The University Of Toledo

NEW COURSE PROPOSAL

* denotes required fields

1. College*: Engineering

Department*: Civil Engineering

2. Contact Person*: Define Apul

Phone: 530-8132

Email: define.apul@utoledo.edu

3. Alpha/Numeric Code (Subject area - number)*: CIVE 6670


Proposed effective term: Fall 2012

5. Planned enrollment per section: 10 per term: 10

6. Is the course cross-listed with another academic unit? C Yes C No

Is the course offered at more than one level? C Yes C No

If yes to either question, please list additional Alpha/Numeric codes, and submit a separate New Course form or Course Modification form for the course(s) referenced below.

a. CIVE 6670

b. c. Approval of other academic unit (signature)

Name and title

If course is to be offered at more than one level, attach an explanation of the different requirements that students must meet for each level. If the requirements are the same for each level, justification must be provided.

7. Credit hours*: Fixed: Variable:

8. Delivery Mode:

a. Activity Type†

   - Lecture

   - Secondary

   - Tertiary

b. Minimum Credit Hours

   - 3

   - 3

c. Weekly Contact Hours

   - 3

9. Terms offered: C Fall C Spring C Summer

Years offered: C Every Year C Alternate Years

10. Are students permitted to register for more than one section during a term? C No C Yes

May the courses be repeated for credit? C No C Yes

Maximum Hours

11. Grading System*:

   Undergraduate

   C Normal Grading (A-F,PS/NC.PR, I)

   C Passing Grade/No Credit (A-C, NC)

   C Credit/No Credit

   C Grade Only (A-F, PR, I)

   Graduate

   C Normal Grading (A-F,PS/NC.PR, I)

   C Grade Only (A-F)

   C Satisfactory/Unsatisfactory (G only)

   C Audit only

http://curriculumtracking.utoledo.edu/NewCourse.asp

10/24/2011
Audit only

No Grade

Prerequisites (must be taken before):

PIN (Permission From Instructor)
PDP (Permission From Department)

Co-requisites (must be taken together):

Course to be removed from inventory
Final Term to be offered (YYYYT, i.e. use 20064 for Fall'06)

Catalog description* (30 words Maximum)

This course discusses the life cycle concept for engineered systems. Course content includes the greenhouse gas protocol, life cycle assessment methodology, life cycle impact assessment, and matrix calculations for life cycle analysis.

Attach an electronic copy of a complete outline of the major topics covered.

Syllabus:

Additional Attachment 1:

Additional Attachment 2:

Where does this course fit in the University/College/Department curriculum? (Be specific by course level, if applicable). Indicate prospective demand.

This course will be offered for any PhD student.

If the proposed course is similar to another course in the College or University, please describe the difference and provide a rationale for the duplication. (If this course duplicates material covered in another course within your department or college or in another college, attach a letter of endorsement from that area's dean and department chairperson indicating their support. Clarify the manner in which this course will differ).

Course Approval:

Department Curriculum Authority:

Department Chairperson:
After college approval, submit the original signed form to the Faculty Senate (UH 3520) for undergraduate-level courses; for graduate-level courses submit the original signed form to the Graduate School (UH3240). For undergraduate/graduate dual-level courses, submit the proposals to each office.

Faculty Senate Undergrad. Curriculum Comm.:  
Date: Month / Day / Year

Faculty Senate Core Curriculum Comm.:  
Date: Month / Day / Year

Graduate Council:  
Date: Month / Day / Year

Office of the Provost:  
Date: Month / Day / Year

Registrar's Office:  
Date: Month / Day / Year

Submit New Course Proposal

You will see a confirmation page after you press the "Submit" button. If you do not see the confirmation page, please call x 4320 or send an email to ProvostWebMaster.utoledo.edu. Thanks.

Oct 24 2011
Explaination of Extra Work that Students Taking CIVE 8670 will do compared to students signed up for CIVE 6670

PhD students taking the CIVE 8670 level course will be required to complete all work that MS students would be doing in the CIVE 6670 course. In addition, PhD students will be asked to complete an additional assignment that they would then present to class in a half hour lecture or activity. The nature and details of the assignment will be mutually agreed upon between the instructor and the student.
Detailed Syllabus for CIVE 6670/8670 Life Cycle Engineering

Facilitator, Dr. Deine Apud, The University of Toledo, Department of Civil Engineering

Table of Contents of This Syllabus
1. Typical components of a syllabus and Fink's taxonomy of significant learning (pages 2 and 3)
2. Tentative schedule. Use this to schedule your time (page 4)
3. First meeting's activities (page 5)
4. Assessments (pages 6-14). These are deliverables that you will be graded on. You need to submit the assessments by the due date to be evaluated out of full points. Assessments are deliverables. You NEED to do this work.
5. Preps (page 15). This is work you should do but you will receive no grade for your work. However, if you don't do the work, you may not follow the conversation or may not be able to answer in-class questions. Doing the prep will be very helpful for your learning and for your ultimate project report. If you cannot do all the prep, you can use these references in the future as you further advance your life cycle engineering skills beyond this course.

This course has no exam. Grading scheme is based on assessments summarized on page 4. While this course has no exam, it will require much time and you will need to submit many assessments and do many preps to be able to succeed in class. Plan accordingly. About 9 hrs per week commitment is required to be successful in this class. Note that this course involves a real-life semester-long project (page 9).

The University of Toledo
Department of Civil Engineering
CIVE 6670/8670 Life Cycle Engineering
3 Credits, Offered in Fall Semesters

Professor: Dr. Deine Apud, NDI 3030, Deine.Apuud@utoledo.edu, (419) 530-8122

Meeting times: First meeting will be on August 22, 2011, M, 5:30-8:00pm, Palmer Hall 2036. After this first meeting, the regular class meeting time will be changed to another time based on availability of students.

Textbook: There is no single textbook for this course. I will share handouts and resources with you for each topic we discuss.

Course format: This course is developed based on Fink's taxonomy of significant learning (Fink, 2003). As discussed in Fink's book I believe that good courses are courses that...
- challenge students to significant kinds of learning
- use active forms of learning
- have teachers who care — about the subject, their students, and about teaching and learning
- have teachers who interact well with students
- have a good system of feedback, assessment, and grading.

Fink's ideas on six critical aspects of learning are summarized in the table below. To achieve these learning aspects, students in the class will be reading and discussing literature, working on some quantitative assignments, and a semester-long project. The project for this semester is the development of life cycle-based design guidelines for minimizer harvesting systems.

<table>
<thead>
<tr>
<th>A Taxonomy of Higher Level Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Significance</strong></td>
</tr>
<tr>
<td>--------------------------</td>
</tr>
<tr>
<td>Learning how to learn</td>
</tr>
<tr>
<td>Motivation</td>
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<tr>
<td>Human Dimension</td>
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<tr>
<td>Integration</td>
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<tr>
<td>Application</td>
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<tr>
<td>Foundation</td>
</tr>
</tbody>
</table>


Late assignments: 10% will be deducted for every day the assignment is late. Assignments should be submitted before class starts.

Academic Dishonesty: You are encouraged to work together on homework so you can discuss the problems and learn more than you would if you worked on your own. While working with others, don't forget about academic dishonesty. The idea is to learn together not copy from someone or let someone else do the thinking for you. You should read UT's policy on academic dishonesty available at: http://www.utoledo.edu/ald/students/disfrntct.html
Planned Schedule (Tentative; might change depending on student interest and class progress)

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
<th>Assessment and Prep</th>
<th>Due That Day</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1, August 23</td>
<td>Intro to sustainability</td>
<td>Assessment 1: Modules 1 and 2 in LCA</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Week 2, August 29</td>
<td>Intro to sustainability</td>
<td>Prep 1: Read Chapter 2 of Computational Structure of LCA</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Week 3, September 19</td>
<td>Introduction to LCA and sustainable design</td>
<td>Assessment 2: LCA examination</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Week 4, September 26</td>
<td>Greenhouse gas inventory models</td>
<td>Assessment 2: LCA</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Week 5, September 26</td>
<td>Application of LCA to estimation problems</td>
<td>Assessment 2: LCA</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Week 6, September 26</td>
<td>Emission calculations for environmental services</td>
<td>Assessment 2: LCA</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Week 7, October 3</td>
<td>Refined inventory problem, Assessment 2 by student 2</td>
<td>Assessment 2: LCA</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Week 8, October 10</td>
<td>Process based LCA software</td>
<td>Assessment 2: LCA</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Week 9, October 17</td>
<td>Urban sustainability, municipal codes</td>
<td>Assessment 2: LCA</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Week 10, October 24</td>
<td>Student selected topics</td>
<td>Assessment 2: LCA</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Week 11, October 31</td>
<td>Student selected topics</td>
<td>Assessment 2: LCA</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Week 12, November 7</td>
<td>Project presentation</td>
<td>Assessment 2: LCA</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Week 13, November 14</td>
<td>Final presentation</td>
<td>Assessment 2: LCA</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Week 14, November 21</td>
<td>Final presentation</td>
<td>Assessment 2: LCA</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Week 15, December 5</td>
<td>Final presentation</td>
<td>Assessment 2: LCA</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Week 16, December 12</td>
<td>Final presentation</td>
<td>Assessment 2: LCA</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Week 17, December 19</td>
<td>Final presentation</td>
<td>Assessment 2: LCA</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Week 18, December 26</td>
<td>Final presentation</td>
<td>Assessment 2: LCA</td>
<td></td>
<td>20</td>
</tr>
</tbody>
</table>

Total available points: 200
First Meeting's Activities

1. Change class time.
2. Go over syllabus and intro to life cycle engineering ppt by Dr. Apul.
3. Student introductions and expectations from this class. Write on a piece of paper:
   a. your name and something about yourself
   b. why you are in this class
   c. what you expect to get out of this class
   d. where you want to be headed with your career
   e. what methods work best for YOU when you are learning something (e.g. reading, listening, doing, projects, work by yourself, watching something, internet etc.)
   f. some productivity tip you practice
4. Dr. Apul hands out following documents:
   a. Mitloehner et al., 2005 Sustainability science and engineering: the emergence of a new metadiscipline, Environmental Science and Technology, 37(23), 5314-5324
   b. World Commission on Environment and Development, 1987 Our Common Future, Brundtland report

Homework for next class
For the following questions, read the relevant material, then type and bring your answers to class:
From Mitloehner et al. and the Brundtland report:
   a. What is the most commonly cited definition of sustainability? Where in Brundtland report is this definition written?
   b. How does Mitloehner et al 2005 define sustainable engineering?
   c. What is a peer reviewed article and how is it different than a report or other articles?
   d. What do you think might be the significance of Mitloehner et al., 2003?
   e. What do you think might be the significance of the Brundtland report?
   f. Mitloehner et al mentions a tool called EIOLCA. Browse through www.eiolca.net. Write two questions that come to your mind related to EIOLCA.

From news articles on Bill Gates and his goal of reinventing the toilet:
http://msnbc.msn.com/id/40399615/Story.aspx?
i. Why does Bill Gates want to reinvent the toilet?
j. How, if at all, is reinventing harvesting related to the news articles you read?

Assessments

Assessment 1 (Individual)
Respond to questions related to Mitloehner et al., Brundtland Report, and Bill Gates article (see page 4 for what you need to submit for Assessment 1).

Assessment 2 (Individual)
You will need 10 resources for this assignment:
Resource 1: CVEE 4900 Spring 2011 students’ report on Climate Action Plan for UT
Resource 2: CVEE 4900 Spring 2011 students’ presentation on Climate Action Plan for UT
Resource 3: CVEE 6900/6901 Fall 2011 students’ report on GHG inventory of City of Toledo
Resource 4: CVEE 6900/6901 Fall 2011 students’ report on GHG inventory of Lucas County
Resource 5: CVEE 6900/6901 Fall 2011 students’ presentation on Toledo and Lucas County GHG emissions
You can access resources 1-5 by going to the following page:
http://www.rca.state.oh.us/CEPWeb/Academic/MTS/Sustainability/Curriculum.html

Resource 6: Local government operations protocol for greenhouse gas inventory. You can access resource 6 at:

Resource 7: CH4 Protocol website and its standards section
http://www.ch4protocol.org

Resource 8: President’s Climate Commitment
http://www.presidentclimatchallenge.org/

Resource 9: University GHG Reporting System
http://ui.greenhousegas.gov

Resource 10: http://www.climatecooalplanet.org/coalition/

Prepare a typed document that answers the following questions:
1. What are scope 1 emissions? (copy/paste is ok)
2. What are scope 2 emissions? (copy/paste is ok)
3. What are scope 3 emissions? (copy/paste is ok)
4. What is a carbon footprint? What does it involve?
5. Each report has slightly different headings. Make a preliminary outline for the report YOU will be submitting at the end of this semester and submit this outline.
6. Write two questions about YOUR project for this semester.
7. What are some strengths and weaknesses of the students' reports?
8. What are some strengths and weaknesses of the students' presentations?
9. Using resource 6, answer the following question:
   a. Look at Table D1 on page 185 of Resource 5. What do you get out of this table? Spend a little more time on sections of the table on solid waste and wastewater calculations so we might use these later on in class.
   b. Look at Table E1 on page 198 of Resource 5. What do these numbers mean?
   c. Look at Table E8 on page 311 of Resource 5. What do these numbers mean?
10. Write down at least 3 questions that came to your mind as you browsed through all the resources. Write down what is unclear to you.
11. Our library is a member of the OhioLink system. OhioLink has subscription to several databases that track peer reviewed publications. The database that I like is ISI Web of Knowledge. You can access this database by going to:
   http://www.isiknowledge.com/advancedsearch?vey=en&ln=en&Click on Engineering When list of databases come up, click on ISI Web of Knowledge. Use this database to locate the Mitloehner et al. (2003) article.
   a. How many times has this article been cited?
   b. Copy paste the list of references that cited this article. Browse through the references that cited Mitloehner et al. (2003). In what kind of journals, reports etc. were these other references published?
   c. Use Google scholar to determine how many times Mitloehner et al. has been cited and by whom. Do your results from ISI Web of Science and Google Scholar match?
12. Browse through resource 7. Describe in a few sentences what information is available from resource 7. For what purposes might this resource be useful to you in your career?
13. Browse through resource 8. What is this webpage about? (copy/paste is OK)
14. Browse through resource 9. What is this webpage about? (copy/paste is OK)
15. Browse through resource 10. What is this webpage about? (copy/paste is OK)

Assessment 3 (Individual)
Personal Carbon Footprint Assignment

Calculate your carbon footprint and provide the answers to following question.

a. Provide the results to your carbon footprint that shows the breakdown of emissions from different activities.
b. Why did you pick this calculator? What are its benefits compared to other calculators?
c. What are some of the major limitations and uncertainties associated with the carbon footprint that you just calculated for yourself? Discuss limitations and uncertainties separately. Consider what should ideally be included in your emissions.
d. Calculate the yearly cost of purchasing carbon offsets from three services that are available on the internet.
e. Develop a plan to reduce your carbon footprint and show the plan including how much reductions it will help you achieve. Some calculators do this for you. You can present their results.
f. On average, what is the carbon footprint of a US resident?
g. On average, what is the carbon footprint of a world resident?

Here are some resources for your use:
1. Carbon Footprint Calculations on the Internet
   American Forest: http://www.energypalms.com/learn-more/carbon-calculator/
   Austin’s calculator: http://www.ci.austin.tx.us/energy2/footprint.html
   Chuck Wright: http://www.chuck-wright.com/calculator/carbon.html
   The Conservation Fund: http://www.conservationfund.org/greeno
   USEPA: http://www.epa.gov/climatechange/missions/foot_calculator.html
   Nature Conservancy: http://www.nature.org/energy/interact/carboncalculator/index.htm
   TerraPass: http://www.terrapass.com

2. Peer Reviewed Paper on Comparison of Carbon Calculators
   Available for download from:
Assessment 4 (Group)

First Progress Report for Your Project

Project Description:
This semester you will work on developing design guidelines for rainwater harvesting systems. Rainwater harvesting is not a new technology but it is not widely used. Depending on the building type, location, and other site-specific parameters, it may or may not make sense to use rainwater harvesting. You will use life cycle cost, energy, GHG emissions, available natural resources (e.g., water) and ecological design principles as your criteria to develop design guidelines for rainwater harvesting. You will relate your findings to the LEED building rating system. You can develop the guidelines for the US or for Toledo. We'll discuss this decision in class.

Some local experts are interested in your work:
1. City of Toledo, City Council Member Steve Sted
   http://www.ci.toledo.oh.us/ToledoCityCouncil/CityCouncilMembers/tabid/209/Default.aspx
   We will meet with Steve Sted at UEI, http://www.uei.org/
   Steve is especially interested in changing/improving the city municipal code

2. Toledo-Lucas Sustainability Commission Chair, Jeff Czarkiewicz
   http://www.lci.go.com/

3. American Rivers Healthy Waters Campaign, Katie Rosseau (Swartz)
   http://www.rivward.org/committee.html

Some national organizations are interested in your work:
1. ARCSA: American Rainwater Catchment Systems, Bob Boulware
   http://www.acros.org/
   You should read Mr. Boulware's rainwater design guidelines document. Email me for a copy if I forgot to post it on BB.

2. USGBC LEED rating system
   Research to Practice Program: http://www.centerforsustainablebuildings.org/Ve3.aspx
   and

Analysis tool for your project:
BEAST model: http://fmscolab.wickr.com/Water/Sustainability
Other life cycle costing and analysis methods/tools.

What to submit for the first deliverable:
1. Cover page
2. Tentative table of contents (i.e. your outline) for your anticipated final report
3. The introduction/problem statement section of your report. One to three paragraphs.
4. The objectives section of your proposal. This section should start with: “the goal of this study was to...”
5. Your outline should include a section on Toledo municipal code. Write a preliminary version of this section on whether the code regarding rainwater harvesting should change and if yes in what way. You can access the Toledo municipal code by going here:
   http://www.ci.toledo.oh.us/ToledoCityCouncil/CityCouncilMembers/tabid/209/Default.aspx
6. In addition, try out team member roles and deadlines. Include this as an attachment.
7. Send a confidential email to Dr. Apol on your peer grades using the peer grading excel spreadsheet. This email is sent to Dr. Apol only. not to your team members.

Assessment 5 (Individual)

EIOLCA assignment

A household is considering purchasing a washing machine and has narrowed their choice to two alternatives. In addition to cost and other functional terms, they wish to assess the energy consumption and greenhouse gas emissions over the lifetimes of the two alternatives:

- Machine 1 is a standard top-loading unit with a purchase cost of $500. This machine uses 40 gallons of water and 2 kilowatt-hours of electricity per load (assuming an electric water heater). The household would use roughly 8 loads of laundry per week with this machine.
- Machine 2 is a front-loading unit: it costs $1,000, but it can wash double the amount of clothes per load, and each load uses half the water and electricity.

Which machine should this household buy?

a) Estimate the total annual costs of water and electricity for each of the two machines. Use these values along with the manufacturing costs to develop a purely cost-based comparison of the two machines over a 10-year period. Assume that electricity costs 8 cents/kWh and water is $2 per 1,000 gallons.
b) Use the same cost values as inputs into EIO-LCA to estimate the relative energy consumption and greenhouse gas emission over their life cycles. Ignore the disposal phase. Be sure to express the comparisons of the two machines in terms of one versus manufacturing effects.
c) Briefly discuss your results.

Student solution worksheet:
a. Calculate the total annual costs of water and electricity

<table>
<thead>
<tr>
<th></th>
<th>Machine 1</th>
<th>Machine 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost ($)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water consumption per load (gal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity consumption per load (kWh)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loads per week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity cost ($/kWh)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water cost ($/gal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total annual cost of water:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machine 1:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machine 2:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. Assume lifetime of washing machines is 10 years and ignore the disposal phase.

Manufacturing:
- Go to EIO-LCA.net. Choose "lighting, electronic components, batteries and other industry". Select "household laundry equipment manufacturing" sector. Put in $500 and $1,000 as producer prices.

Water use:
- Industry: mining and utilities
- Sector: water, sewage and other systems
- Dollar amount:

Electricity use:
- Industry: mining and utilities
- Sector: Power generation and supply
- Dollar amount:
### Assessment 6 (Individual)

**BEAST assignment (More details might or might not follow)**

Use BEAST to analyze the economic and environmental implications of using alternative sanitation technologies in different types of buildings. Vary building type (home, dormitory, educational building, and office).

- Home (5 flushes/person/day)
- Dormitory (5 flushes/person/day)
- Educational building (5 flushes/person/day)
- Office (4 flushes/person/day)

Turn in a mini-report that includes a cover page, objectives, methods, results and discussion, and conclusions sections. For purposes of this mini-study, we will skip the introduction, and abstract sections. In methods section describe the parameters you changed and their values. In results present graphs of cost, energy, and CO2 payback periods. Discuss all figures/tables presented. Think through which figures to present don't copy paste all BEAST output to the report.

This is a mini report, so keep it to the point but include all necessary information.

**Input Parameters:**
- Precipitation Data – Toledo, Ohio
- Building Length – 200 ft
- Building Width – 150 ft
- Building Height – 24 ft
- # of Stories – 2
- # of toilets per floor – 10
- Irrigation area – 2000 sf
- Building Type – Office (4 flushes/person/day)
- Occupancy – 150 psf/day
- Toilet type – Standard (1.6 gpf)
- Pressure Provided by City – 30 psi
- Discount Rate – 3%
- Loan required – Yes to all (as assumed loan data)

<table>
<thead>
<tr>
<th>Energy (kJ) consumption from</th>
<th>Manufacturing</th>
<th>Water Use</th>
<th>Electricity Use</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machine 2</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GWP (or CO2 equity) from</th>
<th>Manufacturing</th>
<th>Water Use</th>
<th>Electricity Use</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine 1</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Machine 2</td>
<td></td>
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</tbody>
</table>
Assessment 7 (Individual)
Green product or peer reviewed paper presentation
You have two options for this assignment. You will either analyze a green product or you will review a journal article. Both are described below. You need to pick only one of the two. For either one of the assignments, you should share relevant materials with the class at least a day ahead of time to give class members time to think and learn about your topic before coming into class.

Option 1: Green product assignment (out of 50 points)
Assignment grading is based on your in-class performance. You should share materials (e.g. links, ppt, etc.) with the class ahead of time to give students some headway.
1. Select a 'green' product or technology and present it in class in 20 minutes. In analyzing whether the product is 'green' or not, it usually makes sense to compare the product to its alternative. If someone has already analyzed the product/technology you have in mind using LCA, you are welcome to present their findings.
2. Things you should discuss:
   a. (10 points)
      - Introduce the product/technology and the functions/services it provides
      - Explain why you picked this product
      - Provide literature on the product (e.g. show its website, handout its spec, show articles related to it)
   b. (20 points)
      - Discuss what is green and what is not green about it
   c. (10 points)
      - Make a preliminary conclusion on whether you think the product is really green or not.
   d. (10 points)
      - Answer questions from the audience

For part a, do your homework and know your product well. Use google, google scholar, google news and other information finding techniques to fill your knowledge gaps.

For part b, present multiple perspectives:
- do a preliminary life cycle assessment to estimate energy use and emissions from throughout product lifecycle
- compare 'sustainable product' to 'conventional alternative'
- consider economic, environmental, and social implications of the product
- consider waste associated with different life cycle phases
- consider whether it promotes sustainable lifecycles
- consider if it requires too much expertise or high tech materials
- consider if it requires a lot of water, land, materials, energy, and other resources throughout its lifecycle
- consider other points...

Option 2: Peer reviewed paper presentation
Choose from the following list or choose an article of your interest that Dr. Apel has approved for you to present:
1. Hazemeh and Zein (2011) Are the aims of increasing the share of green electricity generation and reducing GHG emissions always compatible? Renewable Energy, 30(1)-30(6).
4. Any of the good papers on wastewater or water treatment LCA

Suggestions for how to critically review the paper:
1. Read the title and the abstract
2. Look at the figures and tables
3. Look on who the authors are, where was the research done? In which journal was it published?
4. Read the conclusions
Here are some examples of questions you might want to discuss. Pick a few or generate your own.

Examples of General Questions
i. What is the scientific value of the paper?
ii. What is the overall message of the paper?
iii. What are the specific questions asked in this paper? Did the paper answer the questions thoroughly? What parts of the questions remain unanswered?
iv. Do you think the work was well done? Do you think the work was worth publishing?
v. What is new about this work? Do you think the work is important? If yes, why?
vi. Who would care about this info? What are the implications of this work?
vii. What is the most important finding of the paper? (Broadly, every paper should have one clear idea, instead of several diffuse messages with no clear outcome.)
viii. Is the work original and valid?
Originality means new experimental data, new interpretations of existing data, or new theoretical analysis of environmental data.
ix. Did the authors discuss their data and support the evidence based on prior publications?
x. How would you rate the originality, technical quality, clarity of presentation, and importance to field? (excellent, good, fair, poor)
xi. What other info would you have liked the authors to present in this paper?
xii. Is there sufficient information to possibly reproduce the results presented in the paper?
xiii. What are the strengths and weaknesses of the paper?

Technical Writing:
xiv. Is the writing clear, concise, and relevant? Is the message clear?
xv. Are various sections of the paper well written?
xvi. Do you think the figures and tables were worth including?

Methods
xvii. If it is a modeling paper, what are the input parameters, relevant equations, what do they mean?
xviii. What analytical instruments did they use to measure environmental data?
xix. Is there sufficient QA/QC?
xx. What materials did they work with?
xxi. What exactly did they measure?

Results and Discussion
xxii. Do you believe in their data?
xxiii. Did the authors present raw data or processed data with meaningful interpretation?
xxiv. Did the authors appropriately cite prior work?
xxv. What does figure/study mean?
xxvi. Any other questions specific to the paper you picked

Examples of Paper Specific Questions
Here are some items you should pay attention to when reviewing a paper:
What are the components of the paper? Introduction, Experimental etc?
What type of information is given in the introduction, methods, results/discussion sections?
What kind of sentence structure were used? What tense, passive or active voice?
How did the authors cite other published papers?
Do you think the paper flows well?
Are the paragraphs well structured?

Examples of Paper Specific Questions
What computer model did they use?
Are data sources well documented and appropriate?
Preps

Prep 1:
Browse through these resources:
2. www снижен.net
5. http://www.epa.gov/energy/mats
7. http://www.epa.gov/energy/mats
9. Do a search on web of knowledge using the keywords "life cycle assessment". What do you see?

Prep 2:
1. Read this article:
2. Browse through the BEAST model web page including the BEAST model and its description:
   http://www.epa.gov/energy/mats

Prep 3:
1. Browse through pages 90-113 of the Local Government Operations protocol available from:
2. Browse through this website:
   http://www.epa.gov/energy/mats

Prep 4:
1. Read chapter 2 of Computational Structure of LCA. Email Dr. Apul if you don’t have access to this chapter.
2. Browse through this website:
   http://www.epa.gov/energy/mats

Prep 5:
1. Read chapters 3 and 5 of Computational Structure of LCA. Email Dr. Apul if you don’t have access to these chapters.

Prep 6:
Browse through the following websites:
1. Urban Environmental Institute of Toledo: http://www.urbaned.org/
3. Nitrogen footprint. Think about why this is relevant: http://n-no.sspotprint.html
4. CHAPS model: http://www.epa.gov/energy/mats
5. Browse through the following article:

Prep 7: To be determined based on topic