**MEC 3040 HW for Module 1: Intro to Bioenergy**

Please note that homework asks you to go outside of lecture notes and do a bit of research on your own. You might begin by looking at resources and links provided in the Module (find those within each dropdown Module on richmond-hall.weebly.com) and then move to a search engine, book on reserve or librarian. When answering questions, please:

* Cite your source.
* Answer in complete and punctuated sentences or by using or creating tables or charts.
* Be thorough!
* Note that you can type your answers into this document if you wish.

**Section I: Answer all questions**

**1.2: Current and projected energy use**

1. Are there countries that depend more on bioenergy than the US does? Which countries? Describe the types and amounts of bioenergy they use?

2. Many countries are hoping to shift some transportation energy use from petroleum to some form of biofuel. What types of biofuel are other countries using for transportation? How do their choices contrast with ours?

**1.3: Forms of bioenergy**

3. What do energy density values of biofuels suggest about the most appropriate use of biofuels?

**1.4: Bioenergy feedstock materials**

4. US biomass energy use has focused on primary (or virgin) feedstock materials, while European biomass is focused on waste feedstock materials.

(a) What bioenergy technology demonstrates this clearly? Find some evidence and statistics.

(b) Why do you think US and European approaches differ?

**1.5: Bioenergy co- and byproducts**

5. Carbon dioxide is the ultimate byproduct of biomass energy. The holy grail of biomass energy is capture of carbon dioxide to prevent it from entering the atmosphere. Is this being done? Is anyone working on converting carbon dioxide from a byproduct to a co-product? Do some research and explain!

**1.6: Drivers of bioenergy development**

6. Some fear that the appearance of sustainability and/or carbon neutrality is the biggest driver of policies that favor bioenergy. Do some research and summarize a few examples and arguments that suggest that some are promoting bioenergy in what amounts to greenwashing.

**1.7: Bioenergy debate and 1.8: Is bioenergy sustainable?**

7. What are the biggest factors used by those concerned about the use of each of these forms of bioenergy? Do some reading and cite your sources.

(a) solid biomass combustion

(b) bioethanol

(c) biodiesel

**1.9: The food vs. fuel debate**

8. There are valid concerns that growth of virgin biomass could negatively impact food production. Are there forms of bioenergy (feedstock materials and technologies) that would not impinge upon agriculture and food production? Explain.

**Section II: Answer at least 3 of the following 6 questions***Note that all of the sources are linked here:*[*https://richmond-hall.weebly.com/1-introduction-to-bioenergy.html*](https://richmond-hall.weebly.com/1-introduction-to-bioenergy.html)

A. How does the International Renewable Energy Agency (IRENA) define “traditional biomass” and “modern biomass”?

B. Use Energy Information Administration (EIA) or other resources to break out the types of bioenergy technologies that contribute to US use of biomass energy.

C. Biomass heating has recently been getting more recognition and support from state and federal governments. Use the “Outlook for Bioenergy 2015” article in Renewable Energy World to answer these questions:

(a) How high does the price of oil have to be before biomass thermal energy (rather than co-generation) is cost competitive?

(b) What is the most promising biomass technology now widely used in Europe that could be implemented across the US? Why?

(c) Find a definition for “organic rankine cycle” power plants, a super-efficient and expensive CHP technology

D. The World Bioenergy Association believes that biofuels could produce more energy (~1,500 EJ) than is now used globally (~500 EJ). How? In your opinion, have they adequately addressed sustainability in making their estimates?

E. Vermont has a Comprehensive Energy Plan, first created in 2011 and updated in 2016.

(a) What is the overall renewable energy goal for 2050?

(b) What is the state’s current use of biomass for power and heat?

(c) What recommendations are made for biomass?

(d) What are the challenges for meeting those biomass goals?

F. Vermont is now roughly 80% forested and has fairly abundant forest biomass resources, yet has only two large wood-fired CHP power plants. Have a look at the 2012 report from the Biomass Energy Development Working Group and / or ‘Biomass Busted…’ a 2012 Seven Days article on the same topic. What do they suggest about the state’s capacity to develop wood biomass and to construct large biomass plants?