

2012 project for 2.83 and 2.813 (May 7, 2012 T. Gutowski)

### Project theme “efficiency and scale”

In this project, we will analyze a product, service, or an activity in terms of its energy and carbon footprint. And then we will look at how the product will have to improve in order to simultaneously meet potential increases in demand as well as requirements to reduce energy and carbon emissions. As a general example, consider figure 1 below.

*IPCC 2050 Target\**

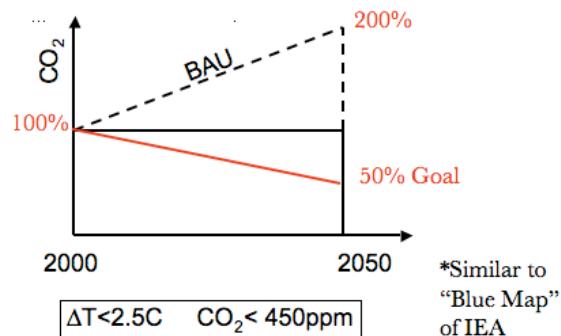


Fig. 1 Shows an expected global trajectory of atmospheric carbon dioxide for a business as usual scenario (BAU) from the year 2000 to 2050. Shown in red is a suggested scenario (50% Goal) to limit atmospheric concentrations of carbon dioxide to 450 ppm or less with a corresponding temperature rise of less than 2.5°C.

To meet this target, all sectors of society would have to pitch in. Presumably, those sectors of society that could not meet this target, would have to be compensated for by other sectors that could provide even steeper cuts in their carbon emissions. We will use figure 1 as a general paradigm for assessing various products and sectors of society. The general notion suggested by figure 1, is that if we allow for a doubling in demand for a given product or activity, and we require an absolute reduction in carbon emissions of 50%, then the carbon intensity for this activity must be reduced by a factor of 4. In our exploration of individual activities we will find some where demand may be modest and so one may meet their target with an improvement less than a factor of 4. However, in other areas we will find that demand may grow much more steeply than suggested by figure 1, and hence the required improvement will be much greater than a factor of 4.

Each project has 3 parts. The 1<sup>st</sup> involves identifying a product, service, or other activity in society and performing a preliminary lifecycle assessment. This part will use tools learned in this class. For example, the eco-audit method, or the input output method. The 2<sup>nd</sup> part of the project involves obtaining information about recent growth in this product,

service or activity. This information can be obtained from various sources, almost always available for free online. The 3<sup>rd</sup> part of this project, is to estimate the approximate improvement in carbon intensity needed to meet the IPCC target. This part of the project, is speculative and technical in nature. Examples of how this paradigm might work have already been discussed in class for airplane services and automobiles. Not all project topics will fit this paradigm smoothly, but we will use this general framework to guide project definition.

**Additional Points:**

- 1) For many of the topics you will choose, you will probably find that a lifecycle assessment has already been performed and will be available online or in the technical literature. It is part of your responsibility to find these examples and compare them to your results. Every project should start with the literature review.
- 2) Of course when we talk about future growth in demand for a product or a service we are speculating. One scenario that is always worth considering is that we maintain the developed world at their current level of consumption, while allowing the developing world to reach the developed world's level of consumption. This will almost always lead to at least a doubling in demand.
- 3) Proposals to improve upon the carbon intensity for an activity can involve at least 3 kinds of solutions; 1) operational efficiency, 2) device efficiency, and 3) fuel switching. In this exercise, you should first attempt to solve the problem using only the 1<sup>st</sup> and 2<sup>nd</sup> kind of efficiency. If you propose fuel switching then you will need to discuss, at least in a general way, the ramifications of this proposal. For example in class, we briefly discussed land use requirements for biofuels. In addition, our speculation about various efficiency fixes for our problem may put aside the issue of financial feasibility or not, depending upon the project proposal.

Given that there are several parts to each project, these projects should be well suited for a team approach. You are encouraged to team up with others in the class to cover all aspects of the proposed project paradigm. We will take some time during class to help facilitate the formation of teams.

<b><u>Project key dates</u></b>	<b><u>Deliverables</u></b>
March 7	One page proposal
April 9	2-3 minute summary of where you are in your project (class discussion)
April 30/May 2	5-10 minute presentation (5-15 slides)
May 16	Final Report due

## **More Details on the Deliverables**

### **1. One page proposal**

A one page proposal will be required of each student. If you are on a team, please list the other team members. The intention of this proposal is to highlight the work you will do as part of the team. Be sure to differentiate your work from the work of the others. Identify the product or activity that you will analyze and in a few words describe what you think the major problem is. List important references, at least five references for undergraduates, at least ten references for graduate students and state your goal for this project. If you are familiar enough with the problem, you may also state a tentative hypothesis. Some proposals may not be accepted on the first round. The proposal needs to demonstrate at least preliminary level of thought about the importance of the proposed problem. In the case of overlap, students may be asked to rework their proposal so as to differentiate their work from others who would like to work in the same area. Alternatively, they may be encouraged to work together as a team.

### **2. Class Discussion**

A short description of your work on April 9<sup>th</sup> will help inform us what you are doing. It is also an opportunity to point out difficulties that we may be able to help you with.

### **3. Presentation**

The project presentations are scheduled (4/30 or 5/2) such that there is time to make modification to your final report as may be suggested at the time of your presentation or shortly after.

### **4. Final Reports**

Final reports are due on the last day of class. Each team or individual needs to address the three elements of the proposed project paradigm including life cycle assessment, estimation of growth and demand, and suggestions for improvements in carbon intensity. Reports must acknowledge previous work in this area and provide references in a journal quality, manner. Suggested format is to list the last name of the first author, followed by the date. If there are multiple references to the same author in the same year, you can sequence them as Sahni 2010(a), Sahni 2010(b), and so forth. Graduate reports will be held to a much higher standard, expecting a comprehension of the current work in this area and an indication as how to go forward and hopefully an incremental step forward based on the work in the report. Please hand in a hardcopy of your report and send in a Word version as well as a pdf. Page requirements per person are, 1) undergrads 5 to 7 pages single space not including graphics, tables and references, 2) for grads the page count is from 10 to 20 (as above). References must be formatted as “journal quality”.