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Alternative fuel: Biodiesel Answer Key

Instructions: Read this webpage (https://afdc.energy.gov/fuels/biodiesel_benefits.html) and then answer the questions below.

Biodiesel Benefits and Considerations:

What is biodiesel?

Biodiesel is produced in the U.S. It is a clean-burning and renewable fuel.

Energy Security and Balance:

Where is biodiesel produced?

Biodiesel is produced in the U.S.

Air Quality:

Why does using biodiesel reduce the amount of carbon dioxide in the atmosphere?

Carbon dioxide released by biodiesel combustion is offset by the amount of carbon dioxide taken in by the plants that are used to make the biodiesel.

Safety:

Summarize the information that is provided about the safety of biodiesel.

When biodiesel is not mixed with anything else, spills cause less damage to the environment than petroleum diesel. Biodiesel is safe to handle, store and transport.

Use the GREET excel database to complete the chart below:

1. Open this link: https://greet.es.anl.gov/greet_1_series
2. Click the link underneath “GREET 1 Series (Fuel-Cycle Model) or this link **GREET_2020rev1.zip**
3. Open the GREET folder
4. Select “GREET1-2020”

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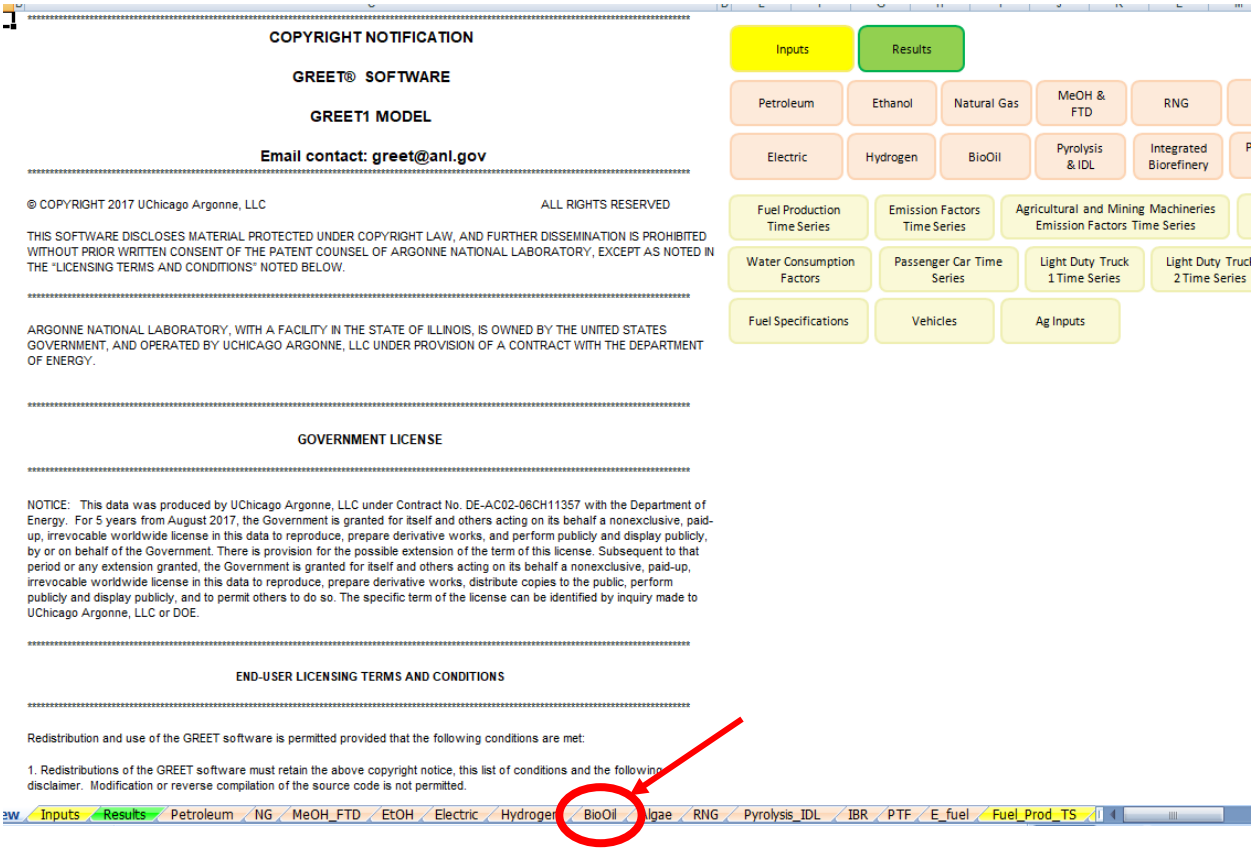

5. To use the GREET database, you have to click on the tab at the bottom of the screen. Biodiesel is called "BioOil", so click the "BioOil" tab. The red arrow above is pointing to it.
6. There is a lot of information on this database. Scroll all the way down to #4) Summary of Energy Consumption, Water Consumption, and Emissions.
7. Because we are interested in reducing carbon emissions and climate change, you will be looking at the values for methane (CH4), carbon dioxide (CO2), and nitrous oxide (N2O). There are other variables in this chart, but we will focus just on these three. There is a red box around them in the table below.

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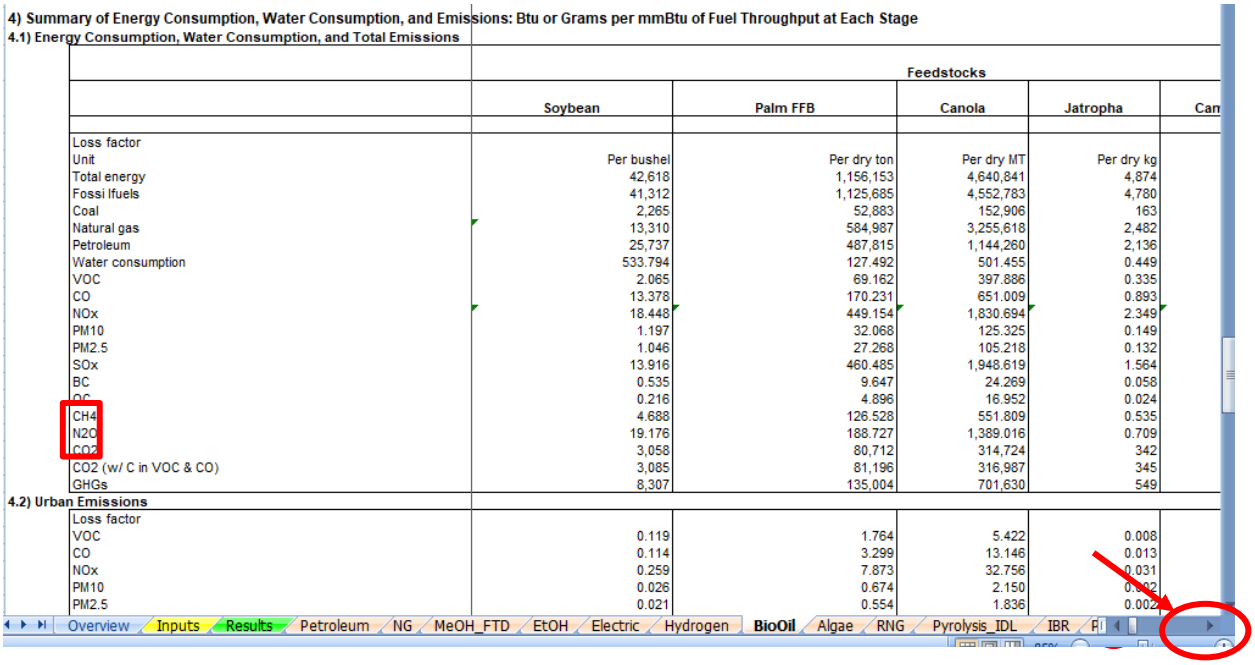

4) Summary of Energy Consumption, Water Consumption, and Emissions: Btu or Grams per mmBtu of Fuel Throughput at Each Stage

4.1) Energy Consumption, Water Consumption, and Total Emissions

	Feedstocks				
	Soybean	Palm FFB	Canola	Jatropha	Can
Loss factor					
Unit	Per bushel	Per dry ton	Per dry MT	Per dry kg	
Total energy	42,618	1,156,153	4,640,841	4,874	
Fossil fuels	41,312	1,125,685	4,552,783	4,780	
Coal	2,265	52,883	152,906	163	
Natural gas	13,310	584,987	3,255,618	2,482	
Petroleum	25,737	487,815	1,144,260	2,136	
Water consumption	533.794	127.492	501.455	0.449	
VOC	2.065	69.162	397.886	0.335	
CO	13.378	170.231	651.009	0.893	
NOx	18.448	449.154	1,830.694	2.349	
PM10	1.197	32.068	125.325	0.149	
PM2.5	1.046	27.268	105.218	0.132	
SOx	13.916	460.485	1,948.619	1.564	
BC	0.535	9.647	24.269	0.058	
OC	0.216	4.896	16.952	0.024	
CH4	4.688	126.528	551.809	0.535	
N2O	19.176	188.727	1,389.016	0.709	
CO2	3,058	80,712	314,724	342	
CO2 (w/ C in VOC & CO)	3,085	81,196	316,987	345	
GHGs	8,307	135,004	701,630	549	
4.2) Urban Emissions					
Loss factor					
VOC	0.119	1.764	5.422	0.008	
CO	0.114	3.299	13.146	0.013	
NOx	0.259	7.873	32.756	0.031	
PM10	0.026	0.674	2.150	0.002	
PM2.5	0.021	0.554	1.836	0.002	

Overview | Inputs | Results | Petroleum | NG | MeOH_FTD | EtOH | Electric | Hydrogen | BioOil | Algae | RNG | Pyrolysis_IDL | IBR | Pl

8. There are many different oils that are used to make biodiesel. Look through the data table and find the type of oil that you think is best in regards to the amount of CO2, N2O, CH4 in the emissions. To move through the data table, use the arrow that has the red circle around it in the picture above. Record the data in the table below. This is what you will share when the group comes back together. (there are extra lines in the data table, you can use them if it is helpful to record information while trying to determine which version of oil you want to use - circle the one that you will share) what are the units? Each gallon of ethanol? (it says Btu or Grams per mmBtu of fuel)

Gas emission	Type of Oil-based Biodiesel (Fuel)					
	Soybean oil-based Biodiesel	Palm oil-based Biodiesel	Corn oil-based Biodiesel	Camelina oil-based Biodiesel	Tallow-based Biodiesel	Jatropha oil-based Biodiesel
CH_4	21.4	127.4	14.6	17.96	35.6	55.7
N_2O	.17	.16	.09	.13	.37	4.9
CO_2	21,708	12,073	8,207	10,122	19,942	10,369

The abbreviations in GREET are defined below:
VOC = volatile organic compounds
CO = carbon monoxide
NO_X = nitric oxide
PM10 = particulate matter with a diameter of 10 micrometers or less

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PM2.5 = particulate matter with a diameter of 2.3 micrometers or less
SO_X = sulfur oxides
BC = black carbon (particulate matter/ soot & contributes to climate change)
OC = organic carbon (respiratory effects)
CH_4 = methane
N_2O = nitrous oxide
CO_2 = carbon dioxide

9. Fill in the row below for biodiesel.
10. When everyone is finished learning about the energy sources, share what you have learned with the group. Each individual should summarize the questions they answered and share the GREET emissions that were calculated. Notes should be taken in the table below so that the information can be shared with your poster group.
11. Circle the energy source you will use to heat your building (remember that we are assuming that the technology for this will be in place) and complete the information below the table.

Answers will vary based in student presentations

Energy Source	Information about energy source	GREET values
Ethanol		
Electric		
Biodiesel		
Natural Gas		
Propane		
Hydrogen		

Type of fuel that will be recommended for use in heating your building structure:

The expectation is that they will choose hydrogen, but it does depend on students' presentations.

Evidence and reasoning for this recommendation:

. Evidence used would be the low greenhouse gas emissions.

12. Return to the "Energy Source" document and continue to step 2.