 pages)
- Data sources and methods (~1 page)
- Results & Discussion (~2 pages)
- References

The final project should feature some original analysis, but the emphasis is on applying new tools, not performing complex modeling or research. The only requirement for the project is that it utilizes one of the tools covered in the course and one of the methods.
<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture Content</th>
<th>Lab Work</th>
<th>HW Due</th>
<th>Readings</th>
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</thead>
</table>
| 3/11  | Introduction  
• Background  
• Course objectives/schedule  
• Intro to reference product: algal biofuel  
• Functional unit  
• ISO 14000 Series  
  o Compliancy checklist | none                                                                                                           |        | 1        |
| 3/13  | LCA and Co-product Treatment  
• Discuss Readings:  
  o Ekvall and Finnveden (2001)  
  o Cederberg and Stadig (2003)  
• Co-product Treatment  
  o Allocation methods  
  o System Expansion  
• In-class exercise  
• Final project description  
• Intro to transportation modeling  
  o Well to pump  
  o Pump to wheel  
  o Biofuel Modeling  
• Open/Install GREET.net | Use Nike Sustainable Apparel Coalition Tool (as time allows):  
http://msi.apparelcoalition.org/#!/materials |        | 2a 2b 2c 2d |
| 3/18  | GREET.net  
• Evolution, history of GREET  
• Software overview, tour  
• Fuel cycles, vehicle cycles  
• Tutorial of GREET.net | Use GREET.net to create a full Well to Wheel pathway by drag and dropping modules from existing database.  
Customize default values and trace effect on results. | HW1    | 3a 3b    |
<p>| 3/20  | GREET.net | Use tutorial to work on HW#2. | | 4a       |</p>
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<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Activity</th>
<th>Assignment</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>3/27</td>
<td>SimaPro</td>
<td>2nd tutorial of SimaPro, PAWs: processes, assemblies, waste scenarios, guided tour</td>
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<tr>
<td>4/1</td>
<td>SimaPro</td>
<td>Single-score results, visualizing/interpreting results, improvement analysis, guided tour cont'd</td>
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<td>4/3</td>
<td>Consequential vs Attributional LCA</td>
<td>Excel: rebound effect CFL bulb example, sensitivity analysis, data tables for LCA: 1 variable, 2 variable</td>
<td>HW3</td>
<td>8a</td>
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<td>4/8</td>
<td>RiskSim</td>
<td>Uncertainty analysis using Monte Carlo</td>
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<td>9</td>
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<tr>
<td>Date</td>
<td>Activity</td>
<td>Notes</td>
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<tr>
<td>4/10</td>
<td>Simulation</td>
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<td></td>
<td>• Probability distribution options</td>
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<td></td>
<td>• Parameter selection (low/most likely/high vs avg/st. dev)</td>
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<td>GaBi</td>
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<td></td>
<td>• Software overview, tour</td>
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<td></td>
<td>• Compare/contrast to SimaPro</td>
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<td></td>
<td>• 1&lt;sup&gt;st&lt;/sup&gt; tutorial of GaBi: Paperclip Example</td>
<td>Begin simple in-class assignment (not graded)</td>
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<tr>
<td>4/15</td>
<td>GaBi</td>
<td>Compete simple in-class assignment (not graded)</td>
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<td></td>
<td>• 2&lt;sup&gt;nd&lt;/sup&gt; tutorial of GaBi</td>
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<tr>
<td>4/17</td>
<td>Final Project Presentations</td>
<td>Final Project</td>
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<tr>
<td>4/22</td>
<td>Final Project Presentations</td>
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Readings (subject to change)

2a – Wired magazine article: http://www.wired.com/design/2013/07/what-are-the-most-sustainable-materials-nikes-new-app-shows-you/

2b – International Standards Organization protocol documents:
   - ISO 14040:2006
   - ISO 14044:2006


3a – Overview video by Argonne (17min):
   https://www.youtube.com/watch?feature=player_embedded&v=w39AKnEN2pk


8a - Technical paper by Ecometrika Press: Consequential and Attributional Approaches to LCA: a Guide to Policy Makers with Specific Reference to Greenhouse Gas LCA of Biofuels, April 2008 -


Optional:


http://www.yale.edu/gillingham/ReboundEffectLongForm.pdf

