Energy and Emissions, Calvin and Carbon: Where are We Heading? Where are You Heading?

Presentation to Calvin Environmental Assessment Program (CEAP) Poster Session
29 November 2007
by Dr. Matthew Kuperus Heun
Target audience: students

Can you connect the dots?
Global
Venus

- 870 °F
- 92 atm
- 65 kg/m³

http://www.solarviews.com/cap/venus/venusmar.htm
Climate Change

- Fossil fuel combustion puts extra CO₂ (a greenhouse gas) into the atmosphere

- \[ CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O \]
Effects of an Overall Warmer Earth

- Loss of sea ice
- Rising sea levels
- Shrinking coastlines
- Shifting vegetation zones

- Effects are differential
Responses to Climate Change

- Consequences of CO$_2$ buildup are unimportant
- Consequences of CO$_2$ buildup are important and issue must be addressed
  - Easy to fix
  - Difficult to fix
  - Impossible to fix: must adapt

Topology developed for DCM Global Climate Change class by Larry Molnar, Physics
Carbon Cycle

- Many emission sources
- Many sequestration sinks
- Total human emission 7.1 GtC/yr
- Net: 3.2 GtC/yr human emissions remain in the atmosphere

http://earthobservatory.nasa.gov/Library/CarbonCycle/carbon_cycle4.html
Carbon Footprint

• A Carbon Footprint is a measure of the impact human activities have on the environment in terms of the amount of greenhouse gases produced, measured in units of carbon dioxide.

http://www.carbonfootprint.com/

• Assessed on individual, organizational, and national levels

http://mingled.co.uk/designs/carbonfootprint.htm
What is Carbon-Neutral?

- **Carbon Footprint** is a net term
- Footprint = Emissions – Sequestration
- Reduce emissions or increase sequestration to minimize carbon footprint
- Carbon Neutrality achieved when Emissions = Sequestration or when footprint = 0
“Accounting Systems Change Behavior”
Winter Behavior of Two Students

- Sophomore year
  - Wear shorts indoors
  - Leave dorm room windows open

- Junior year
  - Wear coats and snowpants indoors
  - Thermostat set to 55 °F
Home Purchasing Behavior of Two Profs

- Both move from Boston to Grand Rapids
- Both buy homes

1988: Large home in Ada
2002: Modest home in GR
Balloon Flight Testing at JPL

- Count mass in kilograms
  - Mass uncertainty ±0.01 kg
  - Flight failures due to mismatched weights
- Count mass in grams
  - Much care taken with weights and weighing (±0.0001 kg)
  - String of successful flights
Free Food at ENGR Department Socials

- Juniors and seniors participate
- 1st- and 2nd-year students don’t
Why Accounting Systems Matter

- Accounting systems reflect our values
- Economics are a huge motivating force for individuals and institutions
- We must adjust our accounting systems when
  - Our values change
  - We want to change our values
Calvin’s CO\textsubscript{2} Emissions
Calvin College Carbon Neutrality Project

Biology 354 and Engineering 333 Students Fall 2007
Profs. Warners and Heun & VP Henry DeVries
What Would it Take to Make Calvin Carbon Neutral?

- Assessed Calvin’s carbon footprint
  - Emissions
  - Sequestration
- Assessed remediation strategies
  - Increased sequestration
  - Increased energy efficiency
  - Increased renewable energy use
  - Incentives
  - Carbon offset purchasing
- Developed a plan with financing to achieve carbon neutrality within 10 years
Personal CO$_2$ Emissions
EPA Personal CO$_2$ Emissions Calculator

- http://www.carbonfootprint.com/calculator
Heun Family Carbon Emissions

MTCE/year

Transportation: 34.4
Energy: 12.2
Air: 22.2
Car: 5.1

Heating
Electricity
Minimizing Personal Carbon Emissions

- Heat and cool your home less
- Drive or fly fewer miles
- Use less water
- Buy local food
- Replace incandescent bulbs with CFBs (then dispose of them properly)
- Buy the most energy efficient appliances you can afford

Things Calvin Does Well

- CEAP
- Renewable energy demonstration projects
  - Solar at Bunker Center
  - Wind turbine
- Sustainability statement
- Boiler & chiller renovation
Three Suggestions
• Report Calvin’s CO$_2$-equivalent emissions for next 5 years in President’s Report

• Invest in instrumentation to measure energy use in all buildings on a per-building basis

http://www.furman.edu/sustain/sustainabilityreport.pdf
Do Governance Right

- Establish an Office for Sustainability
- Appoint a Director for Sustainability
- Supply appropriate resources
- Precedents
Provide Economic Incentives

- Develop a revolving Calvin Energy Efficiency Fund (CEEF)
- Residence hall energy savings competitions

[Links to additional resources]

http://www.aashe.org/resources/pdf/CERF.pdf
Do We Need CEEF?

- Creates a beneficial accounting system
  - Observable benefits of energy efficiency
  - Incentive and funding for new projects

- Compare potential projects against one another in one place on equal basis
  - Which has better economic return for the fund?
  - Which is most implementable?
  - Which best fits Calvin’s ethos?

- Highlights commitment to sustainability
The Kingdom
Because we worship and honor the Creator, we seek to cherish and care for the creation.

Principles

- God is the creator
- God owns the creation
- Human responsibility toward all things in the creation

http://www.creationcare.org/resources/declaration.php
Evangelical Climate Initiative (2006)

- Human-induced climate change is real
- The consequences of climate change will be significant, and will hit the poor the hardest
- Christian moral convictions demand our response to the climate change problem
- The need to act now is urgent. Governments, businesses, churches, and individuals all have a role to play in addressing climate change—starting now.

The Challenge

- Do we at Calvin connect the dots?
- Do you in your everyday life connect the dots?
Connecting the Dots

http://mazda3online.web.aplus.net/images/mazda5_2005_1.jpg

http://en.wikipedia.org/wiki/Automobile_emissions_control

http://earthobservatory.nasa.gov/Library/CarbonCycle/carbon_cycle4.html
Connecting the Dots

http://www.bybb.com/images/television.jpg


http://earthobservatory.nasa.gov/Library/CarbonCycle/carbon_cycle4.html
Questions?