Homework Ten
Physics & Mathematics of Sustainable Energy
College of the Atlantic
Due Friday, June 3, 2016

Please print out this cover sheet and attach it to your problem solutions. Completed assignments should go in my mailbox or be handed in during class. Please don't hand them to me other times, as I might end up losing them and that would make us both sad.

Your Name: _____

Please list all the students you collaborated with on this assignment:

_____   _____

_____   _____

_____   _____

Did you get help from Aura or Morgan?

Did you consult any resources other than our textbook or class notes? (If yes, please include citations in your solutions.)

Were you able to get enough help so you could complete this assignment to your satisfaction?

Approximately how many hours did you spend on this assignment?

Anything else of note about this assignment? (It was too hard, too easy, lots of fun, too repetitious...)

The work I am turning in for this assignment is an accurate reflection of my own understanding of the material.

Signature: _____   Date: _____

Assignment is on the next page....

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1. Go to `https://flowcharts.llnl.gov/commodities/energy` and select the energy flowchart for the US in 2015. How much new electric power (in GW) would we have to bring online in order to electrify the transport sector? Assume that gas engines are 25% efficient and the electric engines are 90% efficient.

2. In this exercise you'll work through some calculations to get a sense of the scale needed for CCS. We're just interested in a rough estimate, so round to one or two significant digits throughout.

   (a) How much CO_2 is emitted per year by the US?

   (b) Suppose we want to put one tenth of this CO_2 underground. To do so, we would need to liquefy the CO_2. What is the volume of the CO_2 we would need to put under the earth? The density of liquid CO_2 is around 1100 kg per cubic meter.

   (c) Now suppose that we wanted to put the liquid CO_2 deep underground somewhere in a saline aquifer or old oil well. Let's imagine that this is an empty cavity that has a height of 100 meters. What would be the floor area of such a cavity sufficient to store this CO_2? Are you surprised by the answer?

3. The Raccoon mountain pumped storage facility, one of the largest in the US, can store around 35 GWh. For how long could this "battery" provide electrical power to all the homes in Maine?