GHG Inventory Lab

Note: This lab was assigned in the course Practicum in Sustainability – Reducing Dickinson's Carbon Footprint, taught by Neil Leary in fall 2012 at Dickinson College. In this lab, students use and become familiar with the college's greenhouse gas inventory and the Clean Air – Cool Planet Campus Carbon Calculator, an excel-based package that Dickinson and many other schools use to calculate their greenhouse gas emissions. Check with your campus operations office to find out if your school uses the Clean Air – Cool Planet Campus Carbon Calculator and to obtain a copy with your school's greenhouse gas inventory data.

Prior to the lab, you will want to become familiar with the Clean Air – Cool Planet Campus Carbon Calculator and your school's greenhouse gas inventory. See http://cleanair-coolplanet.org/campus-carbon-calculator/.

Materials needed for this lab:

- The Clean Air – Cool Planet Campus Carbon Calculator with your school's greenhouse gas inventory data entered.
- The Clean Air – Cool Planet Calculator User's Guide.
- Access to computers; two to three students per computer.
- Access to the Internet.

Time needed: 2 hours

GHG Inventory Lab

Name: _____

Assignment due end of class, Aug 31

BEFORE CLASS:

- Download Dickinson's Clean Air – Cool Planet (CA-CP) Calculator from Moodle. Copy it on a USB thumb drive and bring to class.
- Read the CA-CP Calculator User's Guide, pp. 1-18 and pp. 30-37 (as well as other readings as noted on the syllabus).
- Open the Dickinson CA-CP Calculator (it's an excel spreadsheet). If asked, allow or enable 'macros'.
- Click the tab on bottom labeled '**Introduction'** and read the introduction.
- Click the '**Spreadsheet Map'** tab and use the map to become familiar with the structure of the CA-CP Calculator.

AT START OF CLASS:

- Start a computer and copy Dickinson's CA-CP Calculator onto the desktop.
- Launch the CA-CP Calculator.
- You can work in groups of 2 or 3

1. How much CO_2, CH_4 and N_2O are emitted for each 1 million kWh of electricity purchased by Dickinson, in kilograms (kg) of each gas and in kg of CO_2 equivalent (eCO_2)? Enter your results in the table.

Hint: Use the Emissions Factor Map (tab is labeled 'EF_Map') in the CA-CP calculator to find how much of each gas is emitted from generating a kWh of electricity. On the far right are yellow boxes for summary information about emission factors for each gas. Click on the box for each gas to be taken to a spreadsheet with emission factors for that gas. To convert to CO_2 equivalent emissions you'll need the Global Warming Potential (GWP) for CH_4 and N_2O. Access the GWP spreadsheet from the Emission Factor Map.

Gas	kg of gas	kg of eCO_2
Carbon dioxide		
Methane		
Nitrous oxide		

2. Dickinson's central energy plant boilers are dual fuel, meaning they can, and are used to, burn either oil or natural gas. What would be the effect on Dickinson's CO_2 emissions if Dickinson replaced 10% of its 2011 natural gas consumption with distillate fuel oil?

   Hint: Find Dickinson's 2011 natural gas consumption on the 'Input' sheet. Calculate the CO_2 emissions that would be avoided by a 10% reduction in natural gas consumption. Then calculate the emissions that would result by burning an amount of distillate fuel oil that has an equivalent amount of energy. You will need to find out the energy content of a gallon of fuel oil for this latter calculation. Find this by going to the Emission Factor Map and clicking the yellow box labeled 'EF_Energy Summary of all Energy Use factors,' where you will find how many MMBtu are in a gallon of fuel.

3. In October we will drive three Dickinson mini-vans to Poultney, VT to visit Green Mountain College. How much will our roundtrip add to Dickinson's GHG emissions? Would we reduce our emissions if we drive two full-size 15-passenger vans instead of three mini-vans?

   Hint: Search online to find estimates of the fuel efficiency of mini-vans and full size vans. Use Google Maps to find out roundtrip mileage to Poultney, VT. Calculate how many gallons it will take to drive the vans RT to Poultney. Find emission factor for gasoline on the EF_CO2 sheet and use that to calculate CO2 emissions.

4. How much CO2 is generated by your electricity use in your dorm room during the academic year? Estimate the wattage of electrical appliances in your room (http://michaelbluejay.com/electricity/) and use the following formulas and table to estimate your emissions.

   Electricity use of an appliance: kWh/yr = (Watts x (hours/day) x 210 days/yr)/1000

   Annual CO2 emissions from the appliance: kg CO2/yr = EF_{elec} x kWh/yr

   Where EF_{elec} is the emission factor for electricity in kg CO2/kWh. The average EF_{elec} for our region is 0.42974 kg CO2/kWh.

Appliance	**Watts**	**Hours/day**	**kWh/year**	**kg CO2/kWh**	**Kg CO2/year**
Computer - laptop	50	3	31.5	0.42974	13.5

TV				0.42974	
Mini-fridge				0.42974	
Lighting				0.42974	
				0.42974	
				0.42974	
				0.42974	
				0.42974	
Total					

What electric appliance of yours generates the largest CO2 emissions per year? What might you do to reduce these emissions?

5. Enter the preliminary 2012 data from the table into the CA-CP Calculator. Budget data are entered on the spreadsheet labeled 'Input_InflAdj,' other data are entered on the spreadsheet labeled 'Input.'

Institutional data	**Quantity**
Operating budget ($)	106,460,157
Research budget ($)	946,452
Energy budget ($)	2,691,284
Full time students (#)	2364
Part-time students (#)	33
Summer school students (#)	60*
Faculty (#)	227
Staff (#)	563
Total building space (sq ft)	1,871,679
Research building space (sq ft)	612,724
Source/Activity	
Distillate fuel oil (gals)	12,103
Natural gas (MMBTU)	52,182
Gasoline fleet (gals)	20,400*
Diesel fleet (gals)	1050*
B100 (gals)	333
HCFC-22 (pounds)	145*
Synthetic fertilizer (pounds and % N)	24,400; 20%*
Animals, number of:	
Cows	5*
Sheep	15*
Poultry	75*
Purchased electricity (kwh)	17,256,378
Faculty/staff commuting (miles)	4,850,000*
Faculty/staff air travel (miles)	152,700*
Study abroad air travel (miles)	4,100,000*
Solid waste, CH4 recovery & electric generation (short tons)	570*
Wastewater, aerobic (gals)	30,250,000*
Composting (short tons)	140*
Green power certificates (kwh)	18,000,000

*Guestimates, based on previous year's data.

The CA-CP calculator will automatically calculate results when you have input the data. Search through the results sheets to fill in the table below with GHG emissions for 2012.

Source/Activity	MT CO_2	MT CH_4	MT N_2O	MT eCO_2 for all gases
Distillate oil (1-4)				
Natural gas				
Fleet – gasoline				
Farm – beef cows				
Purchased electricity				
Faculty/staff commuting				
Study abroad air travel				
Landfill waste				

Looking at the table of emissions, where do you think Dickinson should focus its efforts to reduce GHG emissions?

6. Fill in the following table using calculations from CA-CP. What do you think accounts for the changes in emissions over time?

	2008	2009	2010	2011	2012
Total emissions					
Total offsets					
Total net emissions					

Make a graph of total emissions for 2008 through 2012 using the calculator.