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ENGR 202 – Section AB

Summer 2021

ASSIGNMENT #1

1. Question 1.5 (Rubin's book)

How do the concepts of green design, industrial ecology, and sustainable development differ from past approaches to engineering design?

Prepare a brief report on this topic, using some specific examples for illustration.

Since the beginning of humanity, the engineers' designs were aimed to maximize performance and minimize costs. Little to no attention was paid to the environment. One example to that is the USSR during the cold war where to win the arm race, they polluted enormous amount of lakes and soil. Russia is living the consequences today where lots of its water has become undrinkable. In first world countries today, there are laws that mandates the engineers to find solutions to ecological problems that the building risk of producing. In some countries even, the engineers do that without need of laws. The entire culture is shifting since we understood the risks of climate change. Why only developed countries? These designs are more expensive and more difficult to make than traditional designs. Third world and developing countries cannot afford these extra costs. One clear example of this is china's coal power plants. Even though we are in 2021, and these are numerous alternatives to coal, china to this day continues to build new coal power plants, because investing green power sources is much more costly, especially with china's enormous population. Compare this to the U.K. where burning coal is very restricted especially in urban areas after the clear air act of 1956.

2. Using the Canadian National Pollutant Release Inventory (through the Environment Canada Website), choose any 3 chemicals and determine their quantities released to the air, water and land.

Substance	Water	Air	land
Ammonia	50 423 tonnes	18 571 tonnes	398 tonnes
Lead	9 787 kg	90 952 kg	103 733 kg
Manganese	994 tonnes	82 tonnes	842 tonnes

3. Question 2.11 (Rubin's book)

Investigate the estimated resource base of world energy supplies of either crude oil or natural gas (choose one). One useful website is the Energy Information Administration of the U.S. Department of Energy (www.eia.doe.gov). Comment on when or whether we might be "running out of this non-renewable resource based on current estimates. Also discuss whether the environmental implications of future energy resource extraction might change because of the location or difficulty of exploiting the remaining reserves. Summarize your findings in a brief report.

According to U.S. energy information administration, the U.S. is the most oil producing country with 19% of the global production, followed by Saudi Arabia with 12% of world production and then followed by Russia with 11% of world oil production. According to the same source, the production of crude oil will increase from now until 2032 toping the 30.09 quads. However, afterwards, the production of crude oil will decrease from 2032 to 2050, reaching 24.80 quads in 2050. Will we run out of oil? On the first look we can pull the wrong conclusion. Yes, the production is decreasing but these are oil fields that are yet to discovered especially in the Artic and Antarctic ocean and especially with ice melting. The location of the new oil fields will be more and more difficult in the future. As mentioned, the new reserves might be in the poles with the extreme temperatures and climate. And in the future, we might need to exploit more regions that have oil sands that were previously not cost efficient. Which will result in lots of pollution while extracting, especially water pollution.

4. Question 12.15 (Rubin's book)

Use the 20-year Global Warming Potential (GWP) values in Table 12.9 to calculate an equivalent CO₂ emission rate for worldwide greenhouse gas emissions as given in Table 12.1.

Assume that total CFCs are divided equally among the three compounds listed. What is the percentage contribution of actual CO₂ emissions to the total equivalent CO₂? What is the next most important greenhouse gas emission based on this analysis? How do these results compare to those using the 100-year GWP in Example 12.17?

Pollutant	Emissions (Megatons/year)	20-year GWP	Equivalent CO ₂
CO ₂	29 800	1	29 800
Methane	375	56	21 000
N ₂ O	5.7	280	1 596
CFCs	0.69	4467 (average)	3 082
		Total	55 478

2. Percentage of contribution of CO₂ (For 20-year GWP):

$$\frac{\text{Emissions } CO_2}{\text{Total equivalent } CO_2} = \frac{29800}{55478} \times 100 = 53.7\%$$

3. The next most important greenhouse gas is Methane (CH₄) with 21000 equivalent CO₂

4. In order to answer this question we have to redo the table:

Pollutant	Emissions (Megatons/year)	100-year GWP	Equivalent CO ₂
CO ₂	29 800	1	29 800
Methane	375	21	7 875
N ₂ O	5.7	310	1 767
CFCs	0.69	5833 (average)	4 025
		Total	43 467

Now we calculate the new percentage of contribution of CO₂ after 100 years:

$$\frac{29800}{43467} = 68.6\%$$